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ABSTRACT

A study was conducted to assess classroom utilization at a university and to make recommendations to optimize the use of the space available. Seven steps were involved in the study: (1) preparing the inventory of space; (2) identifying the variables; (3) making assumptions for the study and changes to carry it out; (4) calculating mean numbers of classes in each classroom (credit or noncredit); (5) reallocating classrooms by department; (6) making recommendations for best use of classroom space; and (7) consulting with department heads about the recommendations. Data were from fall 1999. At least 17 classrooms were identified as under-used, and a detailed utilization map was developed to support the reallocation of space among departments. (SLD)

A Quantitative Approach To Improve Classroom-Space Utilization

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A Quantitative Approach to Improve Classroom-Space Utilization

Introduction

Following a shortage of classroom space on campus, a study was conducted to assess classroom utilization and to make recommendations towards optimizing the use of this space. Since the practice at this college is that each department controls a certain number of classrooms, the purpose of the study was to determine if there was any need to reallocate classroom space over the departments for more equitable and efficient utilization.

Quantitative approaches aiming to maximize classroom utilization have previously been made by Smith (1982) through the study of the correctness of the data used to build the schedule of classes. Other approaches used by Porter and Matt (1986) and later Hall and Clay (1997) were based on surveys, questionnaires and interviews to assess student and administrator's preferences and interests.

Methodology

Seven major steps were involved in the study. They are:

1. Preparing the Inventory

The first step consists of becoming thoroughly familiar with the inventory of classrooms and the specifications of each classroom. In most institutions, an inventory will be available. However, it is unlikely that this inventory and the related classroom information available will satisfy the needs for a study of this type. These needs center around answering a set of questions for each classroom such as:

A. What type of a room is this: classroom, lab, conference room, etc.?
B. If the shortage is in classrooms, then the next question would be: can this room be used as a classroom, regardless of its current use? For example, if this room is currently used for storage, can other arrangements be made to store the material elsewhere?
C. What size is the room? Here, a simple classification like: small, medium, or large, with specifications tailored to the institution's needs, may be sufficient.
D. Can this room be partitioned into smaller classrooms?

An example of part of an inventory is shown in Table 1.

Table 1
Classroom Inventory

Classroom	Description	Size
1	Sculpture and pottery lab	M
2	Classroom - can be used by any department.	L
3	Classroom with 3 TV sets	L
4	Classroom connected to 201 through 202	S
5	Testing Center - can be partitioned into 2 small classrooms	L
6	Classroom with computers - labeled "Lab."	S
7	Classroom partitioned with 127 and 128 - Ed wants to keep it.	S
8	Nursing classroom - cannot be used by other departments.	M

2. Variable Identification

The next step was to identify the variables that needed to be included in the study. A similar attempt using some of the same variables as those used in this study has previously been made by Gracie (1986). On this campus, these variables were:

1. Time of Day. It was decided to break up this time into:
   - up to 4:59 p.m.
   - 5:00 p.m. and later.

   Only the first category was analyzed.

2. Days of the Week. It was decided to conduct the study for Mondays through Fridays only, given that classroom space was abundant during week-ends. Data were collected and analyzed for each weekday separately.

3. Laboratory versus Non-Laboratory Classrooms. Since there was no apparent lab-space shortage, it was decided to study only the non-lab classroom situation.

4. Classroom Size. The number of students in the classroom in relation to the physical capacity of the classroom was one factor that was considered as shown below.

5. Credit versus Non-Credit Courses. Two separate approaches were used, one for credit and one for non-credit classes.

Data based on Fall 1999 utilization were analyzed. It was also decided to summarize the results two ways: by department and by classroom. Summarization by department consisted of aggregating the data for all the classrooms available to that department.

3. Assumptions and Changes

The next step consisted of laying down the assumptions under which the study was conducted, and the changes that were necessitated for the study to be completed.

Examples of Assumptions

1. No new construction, but partitioning is possible.
2. Counting all pre-college classes as credit classes.

Examples of Changes

1. Using room 7 (currently the Faculty Senate room) and room 12 (currently the Writing Project room) as classrooms.
2. Aggregating classroom assignments for Department A with Department B.

4. Calculations

In this study, different approaches were used for credit and non-credit classrooms. In both cases, the objective is to calculate the college-wide mean number of classes that were held per classroom. This number was then used to allocate classrooms by department.

A. Credit Classrooms

The total number of non-lab contact hours for the entire college was divided by the total number of non-lab classrooms available to yield the mean number of contact hours per classroom, $\bar{x}$.

$$\bar{x} = \frac{\text{Total contact hours offered by the entire college}}{\text{Total non-lab classrooms at the college}}$$

In this study, this number was 468. However, another smaller number, 440, was used instead. The calculations and the results are shown in Table 2.

Table 2
Calculations for the Allocation of Credit-Classroom Space

Department	Contact Hours	Percent	Initial Classroom Inventory	Final Classroom Allocation	Current Classroom Allocation	Difference
A	1,928	7.4	5	5	5	0
B	1,248	4.8	3	4	6	-2
C	985	3.8	3	3	6	-3
D	5,136	19.8	12	12	5	7
E	3,920	15.1	10	10	4	6
F	7,016	27.1	17	17	17	0
G	2,912	11.2	7	7	5	2
H	248	1	1	3	5	-2
I	2,544	9.8	6	5	5	0
Total	25,937	100.0	64	66	58	8

The reason for the use of a smaller number than the arithmetically-derived one is that, in the final analysis, several reasons, –political as well as quantitative– were expected to push the total number of classroom allocations upward. This smaller number, 440 in our study, was used to obtain the "Initial Classroom Allocation" column in Table 2, which, as a result, comprises a smaller number of classrooms than the actual inventory. This number of classrooms was useful as a starting point, which was subsequently increased because of special situations. For example, although Department B should get only 3 classrooms out of 64 based on the proportion of classes offered, it was finally allocated one more classroom (the "Final Classroom Allocation" column in Table 2), mainly because of the convenient location of this classroom in the department's building. Had the originally-computed mean of 468 been used first, no additional classrooms would have been available to accommodate situations such as this one.

The data in Table 2 also indicate that, overall, this department, which currently controls 6 classrooms (the "Current Classroom Allocation" column in the table), stands to lose 2 of them in the reallocation process (the "Difference" column in the table).

B. Non-Credit Classrooms

The results of the reallocation of non-credit classrooms are presented in Table 3. At this college, there is a total of 13 classrooms used primarily for non-credit classes. During Fall 1999, there was a total of 637 non-credit offerings by various departments ("Non-credit Courses" column total in the table). The results of the reallocation, which started with only 11 classrooms ("Initial Classroom Inventory" column total) instead of 13, are shown in Table 3. The objective was to allocate to each department a number of classrooms relative to its share of non-credit offerings.

Table 3
Calculations for the Allocation of Non-Credit-Classroom Space

Department	Non-credit Courses	Percent	Initial Classroom Inventory	Final Classroom Allocation	Current Classroom Allocation	Difference
A	417	65.5	7	7	7	0
B	63	9.9	1	2	2	0
C	38	6.0	1	1	1	0
D	0	0	0	0	0	0
E	58	9.1	1	2	1	1
F	50	7.8	1	1	1	0
G	0	0	0	0	0	0
H	11	1.7	0	0	0	0
I	0	0	0	0	0	0
Total	637	100.0	11	13	12	1

Based on these calculations, Department A, which offered 65.5 percent of all non-credit classes, gets 7 non-credit classrooms ("Final Classroom Allocation").

5. Total Reallocation

The last step in the calculation process consisted of generating a list of new classrooms by department. Some considerations in generating this list were:

- making the least amount of change from the current allocation,
- classroom size, and
- classroom location.

6. Recommendations

Recommendations can be as important as the reallocation itself. Some recommendations made in this study were:

1. There is a need to establish a campus-wide policy dealing with the optimization of the use of computer labs. Currently, designating a classroom as "computer lab" significantly curtails its utilization. Whereas it is commendable to use computers in the classroom, a campus-wide policy that will allow cross-utilization of these rooms will lead to additional classroom-time availability. In addition to the Internet Café, there are at least 17 such classrooms on campus, some of them virtually unused.

2. The availability of storage space may result in classroom-space savings, particularly with the Health Sciences. In these programs' classrooms, some rarely-used equipment is permanently stored.

3. There is a need to revisit all of the equipment and materials stored in classrooms. In some departments such as Department E, bulky equipment residing in classrooms and labs may be obsolete or no longer used and can be disposed of. In other departments such as C, a large quantity of cardboard boxes are being stored in classrooms and labs. Disposing of this material will eliminate a potential fire hazard as well as free up much-needed space.

4. A policy needs to be formulated vis-a-vis the use of classrooms by outside groups. This policy should allow for priority to be given to college functions, and should address time restrictions for outside groups.

5. Consideration should be given to the use of conference rooms and amphitheaters. These rooms could be controlled by a central entity on campus to use for last-minute needs.

6. Departments need to pay closer attention to classes that get frequently cancelled in an effort to discontinue offering them. A list of these classes and the frequency with which they were cancelled between Fall1997 and Spring 2000 is available at our department.

7. A major factor impacting classroom utilization is scheduling mode, that is, whether to schedule three 50-minute classes or two 75-minute classes weekly, or any other arrangement. Although this flexibility is left to the department and should continue to be so, it must be kept in mind that uniformity in scheduling leads to more efficient utilization. As an example, more classes

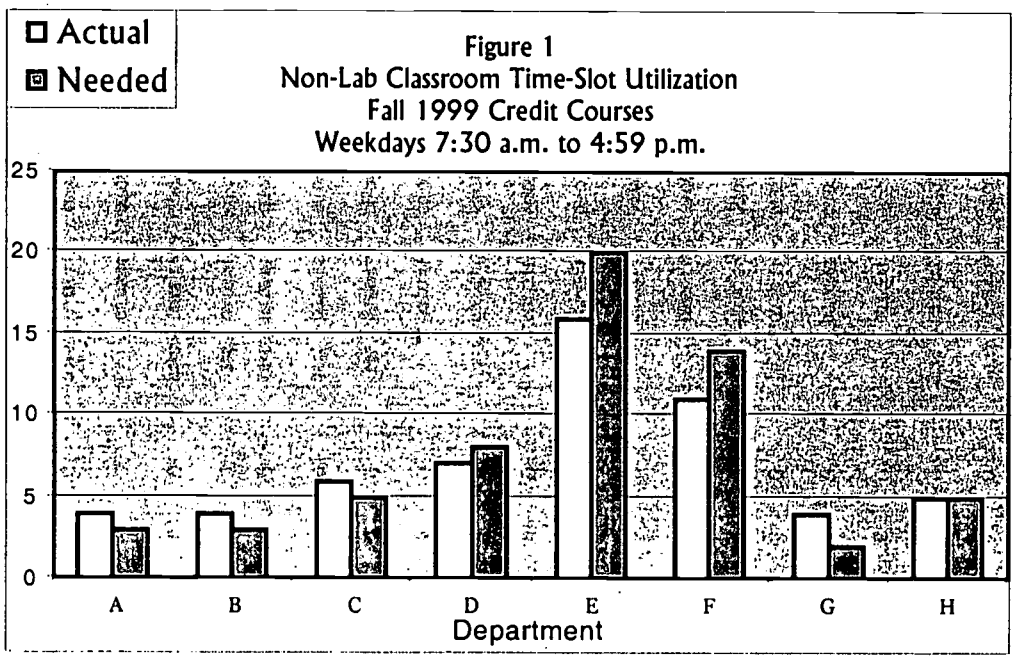
could be scheduled on Tuesdays and Fridays if all classes were 75 minutes long or multiples thereof than a mixture of 50-minute and 75-minute classes.

8. Although no new construction is envisioned in this allocation plan, serious consideration should be given to partitioning some classrooms. Notably with classrooms used by Department D, class sizes are small and classroom space is relatively large, and thus underutilized. This change could be more attractive to the department if the additional classrooms generated were given initially as a bonus to Department D without taking away classroom space in return.

9. Classroom allocation for both credit and non-credit courses should be done at the department level, with input from non-credit coordinators. This arrangement will increase availability within the departments through cross-utilization of classrooms between credit and non-credit classes.

10. The high cancellation rate of non-credit classes decreases the efficiency of classroom time-slot utilization for the entire college. This problem could be substantially alleviated if noncredit registrants could be informed about their classroom location only a short time before the start of class. This may be accomplished by posting the classroom location on the College's web site or in a conspicuous agreed-upon location on campus one or two days prior to the start of the class.

7. Consultation With Department Heads



Once the calculations were completed, consultation with department heads was necessary to obtain their approval. Since it was expected that approval by the departments losing space was going to be difficult, an additional effort was expanded to offer all departments convincing evidence that was clearly presented. Two visual tools were used at this institution for these purposes. One is a simple histogram illustrating the difference between actual and needed classroom space (Figure 1), and the other is a color map of classroom utilization (Figure 2).

Figure 2
Non-Lab Classroom Utilization
Classroom C
Fall 1999 Credit Courses

Hour	Weekday				
	M	T	W	R	F
7:30 - 8:59					
9:00 - 9:59					
10:00 - 10:59					
11:00 - 11:59					
12:00 - 12:59					
1:00 - 1:59					
2:00 - 2:59					
3:00 - 3:59					
4:00 - 4:59					

The Utilization Map

This visual tool represents the intensity with which a certain physical entity is being utilized: the darker the color the heavier the utilization. Maps can be drawn for an entire department, a building, or a specific classroom. The more specific the physical entity for which a map is drawn the more useful the map. Thus, classroom maps showing time-of-day and day-of-week utilization (Figure 2) provide more revealing information than college maps showing only time-of-day utilization for each department (Figure 3).

Figure 3
Non-Lab Classroom Utilization By Department
Fall 1999 Credit Courses
Weekdays

Hour	Department						
	A	B	C	D	E	F	G
7:30 - 8:59							
9:00 - 9:59							
10:00 - 10:59							
11:00 - 11:59							
12:00 - 12:59							
1:00 - 1:59							
2:00 - 2:59							
3:00 - 3:59							
4:00 - 4:59							

For example, it can be readily concluded from Figure 2 that higher utilization can be made in Classroom C before 10:00 a.m. and after 2:00 p.m. every weekday except Monday. In Figure 3, one observation that can be made is that Department B appears to under-utilize its space in general, while Department D appears to be significantly more efficient in this respect. Although this information is useful, it is not sufficient to make reallocation decisions about which classroom can be more optimally used during which weekdays and which can be transferred to another department.

Another important use of detailed utilization maps such as the one shown in Figure 2 is the facilitation of classroom cross-utilization among different departments: they allow needy departments to identify other departments with classroom availability at the times needed.

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