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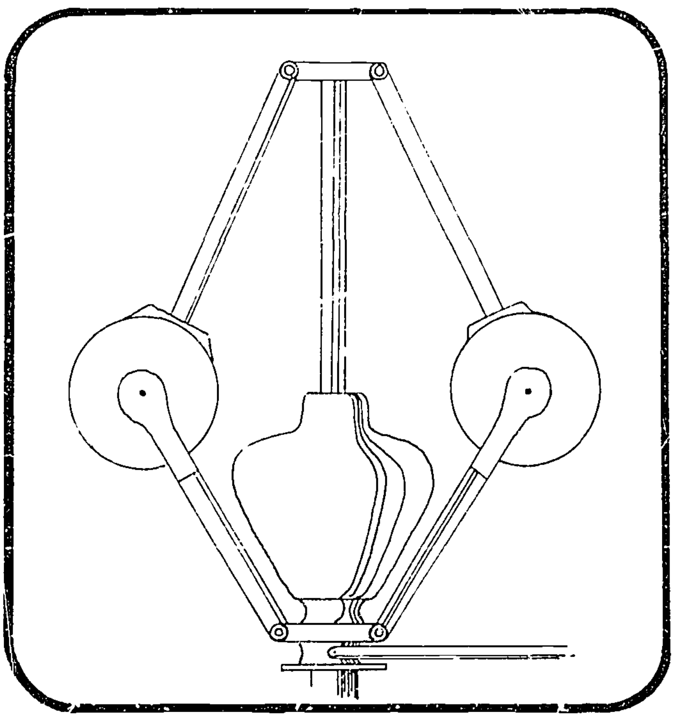
ABSTRACT

This paper presents a model that uses projected pupil enrollment to estimate gross space needs and associated costs for various classifications of educational activities. The simulation consists of two linked programs, one using a version of the modified "cohort-survival" technique and the other estimating space and money necessary to meet the projected needs. Computerization of the model provides the user with a variety of information, including the total square feet to be constructed and the adjusted costs. (Figures 3, 4, and 5 on pages 13, 15, and 16, and Table 2 on pages 18-19 may reproduce poorly in hard copy because of marginal legibility.) (Author)

Simulation of space needs and associated costs

A Technical Report



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SIMULATION OF SPACE NEEDS AND ASSOCIATED COSTS

In a rapidly expanding and complex world, education has functioned in an environment much of its own. A number of decisions in educational planning to date have been ad hoc. One might view the traditional administrator's position as somewhat like a chess pawn, capable of moving only in one direction (lacking flexibility) and one step at a time (short range).

Administrators have suffered because they have not possessed information relevant to the questions at hand. Future administrators and educational planners must strive to bring integration to an educational system which is open and actively interacting with its environment. Decision makers must change and adapt with this in mind.

Administrative decisions, and planning should be based upon the modern tools of educational planning and decision making. To play any game well, one must first learn the rules so that predetermined objectives can be efficiently and effectively achieved.

Resources available to the educational system are scarce. However, there may be better ways of allocating them among competing claims that are presently in use.

For example, how many decisions made in education and their ramifications are checked over a period of two or three years? Further, are allocation decisions being made with information regarding resources which might have to be committed to sustain any benefits which are achieved by the original allocation or investment?

Recently, innovations such as individualized instruction, individually prescribed instruction, computer-managed instruction, computer-assisted instruction, the middle school concept and others have received widespread interest. The implications are simply that there are an increasing number of management tools and media available to assist management and planning from the para-professional to the superintendent.

In the future, the educator will have to utilize such concepts as the systems approach, Program Planning Budgeting Systems (PPBS), simulation and management information systems for maximum efficiency. Educators should eliminate much of the duplication in information handling which is deleterious to the effectiveness of the system.

These decisions in re-allocating scarce educational resources can only be reached if several alternative avenues of action are available along with information regarding how the system will respond over a period of time if each alternative is implemented. Thus, one needs a model which accurately represents the existing system. Simulation can be used to detect future possible fluctuations of the system without inflicting undesirable effects on the system. With such a model one can plan for the future and evolve a means such that educational goals can be realized.

This paper presents a model which was developed to project gross space needs and associated costs for various classifications of educational activities. Activities requiring roughly the same amount of space were lumped together. Using this approach eight general categories of space were identified. This approach seems to be adequate as the space required for general classroom use is considerably less than the amount of space required for a teaching gymnasium. Thus, there is a clean break in space required among all categories. Due to the fact that, (1) educational space is a function of users and, (2) space must be provided for future growth, a population projection model was linked with the resource allocation model. Figure 1 illustrates the general flow of information and approach taken throughout the development of the resource allocation model. As the model illustrates, projected FTE's are converted to space needs which in turn are converted to costs.

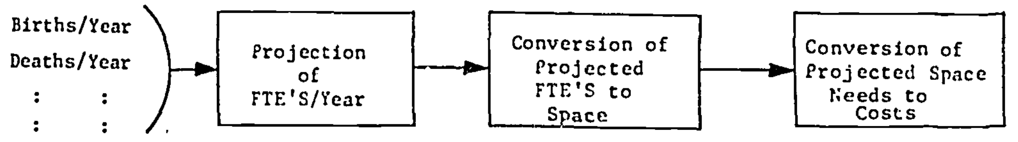

Fig. 1.--General process used in determining space needs and associated costs.

Related Research

Following is a cursory coverage of the literature related to population projection techniques and resource allocation models.

Population Projection Models

Much of the earlier published work in pupil forecasting has been consolidated by Lins [7], Brown [2] and Short [10]. The latter's work includes the following techniques in pupil forecasting: method of analogy, forecasting school enrollment from total population, adjusted diagonal retention pattern, diagonal retention pattern, average enrollment growth pattern and forecasting by analysis.

As most researchers in this field, Lins [7] emphasized that experience ought to precede the selection of one technique or a combination of techniques.

The Florida Department of Education is presently using a modified version of the "cohort-survival" method for student projection. The modification involves a visual inspection of the survival ratios for each grade level. Next, those are eliminated which appear to be atypical (extremely high or low) compared to the other ratios for a particular grade. The remaining ratios are then averaged to project pupil populations.

A recent study by Impara [5], using the modified "cohort-survival" technique, examined various population projection models. The objective was to develop a systematic quantitative method of forecasting pupil population for grades one through twelve. The criterion for selecting a model was that the projections have no more than .5% error in the first projected year and in each successive year. Within the limits of this study, Impara found the "cohort-survival" technique to be acceptable.

A Resource Allocation Model

Currently a great deal of attention is being directed towards Programming, Planning, Budgeting Systems (PPBS). Educational planning in the past has consisted largely of "fire fighting" or annual "survival" planning. Educational management and decision making have been hampered by the lack of: (1) up-to-date relevant information, (2) a process for establishing educational priorities, (3) Long-range planning, (4) specifically stated educational objectives, (5) consideration of optimal resource allocation as opposed to simply allocating educational resources until there are none, (6) identification of resources with specific educational programs, (7) quantitative methods of analysis, (8) planning for future needs, (9) flexible planning methods, (10) being able to show least cost alternatives for problems or programs, and (11) cost-benefit information regarding educational decisions and/or programs.

While the above list is not all-inclusive, it does illustrate the need for retooling present educational management techniques and giving some consideration to the merit of new approaches to educational planning.

Programming, Planning, Budgeting Systems, while they do not offer a panacea to problem solving, certainly provide a comprehensive approach to educational planning and management. As a management system in education, PPBS is very much output oriented and concerned with: (1) long-range planning, (2) developing a budget, (3) identifying specific objectives within each educational program, (4) measuring gains towards specific objectives, (5) systematically considering the most effective means for goal achievement, and (6) allocating scarce educational resources in the most efficient way possible. Hartley [3] lists some thirty characteristics and advantages of PPBS along with several limitations.

PPBS is still an infant in the management of our nation's educational systems. Most of the literature concerning PPBS and education, which began appearing in the journals in 1965-66, has been directed to general discussion of what PPBS is; planning for PPBS; and the implementation of PPBS. Three examples of such articles are: "What is PPB?" [11]; An Operative PPB System: A Collaborating Undertaking in the States [8]; and "Program Budgeting" [4].

School systems are just now becoming more interested in the merits of PPBS. Perhaps the increasing scarcity of educational resources has provided the impetus for a change in educational management techniques and approaches.

The future of PPBS in education, while encouraging, might be aided by three present projects at School District 68, Skokie, Illinois; Metropolitan Dade County, Miami, Florida; and The University School, Florida State University, Tallahassee, Florida. All of the above mentioned projects involve the use of PPBS and are primarily concerned with optimally allocating educational resources. The latter two projects are concerned more with the feasibility and developmental aspects of PPBS. The systems approach taken by Skokie in developing, implementing and monitoring their PPB system clearly demonstrates the complexity of the recent innovation in educational management. Skokie's coding scheme and program evaluation review technique (PERT) network for the development of a program budget is an excellent example of the planning and preparation necessary before considering the implementation or use of the PPBS approach [6].

If one is concerned with educational planning, optimally allocating educational resources, and views educational systems as being "open" ones, then one must consider the systems approach to educational management.

Procedures

Population Projection Procedures

The Modified "Cohort-Survival Model"*

Listed below are the steps for calculations;

1. Calculation of Survival Ratio from birth

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*Examples for calculations were taken from the output in Table 1, page 17. This was done to assist the reader in linking the process with the output.

to grade one. In the 1959-60 school year there were 97 live births reported and six years later in 1965-66, 135 children were in grade one. One then sums the births from 1959-60 school year up to 1965-66 school year Σbirths = 537. One then sums the enrollment in grade one for the years corresponding with the births, Σ grade one - 694.*

$$\frac{\Sigma \text{ grade one}}{\Sigma \text{ births}} = \text{Survival Ratio from birth to grade one.}$$

Substituting: $\frac{694}{537}$ = 1.29 (survival ratio.)

The ratio 1.29 indicates that in-migration, births, etc., exceeded emigration, deaths, etc., for the years considered.

2. Calculation of Survival Ratio from grade one to grade two. This ratio is calculated in a fashion similar to that in step one above, except that one now uses the grade two enrollment corresponding to the year that the students were in grade one. The question examines how many of the grade one students over the past years have survived and moved on to grade two. The survival ratio is calculated in the following manner:

$$\frac{\Sigma \text{ grade one}}{\Sigma \text{ grade two}} = \text{Survival Ratio from grade one to two}$$

Substituting: $\frac{644}{683}$ = .94 (Survival ratio). The ratio .94 indicates that a reduction in membership from grade one to

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*Children are not eligible for school until they are at least six years old.

grade two has occurred over the past years. The reduction, among other things, might be explained by failure and retardation.

3. Calculations of Survival Ratios between other grades. The survival ratios for grades two through twelve are calculated in a similar fashion as outlined above.

4. Predictions of membership in the first grade. One takes the births and multiplies the number of births for each year times the survival ratio for births to grade one. For example, consider grade one and the birth to grade one survival ratio of 1.29. The projected enrollment for grade one for the years 70-71, 71-72, 72-73, 73-74, and 74-75 is found by multiplying the number of live births in the prior year (117) times the survival ratio 1.29 resulting in a projection of 151 students in grade one for the year 1970-71.

5. Prediction of membership in the second grade. The same procedure as was outlined in step four is used, as one takes the projected enrollments for grade one and multiplies each projection times the survival ratio from grade one to grade two. The product is the projected enrollment for grade two.

Example: In step four, 151 students were projected for grade one in the school year 1970-71. If one takes this projection and multiplies it times the survival ratio (.94), one obtains the projection of students in grade two in the following school year, 1971-72.

6. Prediction of membership in other grades. The technique outlined in step five is repeated throughout until all grades designated have been predicted.

The above model produced the projected FTE's which were then used as input data for the resource allocation model which is described in the following pages.

Resource Allocation Procedures

The discussion of the procedures has been broken down into the following classifications: (1) general classroom, (2) teaching laboratory, (3) teaching gymnasium, (4) library space, (5) student learning resource space, (6) administrative office space, (7) resource center, staff and faculty and (8) physical plant service area. Each classification is discussed using the systems approach as in Figure 2. The inputs have been listed for each analysis of space along with the algorithm for converting FTE's to space needs. The procedures for determining the cost of constructing and equipping needed space/classification are also discussed.

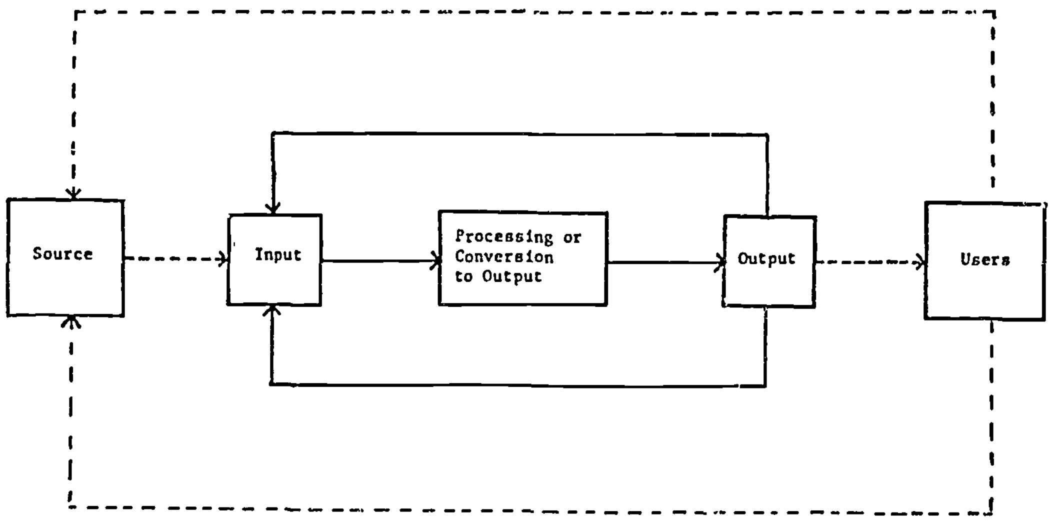

Fig. 2.--Resource allocation model.*

Perhaps the following information will clarify the conceptualization and understanding of the techniques employed in the development of the model for the allocation of educational resources discussed in the following pages.

1. One might refer to the simulation printout concurrently as one reads the following discussion.

2. Since the procedure for most of the classifications is similar, one should keep in mind that Figure 3 contains a general procedure to which one may refer for clarification of specific inputs, processing or conversion techniques and outputs.

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*The conclusions include a discussion of the "users" and "sources" of information. As a result, the dotted lines in the above system become part of the total system, thus completing the model.

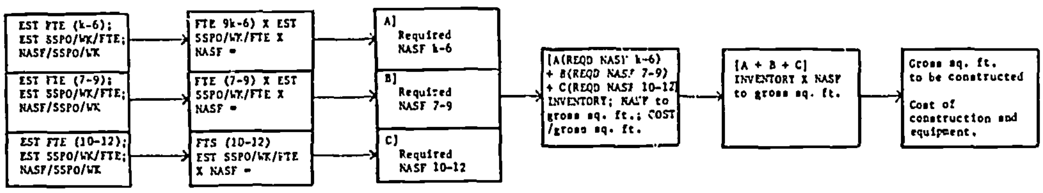

Fig. 3.—Analysis of general classroom.

3. Words appear in the following abbreviated form: FTE - Full Time Equivalent Student; SSPO - Student Station Period Occupancy; NASF - Net Assignable Square Feet; GPL - General Purpose Learning; and TL - Teaching Laboratory.

Analysis of General Classroom Space

Figure 3 shows the conversion of projected FTE's to space and associated costs for general classroom space. The inputs, process of conversion and outputs have been illustrated in a manner consistent with Figure 2. The outputs A, B, and C were used as inputs for the final conversion to gross square feet and dollars to construct.

The format used for the analysis of general classroom space applies to the analysis of <u>Teaching Laboratories</u>

and Teaching Gymnasia. It should be pointed out that the term "inventory" applies in general to on-hand human, physical and financial resources. Throughout all of the analyses discussed in the procedure, the units of the inventory can easily be determined by examining the immediate calculations. For example, in the conversion of total NASF 1-12 to gross square feet to be constructed, inventory obviously refers to space or facilities on-hand which can all be allocated to the classifications being analyzed.

As one can see, the outputs A, B and C in Figure 3 become inputs to the calculation of gross square feet to be constructed. The analysis of the remaining classifications deviate from the procedure outlined in Figure 3 in the following manner:

1. Analysis of Library Space. This analysis differs from that of the general classroom since the percentage of space accommodated per given instant replaced EST SSPO/WK/FTE student in the general classroom model and grades 7-12 are lumped together (see simulation printout). Figure 4 shows the deviations and conversion of inputs to outputs.

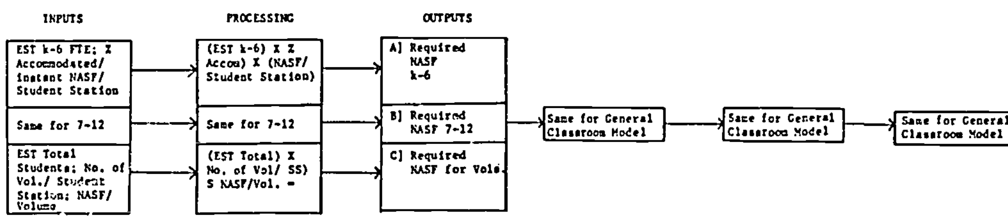

Fig. 4.—Analysis of library space.

2. In the Analysis of the Resource Center and Administrative Office Space estimations of position and percentage requiring space replace EST FTE students and EST SSPO/WK/FTE student in the model for general classrooms. The remainder of the analysis techniques follow the format used for general classrooms. (See Figure 3 and simulation printout for further clarification).

3. The analysis of Student Learning Resource Space has as its initial input the output from the analysis of General Classrooms and Teaching Laboratories. Examination of Figure 3 shows the output in question (required NASF K-6, 7-9, and 10-12 for both analyses).

Figure 5 below shows the outputs from the first two analyses as inputs, and exemplifies the conversion to output.

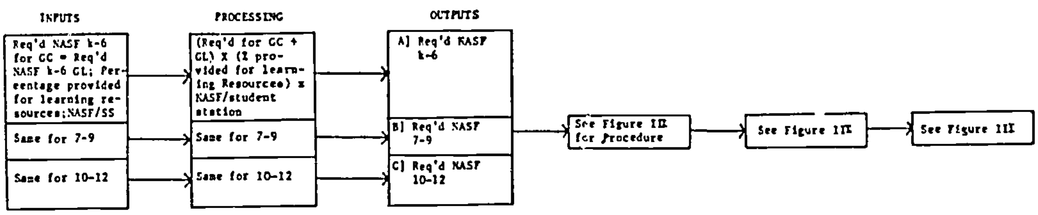

Fig. 5.--Analysis of student learning resource space.

4. The analysis of Physical, Plant Service Area has been purposely treated last since the initial input for the analysis requires output from all of the earlier analyses. Outputs A, B and C for each analysis are summed vertically resulting in a total NASF required for K-12 for each analysis. These totals, seven in all, are totalled again giving the grand total NASF required to meet standards. The conversion of this input to output is shown in Figure 6.

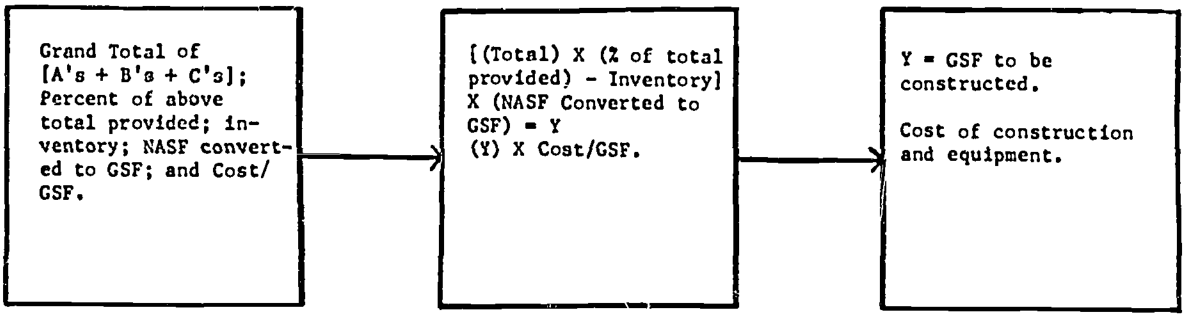

Fig. 6.--Analysis of physical plant service area requirement.

Output

The population projection model was tested using data which permitted the algorithm used within the model to make projections for five years, 1970-71 to 1974-75. Table 1 illustrates the conversion of births and past enrollment to projections.

TABLE 1

POPULATION PROJECTION

YEAR / GRADE	64-65	65-66	66-67	67-68	68-69	69-70	SURVIVAL RATIO	70-71	71-72	72-73	73-74	74-75
0	97	103	108	113	116	117	1.29	115	115	114	107	103
1	132	135	135	139	141	143	.94	151	149	149	147	138
2	119	124	127	128	131	134	1.00	135	143	140	140	139
3	116	119	124	128	129	132	.99	135	135	143	141	141
4	112	115	118	123	127	128	1.00	131	134	134	142	140
5	107	111	115	117	123	129	1.00	128	131	134	134	142
6	102	107	110	115	118	125	1.06	129	128	131	134	135
TOTAL 1- 6								809	820	831	839	835
7	103	109	112	116	121	125	.97	132	137	136	139	142
8	97	99	104	109	113	120	.98	121	128	133	132	135
9	93	94	95	102	107	113	.99	118	119	126	130	129
TOTAL 7- 9								371	384	394	401	406
10	88	90	91	94	100	111	.89	112	116	118	124	129
11	69	79	80	81	94	90	.88	99	100	104	105	111
12	51	61	69	70	71	73	*0.20	79	87	97	91	92
TOTAL 10-12								290	303	309	320	332
TOTAL 1-12								1470	1507	1535	1560	1572

Table 2 illustrates the conversion of projected enrollment for eight areas to dollars to construct and equip the required facilities.

TABLE 2
RESOURCE ALLOCATION

ANALYSIS 1 GENERAL CLASSROOM

YEARS------	YEAR 70/71	YEAR 71/72	YEAR 73/74	YEAR 74/75	YEAR 75/76
ESTIMATED K-6 FTE STUDENTS	809	820	831	839	835
EST. SSPO/WK/FTE STUDENTS	14.00	14.00	14.00	14.00	14.00
K-6 SSPO/WK	11326.00	11480.00	11634.00	11746.00	11690.00
NASF/SSPO/WK	.76	.76	.76	.76	.76
REQUIRED NASF	8607.76	8724.80	8841.84	8926.96	8884.40
ESTIMATED 7-9 FTE STUDENTS	371	384	394	401	406
EST. SSPO/WK/FTE STUDENTS	12.50	12.50	12.50	12.50	12.50
GRADES 7-9 SSPO/WK	4637.50	4800.00	4925.00	5012.50	5075.00
NASF/SSPO/WK	.76	.76	.76	.76	.76
REQUIRED NASF	3524.50	3648.00	3743.00	3809.50	3857.00
ESTIMATED 10-12 FTE STUDENTS	290	303	309	320	332
EST. SSPO/WK/FTE STUDENTS	15.00	15.00	15.00	15.00	15.00
GRADES 10-12 SSPO/WK	4350.00	4545.00	4635.00	4800.00	4980.00
NASF/SSPO/WK	.76	.76	.76	.76	.76
REQUIRED NASF	3306.00	3454.20	3522.60	3648.00	3784.80
TOTAL NASF REQUIRED	15435.26	15827.00	16107.44	16384.46	16526.20
INVENTORY	15000.00	15000.00	15000.00	15000.00	15000.00
NASF-TO BE CONSTRUCTED	438.26	827.00	1107.44	1384.46	1526.20
NASF TO GROSS SQ. FT.	1.67	1.67	1.67	1.67	1.67
GROSS SQ. FT. TO BE CONST.	731.89	1381.09	1849.42	2312.05	2548.75
COST PER GROSS SQ. FT.	24.00	24.00	24.00	24.00	24.00
DOLLARS TO CONST. + EQUIP.	17565.46	33146.16	44386.20	55489.16	61170.10

ANALYSIS 2 TEACHING LAB.

YEARS------	YEAR 70/71	YEAR 71/72	YEAR 73/74	YEAR 74/75	YEAR 75/76
ESTIMATED K-6 FTE STUDENTS	809	820	831	839	835
EST. SSPO/WK/FTE STUDENTS	2.00	2.00	2.00	2.00	2.00
K-6 SSPO/WK	1618.00	1640.00	1662.00	1678.00	1670.00
NASF/SSPO/WK	3.80	3.80	3.80	3.80	3.80
REQUIRED NASF	6148.40	6232.00	6315.60	6376.40	6346.00
ESTIMATED 7-9 FTE STUDENTS	371	384	394	401	406
EST. SSPO/WK/FTE STUDENTS	3.60	3.60	3.60	3.60	3.60
GRADES 7-9 SSPO/WK	1335.60	1382.40	1418.40	1443.60	1461.60
NASF/SSPO/WK	5.05	5.05	5.05	5.05	5.05
REQUIRED NASF	6744.78	6981.12	7162.92	7290.18	7381.08
ESTIMATED 10-12 FTE STUDENTS	290	303	309	320	332
EST. SSPO/WK/FTE STUDENTS	3.60	3.60	3.60	3.60	3.60
GRADES 10-12 SSPO/WK	1044.00	1090.80	1112.40	1152.00	1195.20
NASF/SSPO/WK	5.05	5.05	5.05	5.05	5.05
REQUIRED NASF	5272.20	5508.54	5617.62	5817.60	6035.76

TABLE 2 -- Continued.

TOTAL NASF REQUIRED	18165.38	18721.66	19096.14	19484.18	19762.84
INVENTORY	16000.00	16000.00	16000.00	16000.00	16000.00
NASF-TO BE CONSTRUCTED	2165.38	2721.66	3096.14	3484.18	3762.84
NASF TO GROSS SQ. FT.	1.67	1.67	1.67	1.67	1.67
GROSS SQ. FT. TO BE CONST.	3616.18	4545.17	5170.55	5818.58	6283.94
COST PER GROSS SQ. FT.	37.50	37.50	37.50	37.50	37.50
DOLLARS TO CONST. + EQUIP.	135606.92	170443.96	193895.77	218196.77	235647.85
ANALYSIS 3 TEACHING GYMNASIUMS					
YEARS------	YEAR 70/71	YEAR 71/72	YEAR 73/74	YEAR 74/75	YEAR 75/76
ESTIMATED K-6 FTE STUDENTS	809	820	831	839	835
EST. SSPO/WK/FTE STUDENTS	1.00	1.00	1.00	1.00	1.00
K-6 SSPO/WK	809.00	820.00	831.00	839.00	835.00
NASF/SSPO/WK	10.00	10.00	10.00	10.00	10.00
REQUIRED NASF	8090.00	8200.00	8310.00	8390.00	8350.00
ESTIMATED 7-9 FTE STUDENTS	371	384	394	401	406
EST. SSPO/WK/FTE STUDENTS	1.00	1.00	1.00	1.00	1.00
GRADES 7-9 SSPO/WK	371.00	384.00	394.00	401.00	406.00
NASF/SSPO/WK	10.00	10.00	10.00	10.00	10.00
REQUIRED NASF	3710.00	3840.00	3940.00	4010.00	4060.00
ESTIMATED 10-12 FTE STUDENTS	290	303	309	320	332
EST. SSPO/WK/FTE STUDENTS	2.00	2.00	2.00	2.00	2.00
GRADES 10-12 SSPO/WK	580.00	606.00	618.00	640.00	664.00
NASF/SSPO/WK	10.00	10.00	10.00	10.00	10.00
REQUIRED NASF	5800.00	6060.00	6180.00	6400.00	6640.00
TOTAL NASF REQUIRED	17600.00	18100.00	18430.00	18800.00	19050.00
INVENTORY	20000.00	20000.00	20000.00	20000.00	20000.00
NASF-TO BE CONSTRUCTED	-2400.00	-1900.00	-1570.00	-1200.00	-950.00
NASF TO GROSS SQ. FT.	1.67	1.67	1.67	1.67	1.67
GROSS SQ. FT. TO BE CONST.	-4008.00	-3173.00	-2621.90	-2004.00	-1586.50
COST PER GROSS SQ. FT.	30.00	30.00	30.00	30.00	30.00
DOLLARS TO CONST. + EQUIP.	-120240.00	-95190.00	-78657.00	-60120.00	-47595.00
ANALYSIS 4 LIBRARY SPACE					
YEARS------	YEAR 70/71	YEAR 71/72	YEAR 73/74	YEAR 74/75	YEAR 75/76
EST K-6 FTE STUDENTS	809	820	831	839	835
% ACCOMMODATED PER INSTANT	.07	.07	.07	.07	.07
NO ACCOMMODATED PER INSTANT	56.63	57.40	58.17	58.73	58.45
NASF PER STUDENT STATION	30.00	30.00	30.00	30.00	30.00
REQUIRED NASF	1698.90	1722.00	1745.10	1761.90	1753.50
ESTIMATED 7-12 FTE STUDENTS	661	687	703	721	738
% ACCOMMODATED PER INSTANT	.10	.10	.10	.10	.10
TOTAL NUMBER	66.10	68.70	70.30	72.10	73.80
NASF PER STUDENT STATION	30.00	30.00	30.00	30.00	30.00
REQUIRED NASF	1983.00	2061.00	2109.00	2163.00	2214.00

TABLE 2 -- Continued.

ESTIMATED TOTAL STUDENTS	1470	1507	1534	1560	1573
(ACCOMMODATED PER INSTANT	10.00	10.00	10.00	0.00	10.00
TOTAL	14700.00	15070.00	15340.00	0.00	15730.00
NASF PER STUDENT STATION	.05	.05	.05	.05	.05
REQUIRED NASF	735.00	753.50	767.00	0.00	786.50
TOTAL NASF REQUIRED K-12	4416.90	4536.50	4671.10	3924.90	4754.00
INVENTORY	16832.00	16832.00	16832.00	16832.00	16832.00
NASF-TO BE CONSTRUCTED	-12415.10	-12295.50	-12210.90	-12907.10	-12078.00
NASF TO GROSS SQ. FT.	1.67	1.67	1.67	1.67	1.67
GROSS SQ. FT. TO BE CONST.	-20733.22	-20533.48	-20392.20	-21554.86	-20170.26
COST PER GROSS SQ. FT.	25.00	25.00	25.00	25.00	25.00
DOLLARS TO CONST. + EQUIP.	-518330.42	-513337.12	-509805.07	-538871.42	-504256.50
ANALYSIS 5 ST. LEARNING RES SP.					
YEARS------	YEAR 70/71	YEAR 71/72	YEAR 73/74	YEAR 74/75	YEAR 75/76
TTL NASF IN GEN CLRM +TL K-6	809	820	831	839	835
(PROVIDED FOR LEARNING RES	.05	.05	.05	.05	.05
TTL ACCOMMODATED K-6	40.45	41.00	41.55	41.95	41.75
NASF PER STUDENT STATION	15.00	15.00	15.00	15.00	15.00
REQUIRED NASF	606.75	615.00	623.25	629.25	626.25
TTL NASF IN GEN CLRM + TL 7-9	371	384	394	401	406
(PROVIDED FOR LEARNING RES	.05	.05	.05	.05	.05
TTL ACCOMMODATED	18.55	19.20	19.70	20.05	20.30
NASF PER STUDENT STATION	20.00	20.00	20.00	20.00	20.00
REQUIRED NASF	371.00	384.00	394.00	401.00	406.00
ETTL NASF IN GEN CR + TL 10-12	290	303	309	320	332
(PROVIDED FOR LEARNING RES	.05	.05	.05	.05	.05
TOTAL ACCOMMODATED	14.50	15.15	15.45	16.00	16.60
NASF PER STUDENT STATION	25.00	25.00	25.00	25.00	25.00
REQUIRED NASF	362.50	378.75	386.25	400.00	415.00
TOTAL NASF REQUIRED K-12	1340.25	1377.75	1403.50	1430.25	1447.25
INVENTORY	500.00	500.00	500.00	500.00	500.00
NASF-TO BE CONSTRUCTED	840.25	877.75	903.50	930.25	947.25
NASF TO GROSS SQ. FT.	1.67	1.67	1.67	1.67	1.67
GROSS SQ. FT. TO BE CONST.	1403.22	1465.84	1508.84	1553.52	1581.91
COST PER GROSS SQ. FT.	25.00	25.00	25.00	25.00	25.00
DOLLARS TO CONST. + EQUIP.	35080.44	36646.06	37721.12	38837.94	39547.69
ANALYSIS 6 ADM. OFFICE SPACE					
YEARS------	YEAR 70/71	YEAR 71/72	YEAR 73/74	YEAR 74/75	YEAR 75/76
EST ADMIN POSITION FOR K-6	809	820	831	839	835
REQUIRING OFFICE SPACE	*0029	*0029	*0029	*0029	*0029
NO REQUIRING OFFICE SPACE	2.35	2.38	2.41	2.43	2.42
NASF PER ADMIN POSITION	144.00	144.00	144.00	144.00	144.00
REQUIRED NASF	337.84	342.43	347.03	350.37	348.70

TABLE 2 -- Continued.

EST ADMIN POSITION FOR 7-9	371	384	394	401	406
REQUIRING OFFICE SPACE	.0039	.0039	.0039	.0039	.0039
NO REQUIRING OFFICE SPACE	1.45	1.50	1.54	1.56	1.56
NASF PER ADMIN POSITION	144.00	144.00	144.00	144.00	144.00
REQUIRED NASF	206.35	215.65	221.27	225.20	228.01
EST ADMIN POSITION FOR 10-12	290	303	309	320	332
REQUIRING OFFICE SPACE	.0055	.0055	.0055	.0055	.0055
NO REQUIRING OFFICE SPACE	1.59	1.67	1.70	1.76	1.83
NASF PER ADMIN POSITION	144.00	144.00	144.00	144.00	144.00
REQUIRED NASF	229.68	239.98	244.73	253.44	[illegible]
TOTAL NASF REQUIRED K-12	775.87	796.06	813.02	829.01	839.65
INVENTORY	941.00	941.00	941.00	941.00	941.00
NASF-TO BE CONSTRUCTED	-165.13	-142.94	-127.98	-111.99	-101.35
NASF TO GROSS SQ. FT.	1.67	1.67	1.67	1.67	1.67
GROSS SQ. FT. TO BE CONST.	-275.76	-238.71	-213.72	-187.03	-169.26
COST PER GROSS SQ. FT.	30.00	30.00	30.00	30.00	30.00
DOLLARS TO CONST. + EQUIP.	-8272.91	-7161.17	-6411.60	-5610.80	-5077.66
ANALYSIS 7 RES. CENT.STAF $ FAC					
YEARS------	YEAR 70/71	YEAR 71/72	YEAR 73/74	YEAR 74/75	YEAR 75/75
EST POSITIONS FOR K-6	809	820	831	839	835
(ACCOMMODATED	.90	.90	.90	.90	.90
NO ACCOMMODATED	728.10	738.00	747.90	755.10	751.50
NASF PER POSITION	60.00	60.00	60.00	60.00	60.00
REQUIRED NASF	43686.00	44280.00	44874.00	45306.00	45090.00
EST POSITIONS FOR 7-9	371	384	394	401	406
(ACCOMMODATED	.90	.90	.90	.90	.90
NO ACCOMMODATED	333.90	345.60	354.60	360.90	365.40
NASF PER POSITION	60.00	60.00	60.00	60.00	60.00
REQUIRED NASF	20034.00	20736.00	21275.00	21654.00	21924.00
EST POSITIONS FOR 10-12	290	303	309	320	332
(ACCOMMODATED	.90	.90	.90	.90	.90
NUMBER ACCOMMODATED	261.00	272.70	278.10	288.00	298.80
NASF PER POSITION	60.00	60.00	60.00	60.00	60.00
REQUIRED NASF	15660.00	16362.00	16686.00	17280.00	17928.00
TOTAL NASF REQUIRED K-12	79380.00	81378.00	82836.00	84240.00	84942.00
INVENTORY	85223.00	85223.00	85223.00	85223.00	85223.00
NASF-TO BE CONSTRUCTED	-5843.00	-3845.00	-2387.00	-983.00	-281.00
NASF TO GROSS SQ. FT.	1.67	1.67	1.67	1.67	1.67
GROSS SQ. FT. TO BE CONST.	-9757.81	-6421.15	-3986.29	-1641.61	-469.27
COST PER GROSS SQ. FT.	30.00	30.00	30.00	30.00	30.00
DOLLARS TO CONST. + EQUIP.	-292734.30	-192634.50	-119588.70	-49248.30	-14078.10

TABLE 2 -- Continued

ANALYSIS 8 PHY. PLANTSERV. AREA

YEARS------	YEAR 70/71	YEAR 71/72	YEAR 73/74	YEAR 74/75	YEAR 75/76
TTL NASF TO MEET STANDARDS	137116.66	140738.97	143307.20	145092.80	147321.94
PERC. OF ABOVE TTL STANDARDS	.05	.05	.05	.05	.05
TOTAL NASF REQUIRED	6855.83	7036.95	7165.36	7254.64	7366.10
INVENTORY	16325.00	16325.00	16325.00	16325.00	16325.00
NAST TO BE CONSTRUCTED	-9469.17	-9288.05	-9159.64	-9070.36	-8958.90
NASF TO GROSS SQ. FT.	1.67	1.67	1.67	1.67	1.67
GROSS SQ. FT. TO BE CONST.	-15813.51	-15511.05	-15296.60	-15147.50	-14961.37
COST PER GROSS SQ. FT.	25.00	25.00	25.00	25.00	25.00
DOLLARS TO CONST. + EQUIP.	-395337.72	-387776.15	-382414.96	-378687.53	-374034.20

Discussion

The survival ratio method for projecting FTE students was selected for two reasons: (1) it is the simplest and most widely used model, and (2) the accuracy of the model when using large numbers. It should be pointed out that small numbers were used in the simulation for this document to facilitate ease of application.

In using this model or considering its adoption, one should keep in mind the basic assumptions underlying it. For example, the model assumes that birth and death rate of children, promotion policy, in-and-out migration, dropouts and movement to-and-from non-public schools will remain constant. Further, one should note that accurate data for births and enrollments is needed if projections are to be accurate. One final note, average daily attendance should be used as opposed to enrollment figures. Otherwise, one will provide space which will not be utilized.*

The resource allocation model like the population projection model is fully operational on the CDC 6400 at Florida State University's computer center. As such, the allocation model is deterministic, futuristic and flexible. The main advantage in having the model computerized is that it provides the user employing the model with a variety of information besides the calculation of total square feet to be constructed and adjusted cost.

For example, a user may vary the space utilization factor while holding the other variables or parameters constant and examine the output, space to be constructed, as a function of the variations. Actually, any of the parameters may be changed and the outputs examined in terms of the change. Proceeding one step further, one may now alter combinations of variables which, without the computer, would not only be time-consuming but unrealistic.

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*Enrollment figures are usually 5-20% higher than average daily attendance.

The model, if used in the above fashion, can be used to examine outcomes of various alternative decisions. Having the outcomes in terms of costs, one might then assign a utility value to the alternatives and look at the cost-utility product for each alternative. To date, educational planners have few models, let alone computerized models, available to aid in the decision-making process. This program, in its present state, is then one more program for planning use which is sensitive to allocating scarce educational resources over a period of time.

One should not develop a model which lacks flexibility and serves simply as a means to an end. In this light, the resource allocation model, while it has terminal output, need not terminate at this point. Hopefully, planners will be flexible enough to adapt, revise and change this model as well as others as the educational system changes. One always has a decision of adapting and changing present programs and models or developing one for the particular problem. This is very dependent upon the nature of the specific problem. Consider the resource allocation model and its flexibility in meeting other user needs. Different uses require different inputs which are attainable from different sources.

A drastic change in inputs would surely imply complex changes in the existing program. Thus, one should be wary of using a model designed to do one thing for a problem which is totally different. Through lack of adequate information, educators are often guilty of this. The resource allocation model discussed herein will do only what it has been programmed to do: calculate the space required to accommodate projected student enrollment. The space needs per classification for K-6, 7-9, and 10-12 are only "ball park" figures. Further, the more inaccurate the inputs, the higher the error rate and the less accurate the results.

Some further uses of the resource allocation model which are presently under investigation are:

1. The use of the model in projecting state space needs by counties. The format of the output is illustrated in Table 3.

TABLE 3

FORMAT FOR PROJECTING SPACE NEEDS

Activities	Counties for Year 1970-71	County 1	County 2	County 3
1		'	'	'
2		'	'	'
3		'	'	'
4		'	'	'

2. The use of algorithms to cluster space/ student station/activity and consider various structural designs.

3. The addition of algorithms to determine other required educational resources which are functions of students such as teachers, administrators, para-professionals, media, etc.

The above is a cursory description of the two models which were linked together for simulating space needs as a function of students over a period of five years. The following is a brief discussion of the various options of the program.

One may elect to use only the population projection model and within this selection one may select the years and grades desired. The output of this option includes only those grades which were designated.*

A second option available to the user is the selection of the resource allocation model as a single program. Here one must provide the population projections as initial inputs using cards. Within this option one may select space needs between any range of grades provided

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*As input, one needs the births for eleven years from the present year and enrollment by grade for those grades one wishes to predict, five years back from the present year. This data is entered using cards.

that the population projections were for the desired grades as the program simply sums the projections of grades within the range of K-6, 7-9, and 10-12. Errors in FTE projections would invalidate any outputs of this option.

One may elect to use the complete program and obtain printout for any range of grades as were outlined in the first and second options. The output in Tables 1 and 2 were obtained using this option and grades 1-12.

Summary

The purpose of this study was to develop a resource model as a function of projected pupil enrollment. The simulation consists of two linked programs. First, a program utilizing a version of the modified "cohort-survival" technique and the second which allocates space and accompanying costs necessary to meet the projected needs.

The benefits to the educational system from any attempt to systematize the planning and decision making tasks go beyond the value or the accuracy of the outputs. Further, it is through involvement and activities such as those discussed in this paper that one learns to cope with the "openness" of the educational system, how the parts within the system are interrelated and how each part interacts with the whole.

The models presented in this paper are simple enough for persons with very little experience in either mathematics or programming to follow. As such, they should provide a good initial experience to those interested in using the computer for simulating planning and outcomes of decisions.

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