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UNIVERSITY AND POLYTECHNIC PLANNING THROUGH THE UTILIZATION OF STUDENT ACTIVITIES

submitted by

SAHAR NAJIB S. KHARRUFA, M.Sc.

For the degree of Doctor of Philosophy

of the University of Bath

1985

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SUMMARY

The amount and distribution of activities performed in a site can be beneficially used to study and plan the physical requirements of that site, especially in spatial terms. A high concentration of a particular activity during a certain period of day would mean that a respectively large amount of space to house that activity is needed. Since there is a direct link between the function and characteristics of a particular site or building, and the consequent activities performed in it, it is theoretically possible to establish a relationship between these elements, ie; the individual case, the activities, and the spatial need. This chain would provide the basis for a planning method with advantageous characteristics. It would allow the planner more flexibility in assigning activities to space, the ability to accommodate the needs of each individual case, and consequently a chance to improve the accuracy of his spatial projections. This research concentrates on applying this procedure to campus planning.

The most important thing in developing an activity method for planning is to isolate the factors that affect the activities and determine their actual impact quantitively. Using a large data base containing a detailed list of student's activities in separate campuses, it was possible to formulate and test a theoretical basis to achieve this goal. This was done by

gathering the students into groups that are under relatively similar circumstances, ie; residents and non residents, postgraduates and undergraduates, etc.; and analysing their response to changes in their environment, be that physical, organizational, or academic. To test the accuracy of the theory, the results were consistently checked, where possible, on the students of the other sites. Most of the results showed relatively small margins for error rarley exceeding 13%, but some relationships could not be evaluated for statistical significance.

The outstanding factors that appeared to affect students activities, and hence their need for space, in a campus were: the percentage of resident students, amount and distribution of scheduled hours, the subject being studied by the students, size of campus, its location with respect to urban centres, and the number of postgraduate and part time students. Each of these factors has a negative or positive influence on a particular aspect or aspects of student activities, but the most important are the percentage of resident students and the number of scheduled hours.

Having measured the effect of each factor on the students, it was possible to lay out a system to calculate the activities in a future campus and find its spatial requirements. To show the difference between this method of planning and the existing ones, a test was carried out on a selected range of cases with different characteristics; the results showed a relatively large difference with the activity method consistently expressing need for less areas of space than the other methods.

CHAPTER ONE

INTRODUCTION

Several problems face architects when they attempt to plan or design large educational facilities, such as universities or polytechnics. This research is aimed at those problems that arise due to the effects and limitations of planning methods and procedures, as currently employed. It will be restricted to studying the academic parts of the campus.

1.1 DEFINITION OF PROBLEM

Most of the present planning methods for most building types depend on the use of empirical spatial standards. Empirical standards are rules which are derived from practical observations without resorting to a theoretical background to support them [ref 5].

Spatial calculations in universities and polytechnics are more advanced than the average building type. The reason for most of this can be attributed to the development of the methods concerned with allocating classrooms and laboratories for timetabled activities [refs 7, 46], such as lectures and applied work. Although dissatisfaction has sometimes been raised in some academic circles concerning the utilization levels of space in establishments which were planned by such methods [ref 46], this can usually be attributed to the lack of general agreement on subjects like the distribution of classroom sizes, and methods of timetabling scheduled classes.

The calculations concerning the need for non-scheduled spaces, spaces where the activities are not timetabled, are done using the more usual method of applying emperical spatial rules [refs 21, 35, 45]. These spaces include areas such as libraries, common rooms, circulation areas, and even landscaped areas. Considering that the student spends some 60-70% of his time on campus performing non-scheduled activities (Appendix C), imperfections in the methods used to calculate their need for space means that there still is a considerable margin for probable error in projecting these needs, with the associated consequences concerning expenditure and building resources.

The questionmarks hanging over the accuracy of present planning methods in universities and polytechnics can be identified from studying the discrepancies between some of the present rival spatial standards and how they were employed in actual planning. Table (1.1) shows a comparison between several British universities during the days of their planning in the sixties. The diversity although obvious, should not be taken on face value. Different establishments require different allocations of space, and some of the figures may have been changed before actual building. Drawing any conclusions from the table must be done with care.

It has already been explained that the methods of allocating space for scheduled areas are reasonably well developed. Consequently, in the absence of any physical restraints imposed by the campus site, or any economical restraints, the reasons for different space allocations per student between universities or polytechnics must be attributed to one or all of the following reasons. Either the organization requires special consideration,

UNIVERSITY	PROJECTED NUMBER OF STUDENTS	NET AREA IN SQUARE FEET	AREA PER STUDENT	RESIDENT STUDENTS
SUSSEX	2090	362 000	173.2	10%
LANCASTER	2450	680 000	277.5	30%
BATH	1800	750 000	416.6	30%
BRUNEL	3000	360 000	120.0	33%
YORK	1870	702 000	375	50%
KENT	2100	940 000	447.6	50%

TABLE 1.1

COMPARISON OF SPACE ALLOCATION PER STUDENT ACCORDING TO ORIGINAL ARCHITECTURAL PLANS.

It must be noticed that although only the data which appeared to be compatible was included in this table, allowances must still be made for varying interpretations of spatial criteria by the planners, and that some of the figures may have been changed before actual building took place.

the academic specializations are different, or the spatial standards are. Indeed it is a well known fact that buildings of science and technical establishments do require larger spaces per user than other buildings [ref 35]. This is because technical and scientific work requires facilities such as laboratories and computer rooms, all of which take up considerable areas in the building. However, from table (1.1), consider the differences between the universities of Bath and Brunel. Both are technical universities [ref 3], with relatively similar specializations in them, and both contain a similar proportion of students in residence. Both University employ's a sandwich course system, but the proportion of students involved in such schemes in Brunel is higher. In Bath around two thirds of the undergaduate students attend sandwich courses, while in Brunel almost all of them do [ref 3]. Taking this fact into consideration and after calculating the figures for each university it seems reasonable to expect a ratio of 100/140 with Bath needing the higher ratio of space because of its smaller involvement in sandwich courses. Yet the actual difference between the two is as high as 100/340. In other words, the equivalent of each full time student (FTE) in the University of Brunel has less than half the space at his disposal than a similar full time student (FTE) in the University of Bath. Considering that both universities where planned during the same economic period and under similar conditions, this difference should mainly be attributed to different spatial standards being adopted in the planning stages by the respective planners.

It would not be wise to conclude that spatial allocations in universities and polytechnics vary considerably on the evidence of one table whose figures where supplied by architects that may have widely different interpretations of spatial values and terminology. To add substance to the subject it was necessary to check on these variations in planned areas. To this effect a comparative evaluation was done on an existing university planned by a reputable firm. This was done by recalculating the non-residential areas in that university using a planning method different to the one known to have been used by that firm, and comparing the results with the original plans. The spatial standards used by the two methods would most probably be different, the important factor is to find how much that difference is. The University concerned, Bath, had been allotted a gross area of 132,234 square meters for non-residential use in the original plans to accommodate 3,600 students [ref 30]. The alternative areas were calculated using standards obtained from UNESCO [ref 44], which were meant for use in the initial calculation of university spaces. The UNESCO standards were converted so that they would suit a technological establishment like Bath University, with 3060 students studying technical or scientific subjects, and the rest not. A gross area of 67,269 square meters was calculated by this method, to house the same activities for which the architects had originally allowed 132,234 square meters for. This represents a change of around 101% on the actual plans.

This comparative study can be considered as a more objective evaluation of present planning methods as it is a direct result of comparing the elements which are actually involved. However it must not be taken to indicate that one or both of the methods investigated are wrong. At this stage it is not possible to decide on such matters without further data, although it must be mentioned that the original architectural plans for the university of Bath employed the academic schedule to determine the need for scheduled spaces, while the UNESCO method did not.

The problem of accurate spatial projections takes on a different meaning in different economic environments. C. Doidge in his PhD thesis "University Space Utilization" [ref 17] suggests that in Britain it has often been a problem of overspacing, despite the fact that most establishments suffer from a feeling of overcrowding and lack of space. Commenting on several surveys which were conducted to study the subject he says:

> "These surveys, carried out on campuses which were presumed well-run and suffering from overcrowding, revealed consistently low levels of utilization". "Some reconciliation between the feeling of overcrowding on the one hand and the apparent underuse on the other was offered by studies of two 'exageration phenomena'. The first, 'Democratic Exaggeration', based on a theoretical argument, suggested that a concensus view of utilization by user/observers is always exaggerated because more are present to see well used spaces than poorly used ones. The second, 'Occupancy Exaggeration', based on experimental evidence, argued that people observing a partly full room over-estimate the percentage of seats occupied because they can see the people but not the seats obscured by the people."

The importance of all the variations in allotted building area can be realized when the economic terms are examined. In a technical university of 3,000 students, for instance, a difference of 100 square feet per student, which is the equivalent of 9.29 square meters, at a unit cost of 500 pounds per square meter, as suggested by the educational authorities for the year 1982 [ref 11], would mean a difference of 13,875,000 pounds. Although this represents a large amount of money by any standards, the evidence from the two examples given above on the University of Bath, and from table (1.1) suggest an even larger amount. In fact the difference shown in the case of the example on the University of Bath reached up to 32,000,000. Not only is this a large amount of money with respect to the initial investment, but if it were to be supplying an overabundance of space, it would add considerably to the running costs of the project. In the present economic climate of rising fuel costs and government spending deflation, this can hardly be a comforting thought. In fact the spatial allocations that were used in the final plan that was actually employed in the University of Bath were less than the initial projections which have been used for analysis here [ref 46].

Given that the scheduled areas have a well developed planning system available [refs 7, 44], most of the work to improve the situation must be directed towards the methods used to calculate some or all of the other spaces. The total area allocated to these spaces in the University of Bath, as originally planned by the architects, totalled around 59% of the gross non-residential space, and 61% in the University of Aston [refs 30, 31]. If the figures for the University of Bath were converted to suit a non-technical one, the figure would increase to 65%, and if different spatial standards were used, such as those suggested by UNESCO, which imply a greater utilization level of scheduled spaces, the figure would rise again to reach 82%. The percentages represent a large portion of the total area and are enough to be held responsible for much of the variations.

1.2 DEFINITION OF RESEARCH TOPIC

It should now be clear that there is ample room to improve the methods used to plan certain parts of a university or polytechnic, and that it may be of considerable value to do so. To achieve this objective it is necessary to find a gauge by which to measure the need for area in the related spaces which can overcome the faults attributed to present planning methods. The most obvious way to do this is to employ the activities that are performed in these spaces in a manner which is similar to the way the need for scheduled spaces is calculated. The larger the number of people performing a certain activity at a certain time of the day in a certain space, the larger the area needed to house them.

The problem of applying activity calculating methods to non-scheduled spaces lies in the difficulty of defining quantitatively the activities that are to be performed in a space. This is because the student has the freedom to choose the time and place that he wishes to perform these activities in. To overcome this problem activity surveys were employed. These surveys had been conducted by the Centre for Land Use and Built Form Studies in the University of Cambridge and included around 800 students from three establishments, the University of Reading, the University of Leicester, and Leicester Polytechnic. After vetting the results of these surveys, they were put on computer and edited for use. This allowed a wide variety of subjects to be investigated in accordance with the requirements of the research.

The single greatest advantage of using activities to determine the area of a space is that they actually do reflect the need for that space. Consequently if any related factor affects that need, the change may be detected through their use. This facility will be used in this research to study the relationship between the spatial needs of the campus and the factors which may have any bearing on the spatial requirements. These include factors such as location, size of campus, number of students in establishment, or academic content. Defining their relationship through a theoretical outline and applying it in a planning method would add considerable flexibility to it. This implies that the need for a particular campus could be defined in relation to its individual characteristics and not as a reflection of the average needs of other campuses.

Student activities would of course be of no value in planning administrative areas of a campus or building services. These and other spaces depend on different values to establish the need for their areas. Consequently they do not enter into the scope of this research.

To summerize the objectives of this research briefly it may be said that, "It is an attempt to improve spatial planning projection methods of non-scheduled, non-residential areas which are used by the students on campus. This will be done by making use of student activities to lay down a quantitative expression (definition) of the campus which reflects its individual local characteristics. This quantitative expression can then be used to calculate the particular requirements of that campus. The whole process is bound together by a theoretical model which would define mathematically the relation between the students, the campus environment physically and academically, and the spatial needs of the campus and building design."

The theoretical model which defines the relationship between the campus and the students' activities and consequently the spatial requirements, is the pillar on which the planning hypothesis in this research is based. The presentation of this theory, so that it can be used for such a purpose, will be simplified by employing an interactive definition of a campus. The definition, by using student activities, should be capable of indicating the characteristics of the campus which are related to the spatial need, and any change in the campus which affects this need should affect the definition. A campus which is predominantly worklike in nature, for instance, leaving the students with little free time, should appear different to one in which the students have abundant time on their hands to spend on social activities. Furthermore it should also be clear from the definition why the two examples are different. Thus it would be possible to find if any spatial changes need be introduced too. The recommended presentation for such a definition would be a graphical one which is easy to read and capable of expressing the values involved. The details of this form of expression will be explained in chapter three.

Relating the campus activity definition to the spatial needs would involve translating it into an activity time budget, which shows the time the students spend, or are expected to spend, performing each activity. The activity times may then be used to determine the spaces needed to house the activities. The spatial requirements of any area inside the campus would predominantly depend on the total time the students spend performing the activities which that certain space is used for in relation to the maximum usage period. By finding the percentage of the total which represented the peak time for performing that activity, and finding how many students are involved during that period, the area needed to house that activity can be assessed (chapter 7). For instance if it was found that type "X" space in the campus is usually used for "Y" activities; and that the peak time during which the students performed these activities in their largest numbers was 2:00pm, during which 40% of the student population on campus was involved; then the

"X" spaces in the campus would have to be planned so that they would be capable of housing 40% of the number of students on campus at that time. This is a simplified example which does not include many of the other variables which will be explained in due course.

Further use of the activities definition of a campus can also be made during other stages of the planning process. For instance if the definition were presented in a simple and easily legible graphical form (ill 3.4), it could serve as a communications tool between the planner and the client. Having established a relationship between the graph and the characteristics of the campus, it could be used to indicate what these characteristics are in a certain campus. The planner could thus explain to the client the effect certain decisions could have on the university or polytechnic by showing him the changes in the campus characteristics that would result from those decisions. This would be done without resorting to difficult technical jargon which the client may not be familiar with. Consequently the client would be presented with a series of possibilities which he can choose from, with knowledge of the consequences.

1.3 CONTENTS OF DISSERTATION

The definition of the problem in detail will continue in the second chapter with the objective of defining the field of study and recognizing what can possibly be achieved. The devised planning method will start to take shape in this chapter.

The third chapter is devoted to explain how students activities will be used to define a campus quantitatively in a manner which can be used for planning. Most of it is spent on explaining how the proper graphical presentation is achieved.

Chapter four contains the work methodology, explaining the surveys, and how they were used. Chapter five contains the actual entry into the subject proper. It contains the theoretical background on which the analysis of the survey results were based.

Chapters six to eight are consumed with the actual analysis itself and the deduction of the results on how the new planning method works. Chapter nine is then devoted to applying the method conceived in the dissertation.

1.4 LITERATURE REVIEW

The noticeable factor encountered when reviewing literature concerning university or polytechnic planning, is the wealth of material of British origin on the subject. Most of it seems to have originated as a response to the great university building boom during the late sixties and early seventies. Much of this literature deals with the campus and its buildings as a general architectural subject [refs 16,18,22,24,38], such as the work of M. Holford on the new universities [ref 24], and Dober [ref 48]. The emphasis in these publications has little to do with spatial planning and is usually used to reveiw the buildings' architecture, and the Architects point of views on them. Some of them have attracted attention for their visual presentation such as the work of Schmertz [ref 38].

More recently there has been an increase in the attention paid to the importance of flexibility. As most recent Architects try to incorporate this problem into their designs, the more detailed analysis of university planning has been helpful in casting more light on this issue, such as the general descriptions by Jockusch on British universities [ref 25] and the work done for Der Minister fur Landesplanning on the University of Bochum [ref 16]. Both have not tried to link the subject of flexibility in design with the problem of spatial planning in terms of area despite the fact that some forms of flexibility, the need to expand for instance, are directly related. The emphasis is rather on building design systems that allow for future change.

On the more specialized subject of spatial planning, the scope is still plentiful [refs 1, 16, 29, 34]. Of the more prominent literature, most seem to have concentrated their efforts on studying how to allocate space for timetabled scheduled classes. Among these the work of Harland and Bariether of the University of Illinois [ref 21] is significant. It devotes a lot of space to the subject of timetabled areas with a wide range of options related to most academic specializations in a university, and most student groups. The method developed to calculate the spatial requirements of scheduled areas relates the scheduled hours to the demand for space based on achieving a targeted utilization level. The main problem with the method revolves around the "target" utilization. The value of this target, vitally important to the result, is difficult to define. The Unit for Architectural Studies London, and the UGC have conducted studies on utilization levels [refs 45b, 46]. They concluded that a wide lattitude existed rangeing from 20-50% in British universities.

Research areas and common areas are also dealt with in detail in Baraither's work, with practical methods on how to calculate the needs. The methodology is coupled with a numerical cataloguing system for spatial designation of building areas. The combination is adopted for the fast changing building needs of present day establishments. The planning method suggested in the book is typical of what most present day planners follow. The problem with this approach is its lack of analysis for the requirements of non-scheduled areas. Reference to the spatial needs of these areas is made in terms of empirical rules which are often devoid of any mathematical backing, such as the suggestion that 25% of the student population must be accommodated in the Library. No reason is given for such a particular allocation nor is any justification made available. The spatial cataloguing system also has its problems. Few would dispute its value, but it is limited by the fact that any space inventory needs continuous updating and most of the establishments which have tried to use one have not found the will to do so.

Work generally similar to Bariether's in its approach to the spatial planning of scheduled areas is also available from other sources [refs 12,13,14,15,34,35,37,44], with Edwards in particular paying attention to the norms required for British universities by the University Grant Committee (UGC) [ref 35]. These norms have been continuously updated and published by the UGC [refs 47,48].

Literature is also available on more specialized planning issues such as particular types of campuses, for polytechnics for instance from the UNESCO and the DES [refs 14,35] or on lecture rooms by Taylor [ref 44].

Several attempts have been made to improve on the limitations of university and polytechnic planning methods. A large portion of this has been concerned with utilization levels, basically in timetabled spaces [refs 2,17,27,46,48]. The work of C. Doidge, Kenny and Foster, the "Unit for Architectural Research" in the University College London, and the University Grants Committee is notable among these [refs 17,27,45b,45c,45d,46]. They include studies on utilization levels of non-scheduled spaces, especially in Doidge's case. While all these publications agree that there is a problem of low utilization in scheduled areas, Doidge puts more emphasis on non-scheduled areas, and attempts to explain this phenomenon. Possible solutions to the problem are offered mainly for scheduled space in terms of improving spatial management. The suggestions concerning non-scheduled space are limited, and no attempt is made to offer an alternative to the planning methods that caused the problem. The contents of the literature with respect to non-scheduled areas, basically serves the purpose of identifying the size and extent of the problem and less effort is put on actually trying to solve it. The same can be said of the work of both the UGC and Kenny. They both contain analysis of the use of non-scheduled spaces with examples, explanations, and suggestions as to how the utilization levels may be increased through improved spatial management, or where the bottlenecks are, but the final step of binding the solutions together to produce an improved planning method is missing. The result is a set of suggestions, mainly for scheduled areas, and little more than an identification of the problems of the non-scheduled ones.

The other piece of work which must be mentioned concerns a series of papers from the "Centre for Land Use and Built Form Studies" which is affiliated to the University of Cambridge [refs 4b,5,5b,6,7,8,44b,44c,47]. Report number "1" contains detailed background information on universities and polytechnics which is aimed at covering the subjects that may affect the planning procedure, and is basically descriptive. It lists all the possible elements methodically and then goes to deal with each in different amounts of detail. The following working papers and articles deal with the more specific subject of student activities, surveying and analysis. They contain an informative survey on student activities in several campuses. The same surveys were the source of most of the information on student activities in this research too. The findings from the activity surveys are illustrated in graphs which show how much they were performed through the course of the day for each establishment involved [ref 7, 8]. The data is also statistically analysed for the grouping of activities and students [ref 47]. It is then used as input for a model whose purpose was to simulate students activities [ref 5b,7,44b,44c]. Using the model relies on distributing activities and location according to the students' probable choice at any particular time of day. The application scale includes both the campus to city and internal campus relationships. The simulation starts off close to were this research ends.

In this research the main concern will be to find what the total time spent on each activity is, while the simulation model described above distributes that total over the period of a day. Consequently its use is complementary to the results which are hoped to be achieved later here. However due to the relatively lengthy procedure required to apply the simulation model, an alternative approximation will be offered as a substitute in this research (chapter eight). This alternative will be simpler to use and more specific in its obectives which will be tailored to produce nothing more than what is required to complete the planning process, while the model attempts a complete simulation.

A similar approach as that used in the simulation model was used by Bullock [ref 4c] to study the need for space in timetabled scheduled activities. The objective was to bypass the problems of defining a target utilization level associated with other methods, as described above. Its application does not extend to non-scheduled activities.

There is also a series of books related to the university building era of the sixties describing the particular case of each one. Although most are only concerned with general architectural matters, the work of Matthew and Johnson-Marshal [ref 30, 31], in reviews on the universities of Bath and Aston illustrate the methodology that was used to project the need for space, and to what extent empirical rules were involved to formulate spatial standards. Their objective is to describe the existing methods rather than to discover new ones.

Most of the remaining work is less concerned with the detailed problems of planning [refs 1,26,47,49] although a collection by Brawne [ref 3] contains articles by the planners of several universities, and their thoughts concerning the particular projects they were designing are expressed along with the proposed spatial designation which they are planning for. The figures however are not in detail.

From a non-architectural point of view, there is work on students activities as a singular issue [refs 4,22,26]. Naturally no reference is made to spatial planning but consideration of such material is necessary if the subject is to be studied comprehensively. Brothers and Hatch's work on resident students, in particular is important as this groups behaviour on campus is influenced by several factors which are directly related to the planning of the campus. The book contains several studies on resident students' grouping, behaviour, and academic performance, however few concrete conclusions are reached .

To conclude it must be said that research has been done on campus planning both in respect to non-scheduled areas and student activities. The problem is that what has been done does not provide a planning method comprehensive enough in its input to investigate the possible effects on spatial needs of the local characteristics of each site, particularly in terms of the total time spent on non-scheduled activities by the students. Since ultimatly the provision of any space is to accommodate activities, this drawback can result in misleading calculations and a mislocation of space and funds. The following work will concentrate on attempting to find if this gap can be filled.

CHAPTER TWO

THE ALTERNATIVE PLANNING METHOD

REQUIREMENTS AND OBJECTIVES

Functional criteria started to dominate design in the architectural world early in this century. With its ascent, architects became increasingly aware of the relationship between the space itself, and the activities that were performed in it [ref 39]. In order to be capable of housing a certain group of activities, the design required a multitude of spaces which varied in size and specification. Acquiring an accurate spatial size (area) to contain an activity became a subject worthy of pursuit during the design of every building. At the same time, buildings were increasing in complexity and size [ref 35]. Large complexes such as universities, shopping centres, or large housing estates, were being conceived. The importance of projecting accurate spatial requirements for such large projects was more important since even one fundamental mistake in the spatial demand of an activity could result in a large financial loss. The minimum space required had to be calculated as accurately as possible.

To combat the problems of increasingly complicated buildings and the high demand for accurate spatial projections, a series of empirical rules emerged. An empirical rule is a general rule which is defined not through the use of any theoretical model but from the collective results observed from a number of samples, or in this case, buildings [ref 36]. This kind of information would usually provide an approximate average of the spatial need for a certain function in a certain building type. Such as specifying "80" meters square per "100" students, area for library space in a university [ref 35]. Whilst previously it was left to the experience of the architect to estimate the spatial need, now it was possible to roughly calculate it using the experience gained collectively from a group of similar buildings.

2.1 EMPIRICAL RULES

Over the years, empirical spatial rules have given good service to the architect. With a good background on the subject being planned, the architect or planner could manipulate them to obtain useful projections of spatial need. On the other hand, an inexperienced one could easily be lured into using them without enough consideration given to the particulars of each individual situation.

The problems associated with the use of empirical rules in projecting spatial requirements, which may deceive the inexperienced architect or planner, could sometimes lead to quite serious problems. Although they merely represent a "mathematical average", this numerical representation may sometimes be misinterpreted. The specification of "80" meters square of library space per "100" students in a university stands out to indicate that the student need for library use in a university can be satisfied with such an area. This is not the case. The standard merely indicates that on the average, "80" meters square per 100 students is the approximate area designated for library space in a group of other universities and found to be satisfactory. It may also, in many cases, correspond to the spatial needs of the new building too, but there are several situations where it may not. On such occasions the difference between the two interpretations mentioned earlier may be significant.

When the architect thinks he has used a space standard which represents the need for a space, he consequently thinks he has satisfied it. The fact is that where in some cases a certain function can be satisfied with one meter square per person , in different circumstances, five meters may not be enough. Take for instance the case of two campus sites. One is small and has grown in the centre of a town next to a group of service shops which include a large number of restaurants and take-away shops. The second campus is built on a new site, isolated from any centre of activity. The need for service and catering spaces in the two would undoubtedly be different. The first site, being small and leaving the student close to a large centre which offered a large selection of services at various prices would need less, because of the competition. The architect or planner in such a situation should use the empirical rule as a guideline or tool that can help him establish an approximation of the space need of the particular situation. The "approximation" being the best he can hope for, in the absence of any more reliable method.

The second problem concerning empirical spatial rules has to do with their inflexibility. Faced with the fact that students need "80" meters square of library space per "100" students, the planner can not improvise as to how much space would be needed if he were to replace the library with another form of space for instance. On some occasions the architect may wish to combine several activities into one space or vice versa.

Most of the area in a campus consists of non-scheduled spaces, spaces which are not used for timetabled activities (59-82%, chapter one), and most of this area is calculated using empirical rules [ref 21]. Consequently, and since it has already been explained that there is considerable room for improvements in spatial planning methods in universities and polytechnics (chapter one), it would seem natural that this area constitutes a prime target for research on the subject.

2.2 THE NEED FOR FLEXIBILITY

Because a university or polytechnic campus is usually large in size, used by a large number of people, and is in an almost continous need for change, planning and designing one has become a complex subject. The problem of planning large projects which accommodate a large number of users is a familiar one, as explained earlier. But only recently has architecture seriously faced up to the challenge of designing buildings which are in a constant need for change [refs 21, 23, and 39].

With the introduction of new and changing technology, and the continous shift in need for particular specializations in the technical fields, the universities and polytechnics have had to adapt. The result has been this increasing need for flexibility in campus design and in campus buildings to accommodate the changes required. In their review on the design of the University of Bath, Matthew and Johnson-Marshal comment on the subject as follows; "It is no longer valid, if it ever was, to think of a university as a static thing; it is a living and growing organism in which ever more rapid changes in academic or social demands must be able to find expression in the buildings themselves" [ref 30].

The subject is not one of a simple singular problem, but rather a complex issue to which three basic sides are recognised [ref 30]. First there is the question of overall growth in students numbers. Secondly, there is the problem of differential growth; variation in the growth of different parts of the university. Thirdly there is the problem of internal flexibility; the need to rearrange the spaces in an already existing building, due to change in curricula or the advent of new technology, for instance.

Several solutions have been suggested to satisfy this need for continous change in the physical context of the campus. Most recent designs acknowledge the problem and several methods have been tried to solve it. A method which has attracted attention in the design of office, and hospital buildings, also, is interesting. It relies on gathering the more permanent elements of the building, such as vertical circulation, service shafts, and large structural elements, in concentrated parts, leaving the other areas as free as possible for adaptation [ref 33]. Applications of this method can be seen in the design of the University of Bochum, and somewhat exaggeratedly in the Yamanashi Communications Centre in Kofu, Japan, by K. Tange [refs 16, 23]. Another suggestion has been made to catalogue the campus space using numerical computer techniques. The aim of this is to speed up the time spent on evaluating existing and projected situations so that future demand may be anticipated and met on time [refs 16, 17, and 21]. An example on how to apply this in universities may be seen from the work of Harland and Bariether, or the literature on the University of Bochum [refs 16, and 21]. All of these projects are still relatively new and have only had a limited exposure to the test of time.

In all of the solutions put forward to date, the problem of not being able to predict the future human reaction to the suggested plans has been, and will remain, a major obstacle. During any period of change, the availability of space will not be capable of following the changing demand because of the restrictions laid down by the physical limitations. Even the most flexible buildings cannot be altered for the sake of each and every predicted change. The demand must reach a certain level before change becomes economically viable. During this interim period, when the demand cannot be satisfied, the ensuing bottlenecks must be endured. The human reaction to these bottlenecks are difficult to anticipate. Consequently, a planning method is required which can determine, as accurately as possible, the actual needs of the population in the building so that their reaction, when that need is met, can be broadly anticipated. With such information available to the Architect during the planning period, he can match the building's content to the projection of future needs which were made, and roughly designate the areas of difficulty. With the problem defined, he will then be capable of taking the necessary measures to overcome them, if possible.

2.3 THE ACTIVITY PLANNING METHOD

The activity planning method is the method which will be studied in this research. It depends on forming a theoretical model which should explain the relationship between the physical contents of the campus, the academic environment, and the students' activities. The students' activities will then be related to the amount of space required to accommodate them. The explanation of this theoretical model will be taken up thoroughly in later chapters, but a brief outline is necessary at this stage so that further comments on the method can be understood. This summary is limited to the highlights of the method's development in order to make it simple to understand without resorting to all the detailed descriptions.

* Results obtained from surveys by the "Centre for Land Use and Built Form Studies", in the University of Cambridge (see Chapter 4), on four campuses, Reading Whiteknights, Reading London Road, Leicester University, and Leicester polytechnic, show that there is a marked difference in activity patterns between each of the four sites (Chapter 6).

* It is assumed that these variations are due to factors related to the characteristics of each campus. The factors which are suspected to be involved are listed and categorized. The assumption is investigated (and will be validated, chapters six, seven, and eight) and the effect of each factor is recorded.

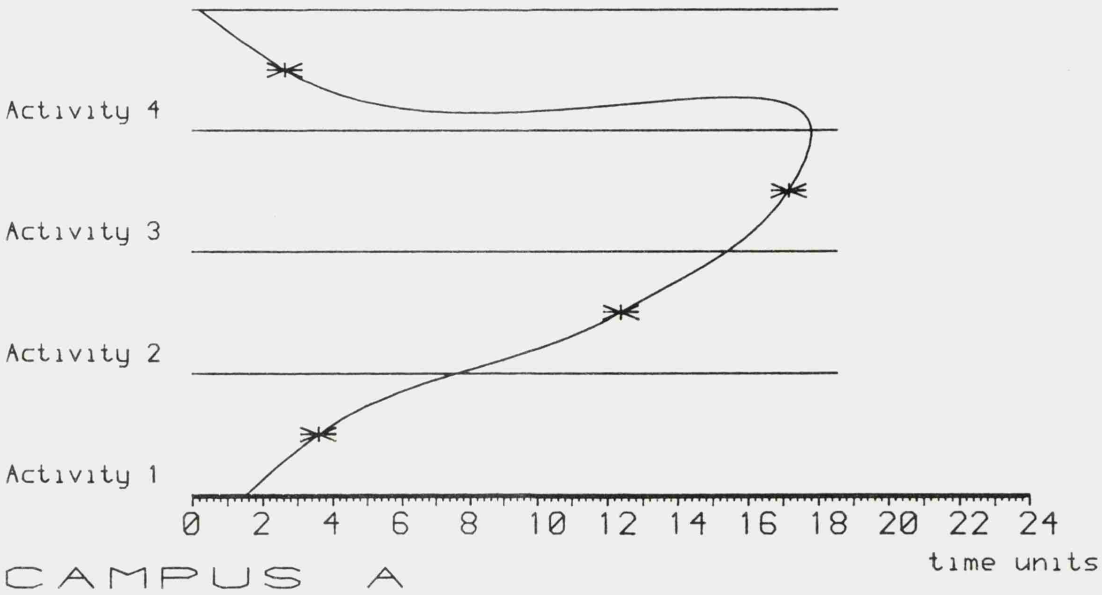
* A theoretical mathematical formula is developed to explain the variations, taking into consideration all the factors mentioned above.

* With the relationship between the characteristics of a campus and the activity patterns explained in a mathematical formula, a graphical formula is also developed which represents the activity patterns of students but presented in a way which helps explain what the campus characteristics were in the first place using the relationship developed above (see ill 2.1). Consequently the variations between the two examples in illustration "2.1" are associated with certain changes in the campuses involved. Such patterns in the graph should appear consistently in other campuses under similar circumstances, if the hypothesis is true.

* A chain is now formed linking the following basic elements of the design method:

  1. The student's activities.
  2. The campus characteristics.
  3. A graphical definition.

The relationship between the elements mentioned in the last point is the key to the whole planning method.



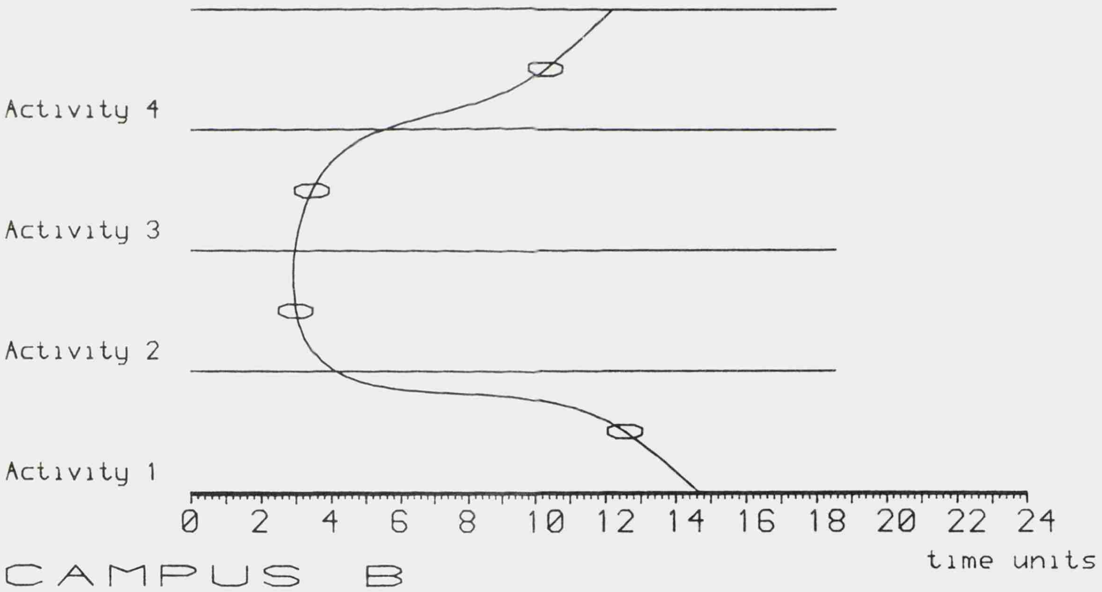


ILLUSTRATION 2.1

EXAMPLE OF A GRAPHICAL PRESENTATION OF
ACTIVITIES IN DIFFERENT CAMPUSES

Once that is found the actual planning procedure can be applied as follows (see ill. 2.2):

1. Deciding with client on major issues using graphical definitions: The first application of the method would start with the discussions between the client and planner. Having set his mind on achieving certain goals, the client naturally seeks advice from the planner on the optimum way to achieve them. Using the easy-to-read graphical aids at his disposal the planner can explain to the client the alternatives and the effect of each decision which need be taken.

2. Finalizing the initial graphical definitions: Having made the decisions and reached agreement on the vital statistics, a graphical definition may now be drawn to show what the future campus will be like. It is possible for the client at this stage, with the results of his decisions displayed in front of him, to change his mind on some of those decisions, if he doesn't agree with their effect.

3. converting the graphical definition into activity patterns and spatial requirements: Having made the decisions, the planner can now translate the activities directly into spatial needs.

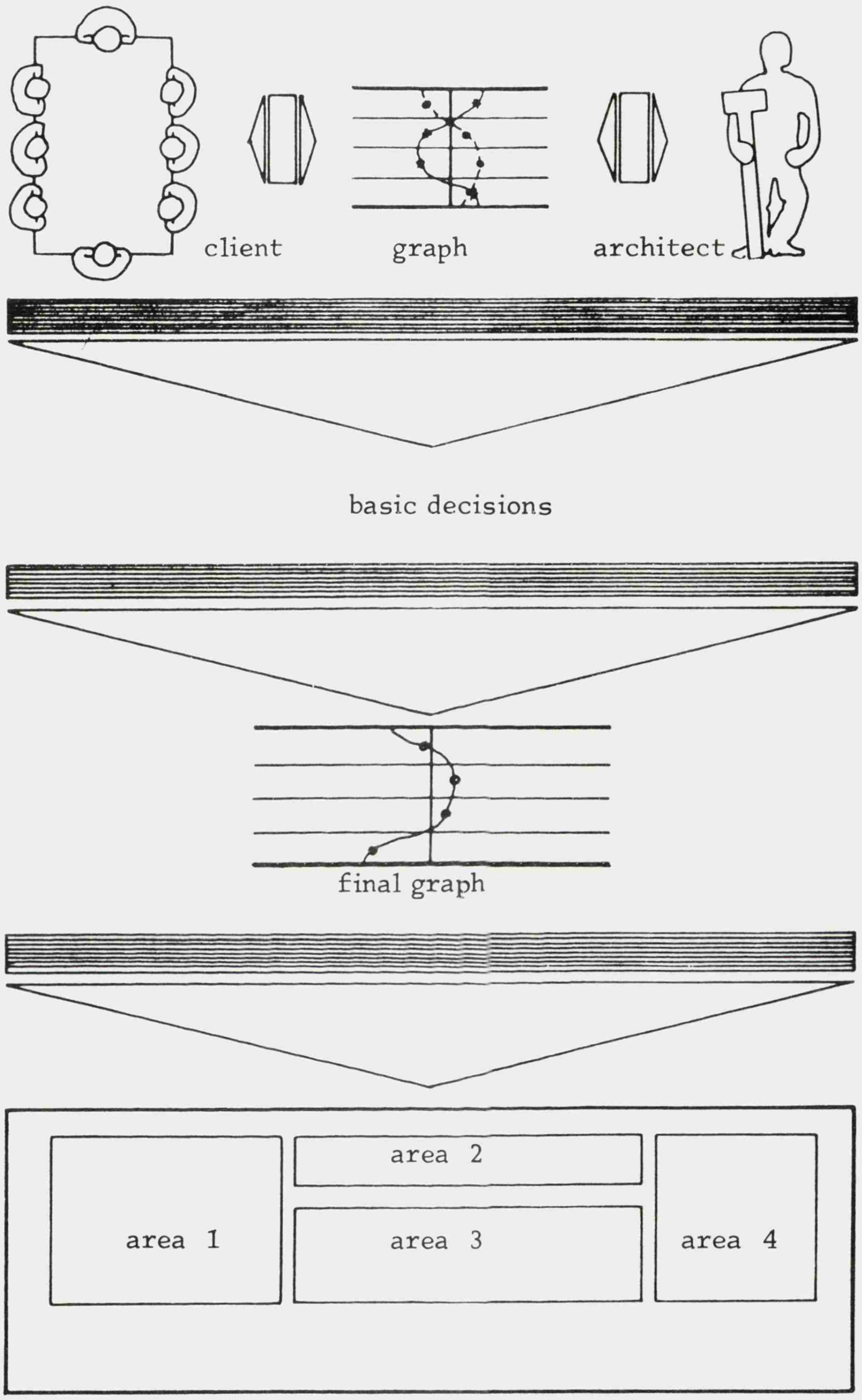


ILLUSTRATION 2.2

AN OUTLINE OF THE PLANNING PROCEDURE USING THE ACTIVITY PLANNING METHOD

2.4 USING ACTIVITIES TO PLAN FOR NON CONFORMAL SITUATIONS

It can be expected that a large number of universities or polytechnics around the world exist with some form of substandard restrictions on their available resources. These are more common in the third world than in the developed countries. Problems such as the lack of space or staff are common [refs 28, 45]. In such situations planning a new building or an extension to one is usually a matter of possible expenditure rather than actual need.

The possibility of providing an aid to help solve some of these problems is one of the main objectives for which the suggested activity method was originally conceived. However since in this research, the work will be restricted to British establishments, the subject will be mentioned here only, and merely as one of the method's possible attributes, and a candidate for further research. Consequently the subject will be dealt with here in slightly more detail than might otherwise have been necessary.

Whatever the nature of the limitations, in a situation where the resources are restricted, planning for an extension or change in a campus is not easy. Priorities have to be established for that particular case, which will ensure the optimum use of these resources. Then a plan must be designed that will show minimum deficiencies in the remaining needs.

One of the more common faults occurs when new resources are designated to satisfy the need for what are thought to be the most outstanding spatial demands. These are usually limited to office areas, lecture halls, and laboratory spaces [ref 28]. Not much is usually left on the list of priorities for the necessary backup facilities such as space for reading and social activities [ref 28]. The architect consequently has to improvise as to how best he may satisfy this need. The necessary information and methods to do any of these are at the present time difficult to find.

Using a more flexible method of planning, and one which can draw the planner's attention to the problem areas, could help to solve some of the difficulties. If activities were employed for instance the planning stages could start by studying the activity patterns in the establishment concerned. The results could be used to compare the situation with other cases (such as those examined in this research). This would hopefully reveal the major deviations from the norm and expected bottlenecks, and the priorities could be established. The projected activities could then be used to make use of the available resources. Some spaces, for instance, can be planned to accommodate more than one activity, or the planner could calculate how much of the space starved activities could be accommodated in certain cheap spaces. This flexibility can help to find ways to adapt to the requirements of the situation.

A practical example of the potential usefulness of student activity methods in planning can be obtained from observing present buildings with severe bottlenecks. In the University of Baghdad, College of Engineering, for instance, several buildings have been added recently to accommodate the expansion in student numbers [ref 45]. These buildings consist mainly of lecture halls and a few office rooms for staff and administration, no provision was made for communal student activities. The result was that students loitered in the corridors and entrances of buildings during their free time. Neither of these spaces were designed with this in mind of course. Consequently the buildings were severely crowded with people and furniture, the flow of pedestrian traffic was hampered, and the people standing in these areas and those passing through were uncomfortable. Furthermore, the outside entrance space of some of these buildings were on the pedestrian route linking parts of the site together, so that when they were crowded, which was often, the people crowding them stood as an obstacle in front of the traffic flow. Not being able to provide the necessary space for these activities it would have been of use to the architect if he had been able to find how much time the students where going to spend doing them and plan for a cheap alternative if possible. The entrances for instance, could have been positioned off the main pedestrian traffic routes in the site.

One of the more interesting points observed in situations where space is limited not properly distributed, is the tendency to over-use the available space for a variety of purposes for which it was not originally planned [ref 18]. This often resulted in the quality of the space deteriorating; the paint soiled, the furniture disfigured; as the occupants tried to adapt the space and its contents to the alien function. It was possible to observe this phenomenon in Baghdad. In such situations the available space is often used for mass activities such as exhibitions, group reading, and social functions. The occupants using these spaces often found them unsuitable for their elected functions. The obvious way to provide for such use patterns would be to calculate for activity zoning according to the observed patterns, find out where the activities are being performed, how much, and by whom, and include it in the plan. The problem in Baghdad was that some of the large number of variable daily activities performed by the students, were almost starved of space. Obviously, developing a basic method which can employ activities as a planning criterion would be the first step towards such a goal.

CHAPTER THREE

DEFINING CAMPUS PERFORMANCE THROUGH ACTIVITY PROJECTIONS

Observing the activities that are performed in a space can be a useful tool. Something can be told of a space used for drinking coffee, different to another occupied by a lecture. A listing of the activities in a space which includes quantitative descriptions would be even more helpful. Defining a space by explaining that it is used for drinking coffee 30% of the time by its users, 45% for social gatherings, and the remaining 25% for individual resting, is a description which can be of considerable help architecturally for designing and determining the needs of that space. Similar descriptions of this kind can be utilized for planning other scales of architectural entities such as buildings or whole sites. This chapter is an introduction into the subject of employing student activities in campus planning.

3.1 STUDENTS' ACTIVITIES

Students usually perform a large number of activities on campus. Dealing with all of them individually would be impractical, so they had to be gathered into smaller groups which contained generally similar activities. Generally speaking, student activities on campus can be divided into scheduled and non-scheduled. The scheduled activities are the timetabled academic activities such as lectures and laboratory work. The non-scheduled activities include everything the students do in the remaining time they ave on campus. From examining the total list of activities, it was found that the following groups contained all of the outstanding ones:

A. SCHEDULED ACTIVITIES

1. Applied.
    a. Laboratory work.
    b. Workshop.
    c. Studio.

2. Theoretical activities.

   a. Lectures.

   b. Tutorials.

B. NON-SCHEDULED ACTIVITIES.

1. Academic preparation.

   a. Individual reading.

   b. Group preparation.

   c. Reading in the Library.

   d. Others.

2. Non-academic activities.

   a. Social and leisure.

   b. Eating.

   c. Sport for leisure.

   d. Circulation.

   e. Others including health care, religious activities and shopping.

This categorization of student activities generally follows the same broad principles which Baraither and Bullock used in their grouping of student activities [ref 6,7,8,21]. This is especially true with respect to Baraither's interpretation of the scheduled activities.

The grouping of scheduled activities appears fair and simple, but the non-scheduled requires further development to mould it into a shape more suitable for the purposes of this research. This required a reduction in the number of categories.

Upon studying the results of the students activity surveys, which will appear in chapter four, it was found that certain activities were dominant while others were only performed nominally. The dominant ones were social, eating, circulation, and reading in all its forms. this meant that it was possible to represent most of the students activities with a few small groups. However it was found during the actual work on the data, that knowing the exact circulation time was peripheral. The space allocated to circulation inside a campus mainly consists of corridors and entrances. The area of these spaces does not basically depend on the time spent on circulation but mostly on the size and location of the other spaces of the site between which the students will circulate. Consequently it was decided that circulation and the remaining activities which are unaccounted for be included in a single category. This would still leave circulation as the main activity and give a good indication of the time spent on it by the students, but reduce the number of non-essential activity groups to this single one. Thus the activity groups that will be used in the remainder of the work can be summarized as follows:

1. Applied.
2. Theoretical.
3. Reading.
4. Social.
5. Eating.
6. Circulation and others.

The actual contents of each group can be seen in appendix (A).

With this small number of very basic activity groups, a simple and uncomplicated criterion to separate student activity patterns in different campuses may be found. The academic changes will either show an increase in total scheduled time in the theoretical or applied section, or as a variation in the ratio of theoretical to applied time. Each possibility has a separate meaning. A large proportion of theoretical to applied hours suggests a Social Arts or Humanities oriented establishment, while the opposite suggests a more technical or scientific one. The non-academic aspects of student life on campus could be measured by the total time he spends, particularly on social activities, there.

An example may be made of school "XYZ" in which students study History for instance. The students of this hypothetical school go to twenty hours of lectures per week, tutorial for an hour, and two hours of laboratory work (Theoretical and applied studies). When not in class they have a two hours lunch break of which they spend around half an hour eating, another half in the library reading, and the rest they spend together chatting, or walking around and having fun (eating, reading and socializing). They also have to spend some time in little errands and walking to class (Circulation and others). A visual example of what actually may happen during a students day may be found in appendix "C", however the full explanation of the data for these graphs and how it was gathered and employed will only be discussed later.

It was found during the work that the "Circulation and others" category varied little in time between the different student groupings and campuses. Consequently it was not necessary to refer to it when discussing variations between them. Since initial work in this research will concentrate on planning aspects related to the campus as an academic and physical entity, a subject which is mainly concerned with the first four activity groups, initial work will concentrate on these. The remainder of this chapter will concentrate on attempting to use these few activity groups to construct a graphical formula that may be employed as a tool in the planning process.

3.2 THE GRAPHICAL FORMULA

3.2.1 THE PROFILE GRAPH

If all of these mentioned activity groups were to be presented in a simple graphical form, it would look as shown in (ill 3.1). For all future reference, this form of graphical representation of students activities will be referred to as a university or polytechnic's "profile graph".

The graph shown in illustration (3.1) has several uses in its present form. It is a quantitatively accurate expression of a campus' activity patterns. However this means little on its own and eventually, in order to understand any message which it may try to convey to its users, the graph will have to be compared to others representing different campuses. In its present form this comparison would not be easy to grasp. Consequently the graph must be developed so that variations in the campus can be understood easily and with as much precision as possible. The way to achieve such an objective is to project the graph with relation to predefined standards. In other words, a reference that would provide the means for direct and simple comparisons to be made so as to allow for the immediate detection of any variations. The aim of this concept is

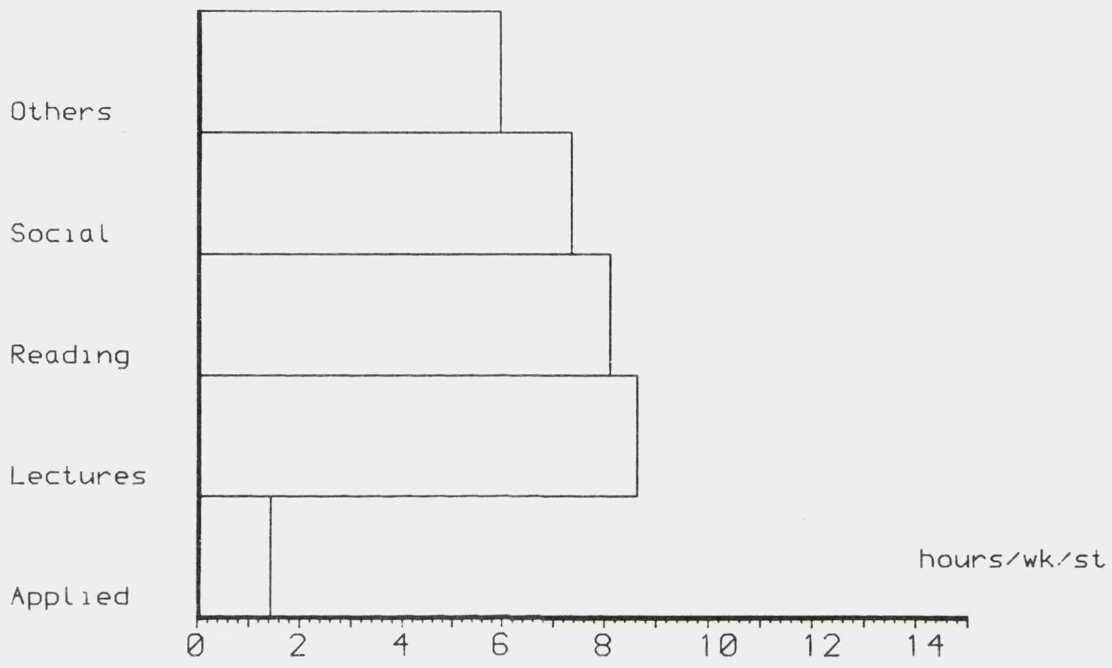


ILLUSTRATION 3.1

A CAMPUS PROFILE GRAPH OF THE WHITEKNIGHTS SITE IN THE UNIVERSITY OF READING not to provide mean or average figures for activities, but rather a tool for comparisons to be made to emphasize the difference, and to show variations in a simple form of presentation. Eventually, each university or polytechnic when represented in such a graphical form could be compared to the reference graph and a meaning can be associated with any deviation from it.

The reference graph would represent a hypothetically standard campus. It is actually only a poor representation of average campuses in Britain. A true standard campus cannot exist in true life. This reference campus will consist of an average mathematical roundup of all the universities and polytechnics on which data is available.

It must be emphasized that this reference campus does not represent an ideal campus, nor does it represent a situation which should be emulated. It isn't even a representative average campus. It is merely the mathematical mean of five separate campuses on which data is available and whose collective average should theoretically be closer to the British average than any other single university or polytechnic on its own by virtue of the weight of numbers involved. That is to say it represents the resultant average of around 800 students, from five different campuses. The profile graph of this hypothetical campus will be the reference graph (ill 3.3). The statistical figures which show how much confidence may be placed in the activities time budgets will be disclosed in chapter four.

3.2.2 THE RELATIVE GRAPH

In order to use the graph of a reference campus as a standard against which others will be repeatedly compared, it must be easily understood. Consequently, the graph in illustration (3.2) would be defined as an inferior form of expression. The complicated shape formed by the activity projections is difficult to comrehend and this makes comparing other graphs to it a problem. The form of the graph must be developed in a manner through which a reference campus would be represented by a simple and basic shape. This basic shape would mean that any alterations would be easily recognised. For this purpose the form shown by the graph in illustration (3.3) was developed. This is the graph of a reference campus which is mathematically calculated so that it is represented by a single perpendicular line. Variations in the graph of a campus, compared to this simple and obvious reference, can be immediately detected. These variations would indicate respective variations on the activity emphasis in the university. In all future text , the graph of any campus which is

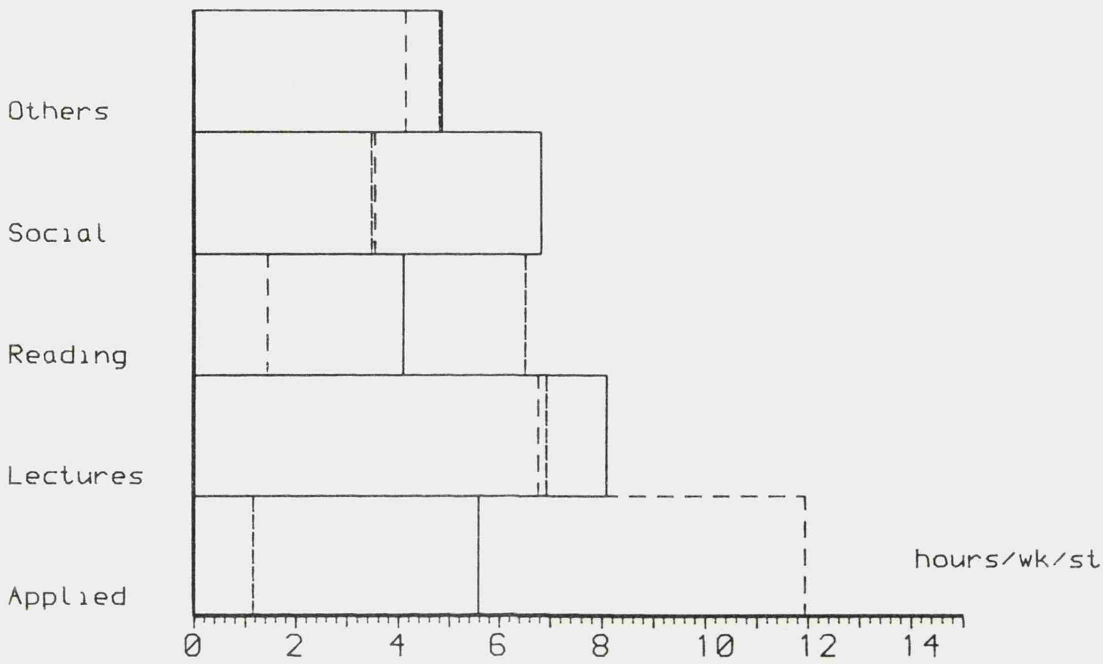


ILLUSTRATION 3.2

USING A REFERENCE PROFILE GRAPH TO DETECT VARIATIONS BETWEEN DIFFERENT CAMPUSES

______ Reference
------ Reading, Whiteknights
- - - - Reading, London Road

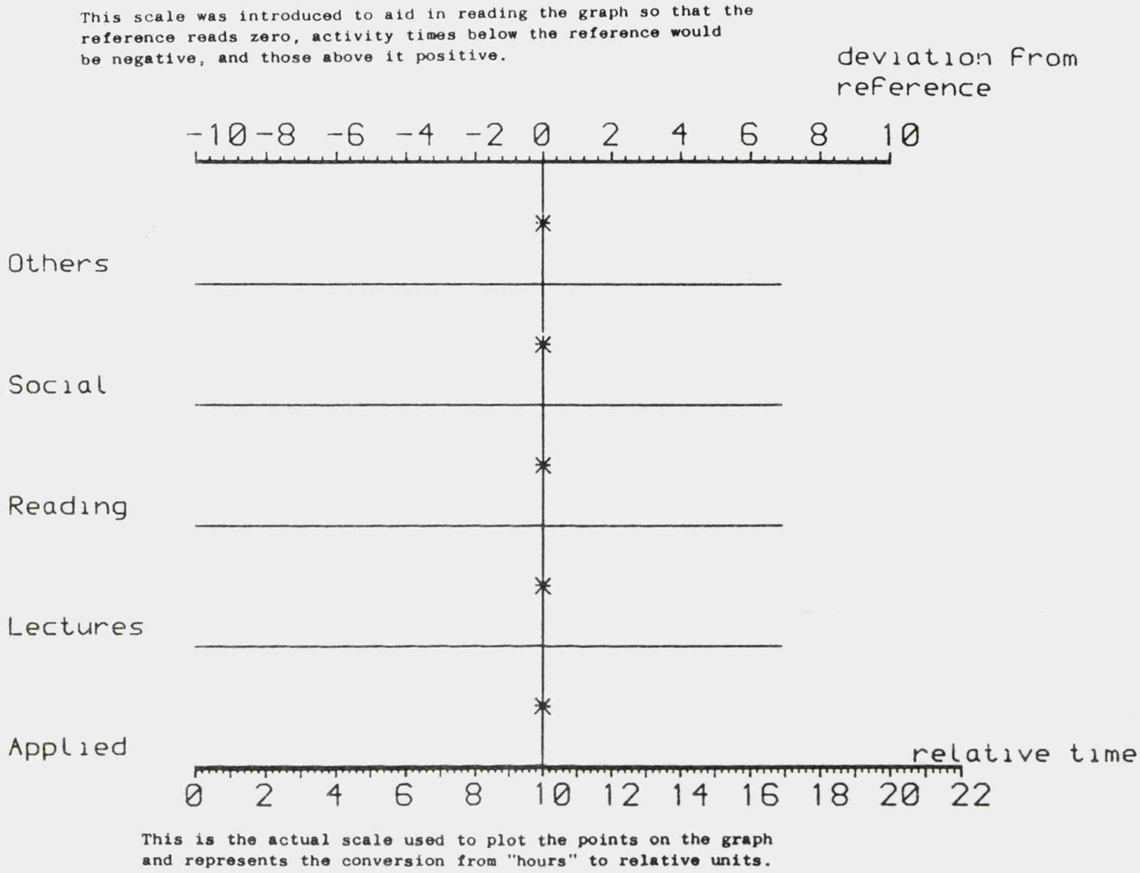


ILLUSTRATION 3.3

A REFERENCE PROFILE GRAPH PRESENTED IN "RELATIVE GRAPH" FORM

* This is the same reference graph illustrated in 3.2 but converted mathematically to follow a straight line.

calculated by such means for similar use will be referred to as the "relative profile graph" (ill 3.4). Illustration (3.4) shows the same campuses as those in illustration (3.2) drawn in "relative" form. The reference campus is, of course, the straight line in the middle. The difference in legibility between the two graphs in both illustrations is obvious.

The straight line shape of the relative graph of the reference campus in illustration (3.3) was reached through simple mathematical conversions. The amount of time that was spent performing the activities in each activity group was multiplied by an activity denominator that would make the projection (Pr), which represents each one, extend to the same degree as the other activity projections in the reference graph to form a straight line. Any changes in the time of any activity would be multiplied by this denominator also. ie;

Projection on graph = Pr

A typical conversion would thus be:

Total activity group time(X) x Denominator(X) = Pr

In order to produce a graph of equal projections, all activities must protrude to Pr(1), as follows:

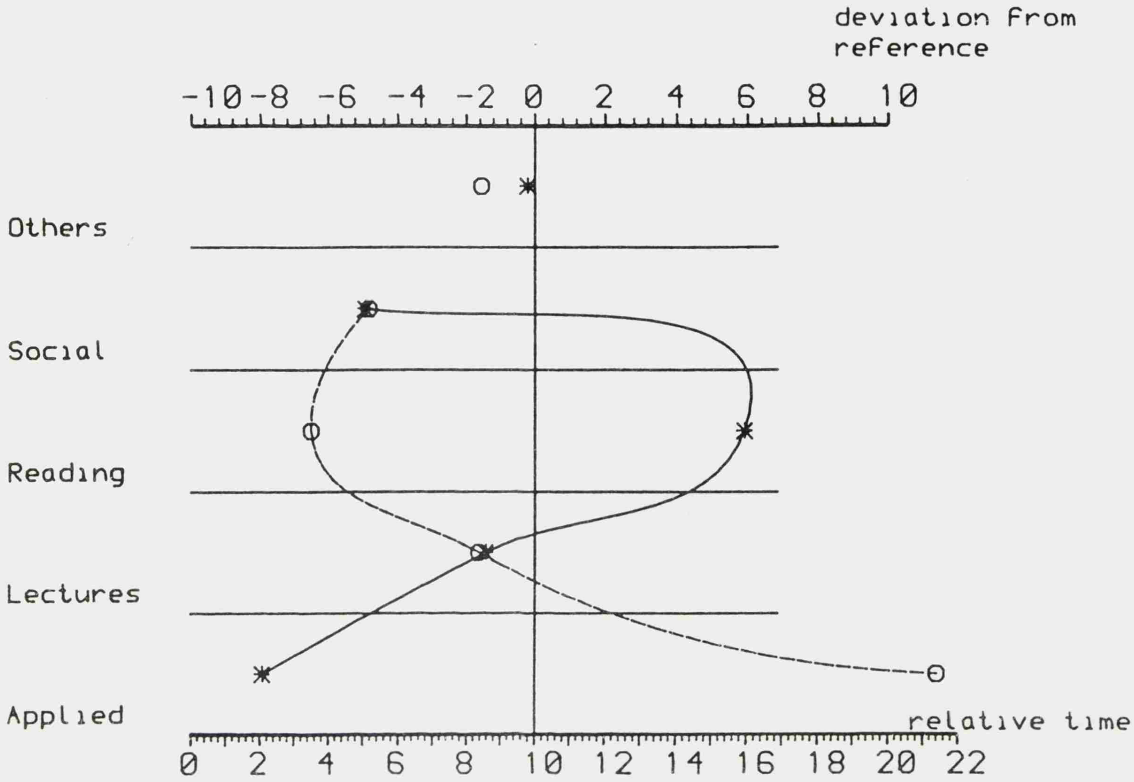


ILLUSTRATION 3.4

USING THE RELATIVE GRAPH TO COMPARE STUDENT ACTIVITIES TO THE REFERENCE

______Reading, Whiteknights

------Reading, London Road

* The units on the X axes are relative units (not hours).

Social activities x social denominator = Pr(1)

Reading activities x reading denominator = Pr(1)

Theoretical scheduled study x theory denominator = Pr(1)

Applied scheduled study x applied denominator = Pr(1)

The value of the denominator for each activity group was found using the same relation, as follows:

denominator(X) = Pr / activity(X)

To acquire a straight perpendicular line for the reference, the total time for each reference activity group was used to calculate a denominator that would produce the same Pr(1) projection. If Pr(1) is assumed to be "10", calculating the value of the denominators would be as follows:

Soc den. = 10 / ref. social time = 2.4629

Rd den. = 10 / ref. reading time = 2.3932

Theo den.= 10 / ref. theory time = 1.2293

App den. = 10 / ref. applied time = 1.7930

The figure "10" is an arbitrary number in relative units which was chosen for reasons of convenience to aid in comparisons. For the same reason another scale with "0" as the average is added to the graph so that any activity time which is below the reference in value will be negative, and vice versa. The actual value of the units in the top scale is only relevant for comparative purposes, they have no absolute value.

To calculate a relative graph for another campus, the denominator would remain constant but the remaining values would change. This is to maintain the conversion rate for each activity so that the relative values remain the same with respect to the reference. If the time spent on social activities in campus (2) changed to social activities (2), the new projection for social time would be:

Social activities (2) x social denominator = Pr(2)

ie;

Social activities (2) x 1.4767 = Pr(2)

The same should apply to all the remaining activity groups. The graph of the two Reading campuses in illustration (3.4) were calculated this way. Those for Whiteknights were done as follows:

Social = 3.46 x 1.476 = 5.1

Reading = 6.5 x 2.540 = 16.51

Lecture = 6.92 x 1.238 = 8.56

Applied = 1.15 x 1.793 = 2.07

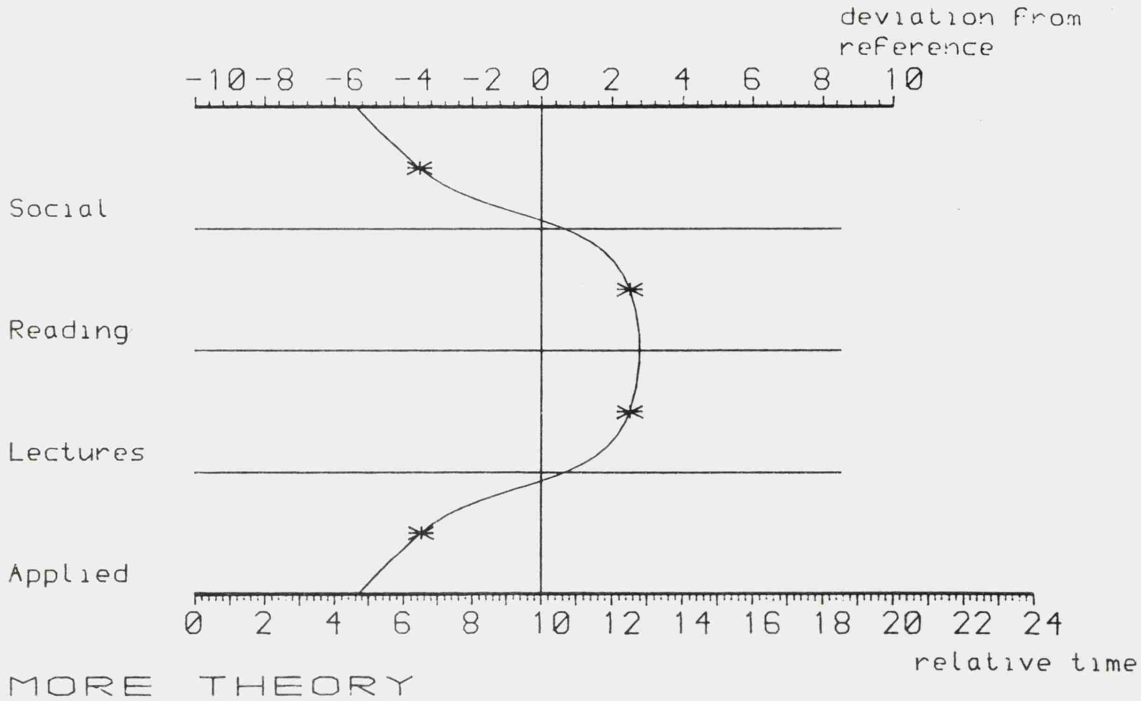
The activity figures will be tabled in chapter four. Those used in these calculations were taken from table (4.1).

3.3 DEFINING A CAMPUS USING THE RELATIVE PROFILE GRAPH

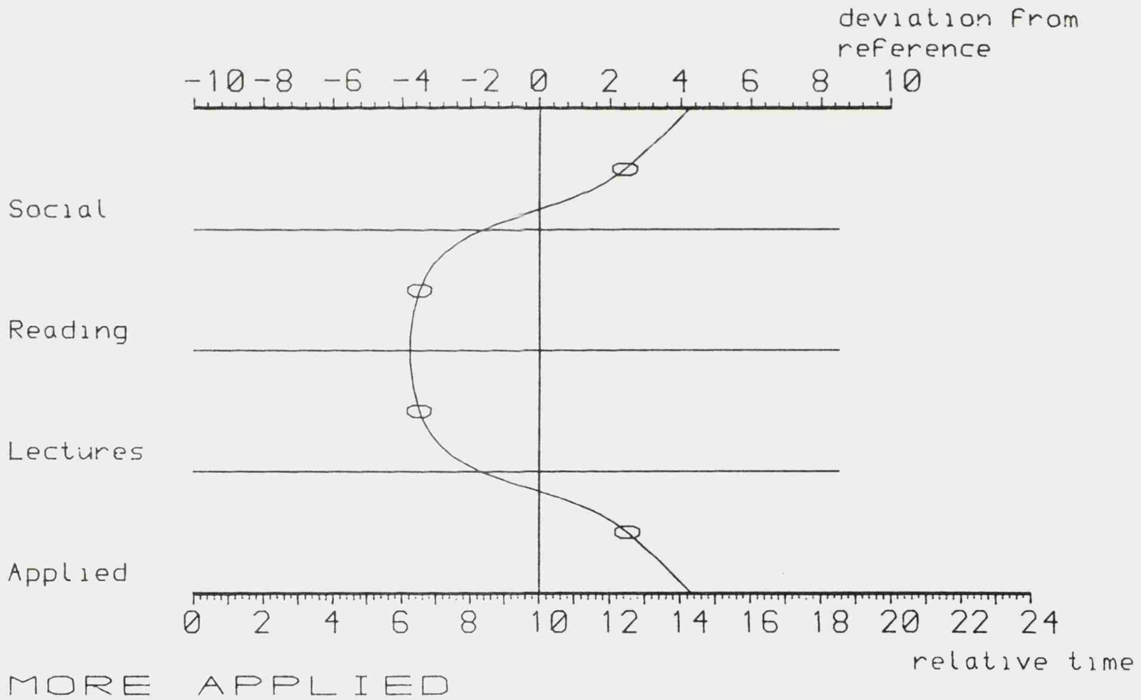
Having established the elements and basic shape of the graph, how is it going to function, and what will it be used for? To answer these questions it will be necessary to use some of the more obvious results that were concluded later in the thesis (chapters 6,7 and 8), and use them as assumed examples. The actual accuracy not being an issue at this stage. Take for instance the case of two hypothetical campuses which are almost identical except in their allocation of scheduled hours. One has mostly theoretically oriented studies, such as Social Sciences, the other is more inclined towards practical and applied work, such as Mechanical Engineering. It is often assumed by university staff that the student has to spend more time in preparation for a lecture than he does for a workshop or laboratory [ref 28]. Consequently it would be feasible to assume that the students in the first campus with the more theoretical studies would have to do more reading and studying to prepare for their lectures and tutorials than the second group of students would have to for their practical work. This would show easily on the graph as can be seen in illustration (3.5) (see also figures 1,2 and 3,4 in app. (F)).

The shape of the two graphs in illustration (3.5) identify an obvious "signature" for both kind of campuses involved. The bulgy profile signifying a theoretically inclined establishment with the students doing a lot of reading and less socializing, and vice versa for the other campus which has a depressed (concave) profile.

A different situation may be illustrated by assuming another pair of campuses. This time the difference is that one of them contains an element which increases its appeal to the students and the second a reverse situation which decreases its appeal. Several factors can be thought of that can produce such an effect, one of which is the possibility of finding a larger number of students



MORE THEORY

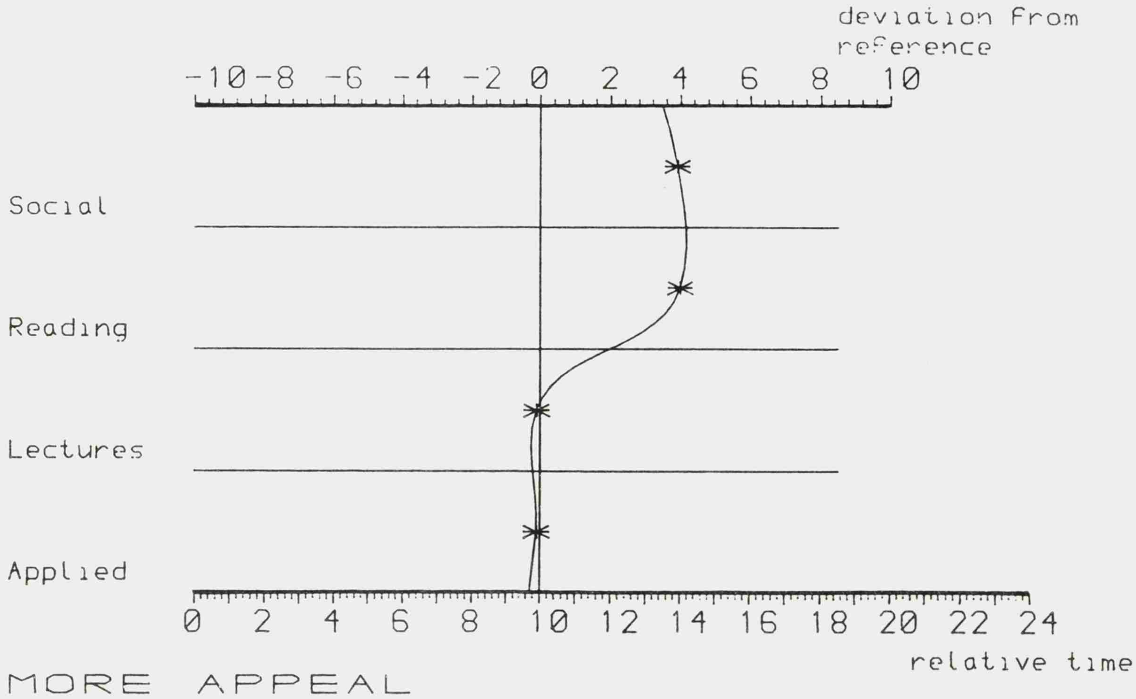


MORE APPLIED

ILLUSTRATION 3.5

THE EXPECTED EFFECT OF VARYING THE SCHEDULED HOURS THAT STUDENTS ATTEND present and enjoying their free time on campus, or the availability of attractive facilities . This situation would probably increase the campus' attraction to the student resulting in a willingness to spend more of his own free time in it. The results would show on the graph in a manner similar to that explained in illustration (3.6). Once again a certain and specific "signature" can be recognised for each campus.

The possible future value of the relative graph may be illustrated by drawing a parallel between it and the "age-sex" graph used in socio-economic studies [ref 8.b]. It is basically a graph which divides the population of a group of people, such as those of one country, into males and females, and plots the number of each on opposite sides of the vertical scale according to age groups. Usually in five year intervals. Its similarity to the profile graph discussed in this chapter lies in the fact that it only illustrates a few elements of the population, yet it can be used as an indicator to their characteristics as shown in illustration (3.7). It can differentiate between countries according to stage of development, or display the effect of large scale warfare or immigration. Similarly a campus profile graph only illustrates a few of the elements related to a campus, but may be used to indicate several of its characteristics.



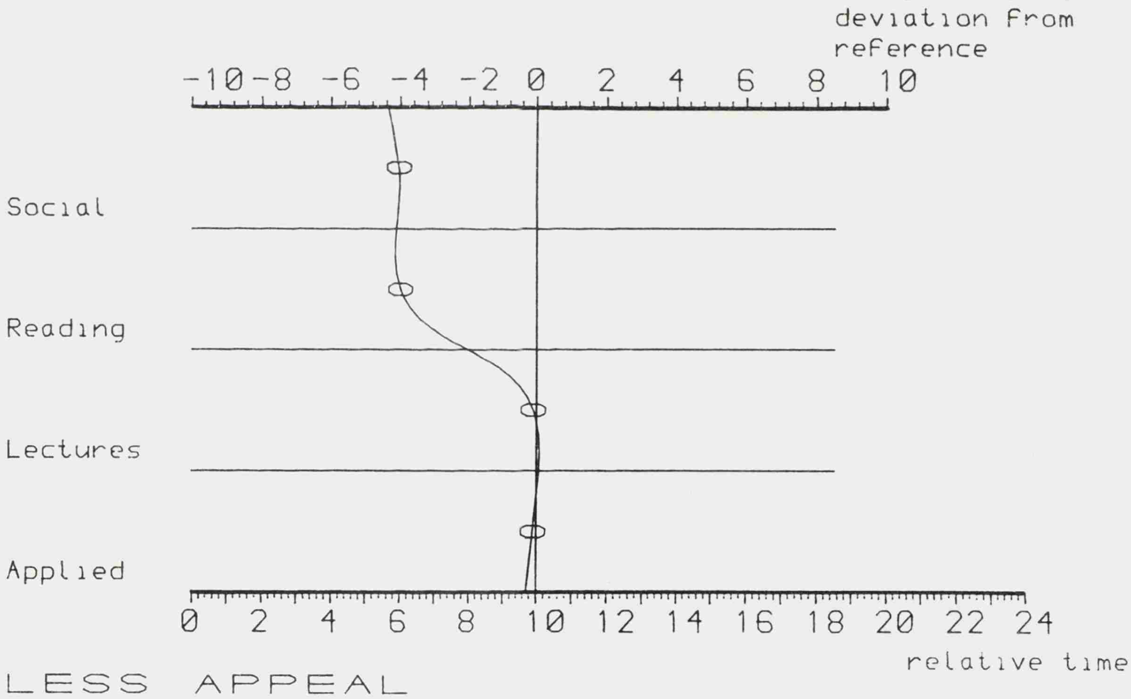
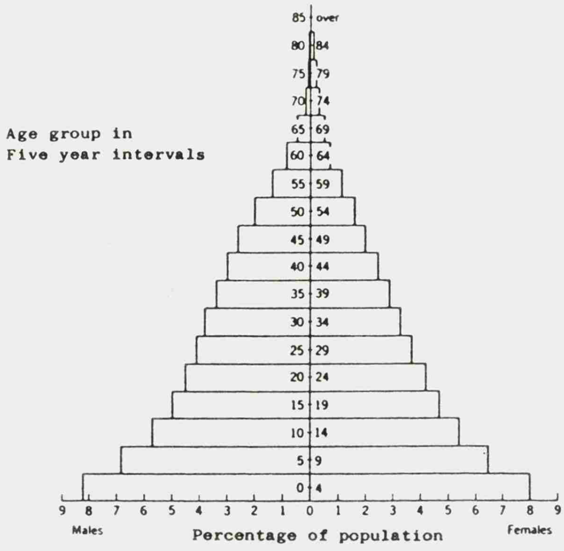
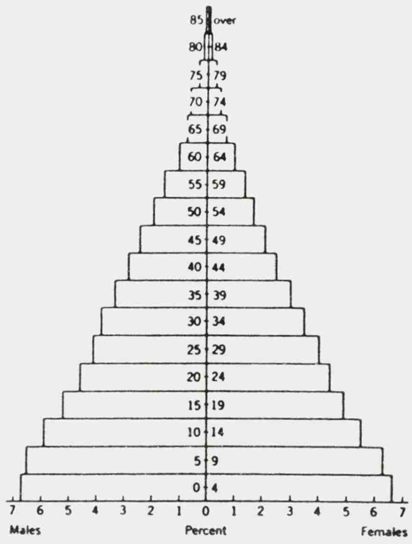


ILLUSTRATION 3.6

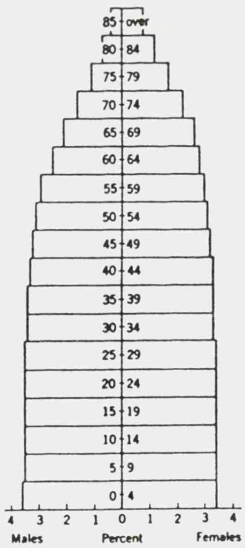
THE EXPECTED EFFECT OF VARYING THE CAMPUS APPEAL ON THE STUDENTS



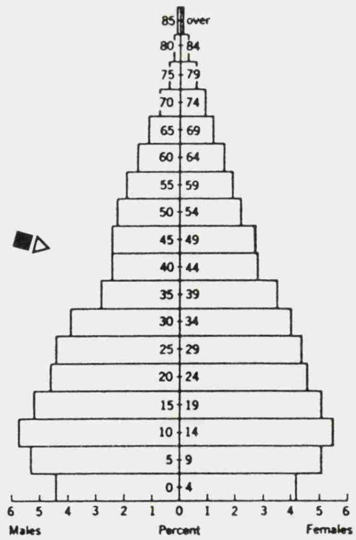
Underdeveloped country
Concave conical profile
Ceylon 1955



Developing country
Bulgy conical profile
India 1951



Developed country
Rectangular profile
USA 1960



The effect of war
Dent in male population (35-49)
Japan 1960

ILLUSTRATION 3.7

THE AGE SEX PYRAMID. EXAMPLES TO
ILLUSTRATE NATIONAL CHARACTERISTICS

The actual reaction of the students to campus life will be revealed on analysis of the data on students' activities in later chapters. Consequently it must be emphasized that the cases mentioned here are purely hypothetical and were assumed to illustrate possible situations and the effect each would have on the profile graph.

CHAPTER FOUR

THE SURVEYS AND METHODOLOGY OF WORK

The results obtained from the surveys are the anchor on which most of the work in the thesis depends. Consequently it is of importance that all the aspects related to it be explained in detail so that the results may be analysed with respect to their proper background. This chapter will concentrate on reviewing the methodology of work, the campuses on which the surveys were conducted; and how the data collected on them was used. The composition of the students involved will also be discussed in relation to the surveys. The basic results obtained from the data will be displayed at the end so that the more detailed analysis of later chapters can be based on it.

4.1 METHODOLOGY OF WORK

The subject of this research is based on the relationship between student activities and the campus environment. The the majority of it is concentrated on recording and analysing the activities, on a daily and weekly basis. Recording the necessary campus characteristics such as location or size is relatively simple, while doing the same on students activities is not so. To acquire a picture of student activities in a campus, an evenly spread large and random sample of students is necessary. Spread over the seven days of the week, it would probably involve tens of thousands of activities. Furthermore, if variables in campus characteristics where to be analysed, such as location and size, more than one campus would have to be surveyed. The total amount of data involved was obviously going to be large. Fortunately, the early inquiries revealed that similar work had been done by the "Centre for Land Use and Built Form Studies", in the University of Cambridge.

The data mentioned had been collected between the years 1970-71 and involved students from three establishments. The University of Reading, both the Whiteknights site and the other location at London road, Leicester University, and Leicester Polytechnic. It was possible to find all the relevant data on the mentioned establishments on which the surveys had been conducted, with respect to the time that they had been done in. Consequently it was possible to relate the relevant factors to each other when necessary. No serious changes had taken place in higher education in general, and in universities and polytechnics in particular, since that time, so it was decided that new surveys needn't be conducted.

A detailed description of the data and how it was collected may be found in the Centre for Land Use and Built Form Studies publications, working papers number 40, 43, and 44 [refs 6, 7, and 8], however, a brief description follows.

The data was taken from a 10% sample of students in the University of Reading comprising some 390 students. A smaller 5% sample was taken from both Leicester University and Leicester Polytechnic, which corresponds to 157 and 139 students respectively.

A diary was presented to every student who participated in the survey. The diary contained several items to help the student fill in the information correctly. A map of the campus with all the building names and code numbers was drawn. A reference hypothetical day was filled in, in the same manner that the student was expected to do, to serve as a guide. At the end of the diary, there was a questionnaire inquiring from the student about all the aspects of his personal life which might affect his daily behaviour, such as residence, age, and which school he is affiliated to. The student was asked to fill in all his activities over a period of a full week, a seven day period. The daily activity listings required that detailed information be entered on each activity in detail; when it started, where it happened, what it was, and when it ended. Illustration (4.1) shows an example of a questionnaire from the batch that was distributed to the students of the University of Leicester.

After receiving the diaries from the students, the answers where converted into code form for entry into the computer. The largely diverse activities which were recorded by the students were categorized into 337 distinctive ones and each activity was given a separate code. The location of activities was separated into two categories: on campus and off campus. On campus activity locations were referred to by using building and room numbers. Off campus reference to location was made using the national grid. Accuracy was maintained to a distance of ten meters in the case of Reading, but decreased to one hundred meters in Leicester after the

Date for which this sheet applies 25th. November 1970

Time	Activity	Location
8.30	Wake up	Villiers Hall. Own Room
8.45	Got up and Dressed	— " — — " —
8.55	Breakfast	" Dinning Room.
9.15	Quick look through newspapers	" Common Room
9.40	Travelled by Car (Driver)	University Bennett Building
10.00	Check computer programmes that had been submitted the following evening.	Computer Preparation Room.
10.20	repunched several computer cards	— " —
10.30	Walked	Percy Gee Coffee Bar
10.35	Drank Coffee Talked	— " — — " —
11.10	Walked.	Snooker Room.
11.10	Watched Snooker	— " —
11.20	Played Snooker	— " —
11.55	Checked mail in Pigeon Holes	Percy Gee P/H
12.00	Had Lunch	Percy Gee refectory
12.30	Drank coffee Talked and read newspapers	Salisbury Room
1.00	Walked	to Library (S.R.C).
1.05	looked for and took out a specific book.	Student reference Collection
1.10	Walked	Charles Wilson Building.
1.15	Read Book, and took notes, in the reading room.	3rd Floor, Charles Wilson
3.00	Walked	Percy Gee Coffee Bar
305	Drank Coffee Talked	— " — — " —
3.30	Walked	Bennett Building
3.35	Checked to see if Computer Programmes had been run.	Bennett Building Computer Prep room.
4.00	Walked	Lancaster Road Car Park
4.05	Travelled. Car (Driver)	Villiers Hall.
4.30	listened to Records	Friends room. (Villiers Hall)
5.15	Queued up for evening meal	Villiers Hall Dinning Room.
5.30	Eat Meal.	— " — — " —
5.50	Watched News on television	— " — J.C.R.
6.20	Read Notes	— " — own room.
7.30	Relaxed, Drank Coffee.	— " — House Pantry.
8.30	Travelled (car, driver)	Mayors Walk.

For each entry, put the time, the activity, and, in the 'location' column, the room name or number and the name of the building (on the University site), or the address

Where you are recording a journey, put the mode of travel in the 'activity' column, and the destination in the 'location' column

ILLUSTRATION 4.1

A HYPOTHETICAL EXAMPLE OF A DAILY ACTIVITY DIARY, SIMILAR TO THE ONES THE STUDENTS FILLED initial experience at Reading, had deemed the extra accuracy unnecessary.

The data was recovered from the Centre for Land Use and Built Form Studies in three formats. The original hand written diaries, the hand written code version, and the computer encoded data in punch card format. The first two, the diaries and the hand written codes, were used for editing the card format and correcting the punching mistakes, plus supplying missing information when it was not found there. They also proved invaluable when used for checking on some of the information such as travel time between residence and campus. The coded version was not suitable since the students sometimes took a indirect route to campus stopping at bookshops or laundries on the way. The information had to be reproduced directly from the original diaries.

A large proportion of the information regarding the coding of the data was recorded and explained in working paper number 44 [ref 8], except for the questionnaire codes and a few details concerning the differences in coding between Leicester and Reading. The missing information on the questionnaire codes were decoded using the original hand written diaries.

Most of the time and effort that went into the preparation of the data was spent on editing and correcting the punching mistakes on the data cards. A large number of these were spotted while checking the card's physical shape simply because some holes were outside the proper punching area. This led to further checks by computer which revealed large numbers of them. The details of this operation will be discussed separately later as it is important to the determination of the accuracy of the results.

The cards were found to be in generally good shape considering their age. Nevertheless large numbers of them needed physical treatment at one stage or the other before they where accepted by the computer card readers, and several had to be completely repunched.

Two computers were used in the work. The first was a multiuser Honywell machine running the interactive Multics operating system. This was mainly used for pilot jobs which did not involve the use of large data files, statistical analysis, and for communications with the other computer. The other computer was an "ICL 2980" which was used for the larger jobs which involved handling of the data. All of the information had to be stored on tape to reserve computer memory space.

4.1.1 PREPARATION OF CARD DATA FOR PROCESSING

Before the data could be used for actual input into computer programmes, it had to be prepared. Since this stage of work is important in determining the accuracy of the final results, it will be dwelt upon in detail. Preparation took the form of the following procedure:

A. CARD VETTING.

Upon input of the first batch of cards into the computer, it became obvious that it would be more convenient if the cards were vetted before input. Besides around 500 cards whose physical condition required that they be copied, there was also some 700 mispunched cards which were confusing the computer card reader and had to be corrected. There was also a number which were not in sequential order. Consequently all three possible mishaps had to be checked and the necessary action taken in each case. The cards from the University of Reading were worse than the rest. The same work had also been conducted by the original users but on the tape recorded data.

B. CONVERTING CARD FORMAT INTO COMPUTER INPUT FORMAT

In order to increase the efficiency of the punching procedure, the cards had originally been punched as shown in illustration (4.2). Up to this point, the

```
10002200020
1000220010800501001340999081520100134099708500010002600000900101000260002
1000220021005001000070000101030100026000011001010002600131210001001340000
1000220031210001001340000121540800134099613002020013409971400401001340999
1000220041430150001340999160031100134099916201500013409991745205001340997
1000220051515301001340996190015000134099922003030013409992315150001340999
10002210020
1000221010030710001340999081050100134099908202010013409970920001000330000
1000221020930101000330000110010100033000012001010003300001305001001340000
1000221031315202001340997134540800134099614301500013409991530700001340999
1000221041700501001340999173020500134099718150010013300001820305001330998
1000221051900001001340000190515000134099922353110013409992250150001340999
10002220021
1000222010030710001340999080050100134099908202010013409970920001000330000
1000222020930411000330000100013100033000013000010013400001310202001340997
1000222031330408001340996135500100026000014001010002600031510001000070000
1000222041515303000070002160000100134000016153060013409991745205001340997
1000222051815413001340996190015000134099920504130013409962200150001340999
1000222062400710001340999
10002230019
1000223010800501001340999082520100134099708400010003300000900101000330000
1000223021000131000330000130500100134000013152020013409971335408001340996
1000223031400306001340999143000100027000014358800002700141440001000290000
1000223041445303000290029160000100134000016051500013409991740413001340996
10002230518002050013409971830150001340999203033100029002З
10002240019
1000224010130001001340000140710001340999081550100134099908302010013409997
1000224020900150001340999120030600134099912452020013409971315408001340996
1000224031400001001270000140530500127099815000010013400001505150001340999
1000224041700502001340994174020500134099718054130013409961900150001340999
100022405212000100029000021253020002900032230334000290000
10002250019
1000225011300001001340000131050100134099913307100013409990910501001340999
1000225020920201001340997100015000134099912452020013409971330408001340996
1000225031400411001340999142030500134099914303030013409991600150001340999
1000225041715205001340997180041300134099619000010012700001905305001270998
10002250521000010013400002115311001340999213015000134O999
10002260003
1000226010030401001340999010050100134099901157000134O999
10003140028
1000314010700502001010994074520100101099108151000010109990835001000330012
1000314020900101000330003100015000033001211001200003300041145101000330004
1000314031245001374407200125080037440720012550010001000001300202001010991
1000314041403001000330012142515000033001216500010000200001700151000020000
1000314051800001000070000180220400007000318150010010109991900204001010991
1000314061910510001010999191244700101099920004070010109992035302001010996
1000314072200342001010996234050100101099423504470010109992400710001010999
```

ILLUSTRATION 4.2

THE DATA IN ITS ORIGINAL CARD FORMAT. AN EXAMPLE FROM READING UNIVERSITY data was still in the same form. Not being a very convenient form for processing and analysing, it was decided that it be converted into a more agreeable one (ill 4.3). In the new format, each entry was arranged starting with the sample number, then the date, and then the number of activities in the entry, the latter being necessary for computer programming. The day's entry itself was arranged so that each line contained the following:

column 1: Time the activity starts.

column 2: Activity code number.

column 3: General location code number. Inside campus =0. Outside campus =1,2, or 3.

column 4: Building number if inside campus. National grid "X" axis bearing if outside.

column 5: Room number if inside campus. National grid "Y" axis bearing if outside.

C. CHECKING ON POSSIBLE ERRORS

Up to this point only minor changes had been made on the original contents of the data. Since it obviously contained many errors, the information had to be checked for accuracy, either by computer or by hand, and the resultant mistakes corrected. This proved to be a major operation. Some of the errors were obvious

```
 10002
    20
    20
  800   501    0  134   999
  815   201    0  134   997
  850     1    0   26     0
  900   101    0   26     2
 1005     1    0    7     0
 1010   301    0   26     0
 1100   101    0   26    13
 1110     1    0  134     0
 1210     1    0  134     0
 1215   408    0  134   996
 1300   202    0  134   997
 1400   401    0  134   999
 1430   150    0  134   999
 1600   311    0  134   999
 1620   150    0  134   999
 1745   205    0  134   997
 1815   301    0  134   996
 1900   150    0  134   999
 2200   303    0  134   999
 2315   150    0  134   999
 10002
    21
    20
   30   710    0  134   999
  810   501    0  134   999
  820   201    0  134   997
  920     1    0   33     0
  930   101    0   33     0
 1100   101    0   33     0
 1200   101    0   33     0
 1305     1    0  134     0
 1315   202    0  134   997
 1345   408    0  134   996
 1430   150    0  134   999
 1530   700    0  134   999
 1700   501    0  134   999
 1730   205    0  134   997
 1815     1    0  133     0
 1820   305    0  133   998
 1900     1    0  134     0
 1905   150    0  134   999
 2235   311    0  134   999
 2250   150    0  134   999
```

ILLUSTRATION 4.3

THE DATA AFTER CONVERSION INTO A FORMAT SUITABLE FOR INSPECTION AND CALCULATION and could be corrected without reference to the original diaries, but a large number was not and the diaries were in constant demand throughout the process as a result. On occasions, the original entries made by the students would prove to be faulty and a degree of improvisation would become necessary. Most of these problems could be solved by referring to similar situations on other days. On some difficult ones though, the only answer would be to apply some educated guessing, but these situations were rare enough so as not to affect accuracy; about 0.03% of all entries.

The following items were checked and corrected:

1. Number of activities for each day.
2. Time sequence of activities.
3. Sequence of entry dates.
4. Existence of activity codes.
5. Relationship between activities, building, and room number; or location code on national grid.

Around 12,000 errors were detected and dealt with at this stage.

The other remaining obstacle confronting the use of the data was that some had a "half day" in their diary corresponding to the day in which they delivered it to the surveyors. Since these could lead to some misleading results, because they consisted of additional activities which were not within the scope of the standard five day week or even a full day, all such entries were deleted from the files. This completed the process of data editing and it was now in final form.

4.1.2 VETTING OF QUESTIONNAIRE DATA

Only the data concerning the University of Reading was found in card format. The rest had to be coded and entered into the computer direct from the original diaries. Since the amount of data in the questionnaire was considerably less than that of the activity data, and the amount actually required for this research even less, it was possible to check and double check all the entries by hand. Considering the limited size of data concerned, it would have been time consuming to check it by computer. The important items, such as residence on campus or not, were checked again against the student's entries in his activities schedule to see if he actually slept on campus or not.

The remaining time was spent on the actual formation of the theory, processing the data, comparing the results with the theory, and the analysis of the information obtained from all the available sources. The only apparatus worth mentioning that was used during this period is the computer hardware mentioned earlier, which was used for data and graphic processing. The data itself and the programmes which were used, are available on tape from the University of Bath.

4.2 DESCRIPTION OF THE CAMPUSES SURVEYED

Although four campuses are actually mentioned in the survey, only three higher education establishments are involved. They are the University of Reading, the University of Leicester, and Leicester Polytechnic. The University of Reading is spread over two sites which is why a total of four campuses are usually mentioned, and sometimes even five since some of the students in Reading University use both of the sites simultaneously. This involves them in an environment which is different from that of the other students who use only one single site. This new group of students will be referred two as "Dual site" users. The difference between them and the single site users will be made obvious during the analysis of the results.

4.2.1 THE UNIVERSITY OF READING

The University of Reading was incorporated by Royal charter in 1926. The city of Reading itself is a

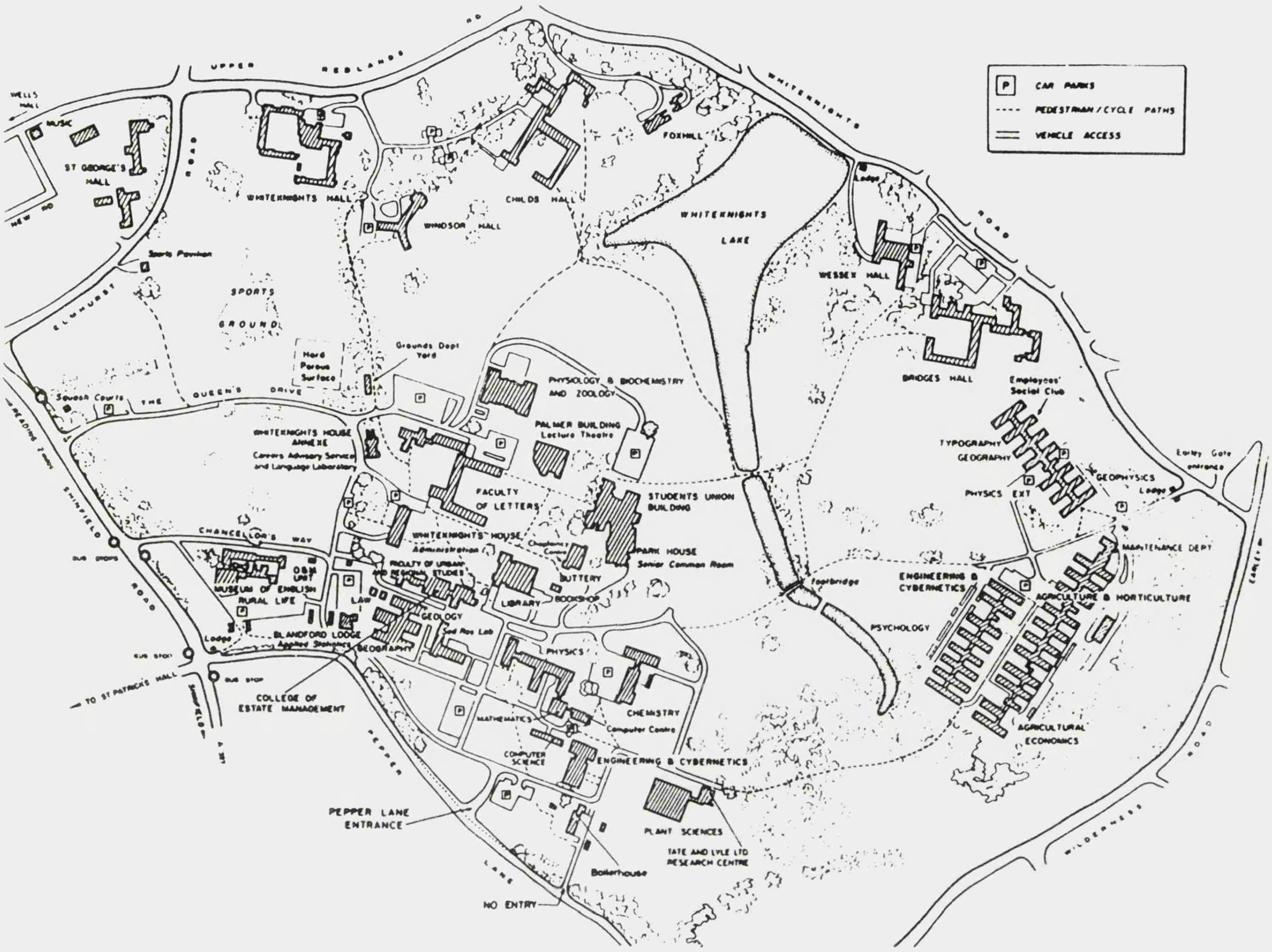


ILLUSTRATION 4.5

READING UNIVERSITY.
WHITEKNIGHTS SITE PLAN.

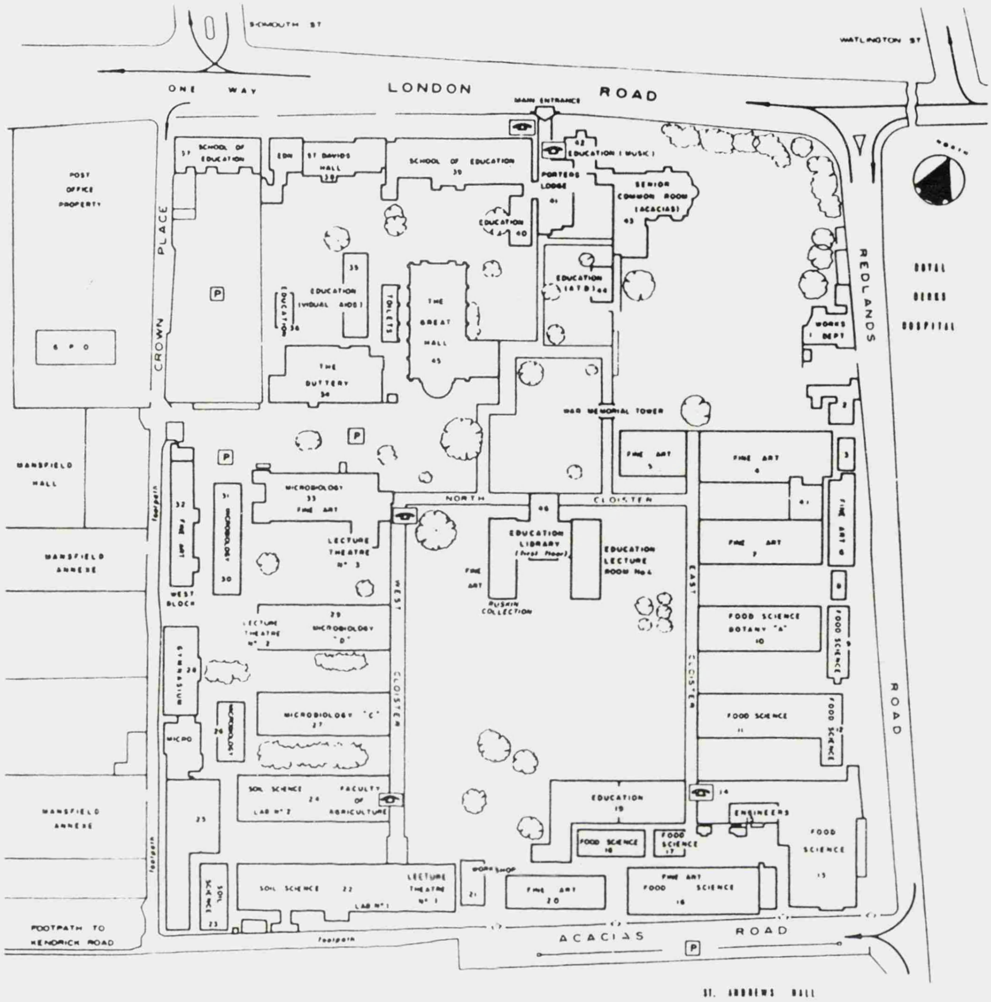


ILLUSTRATION 4.4

READING UNIVERSITY.
LONDON ROAD SITE PLAN.

relatively small centre of population and unlikely to be able to supply a large number of applicants to the university on its own. In this respect it is similar to most other universities where students tend to come from elsewhere creating a heavy need for residential places.

As mentioned earlier, the university is spread over two main sites. The old site, which used to house all of the university, is the smaller of the two and lies about half a mile from the city centre. It is densely packed, mainly with one and two story buildings and of somewhat low stature. The inside gives a feeling of homeliness due to the small scale employed in the buildings. Most of the site is used to teach science oriented subjects.

The other site, the Whiteknights Park sits is different altogether. It is a very roomy site, over 300 acres, filled with large spaces of landscape. The buildings are of the more modern type compared to the London Road site and are more reflective of the modern trends in university building designs. The site lies a further half mile away from the city centre than does the London Road site and communication between the two sites by foot is common taking around 10-15 minutes.

Academically the University is organized into four faculties. They are the Faculties of Letters and Social Sciences, Science, Urban and Regional Studies, and the School of Education.

There are eleven halls of residence in the university. They accommodate around two thirds of the students. Most of them are situated in the Whiteknights site surrounded by large areas of landscape and containing a abundant of facilities to support them.

4.2.2 THE UNIVERSITY OF LEICESTER

Leicester University is the youngest of the old universities and was incorporated by Charter in 1957. In the year 1971 when the survey was done, it contained some 3,400 students. The main University site is on a street called Universities Road and adjoins a large park which separates it from the residential areas to its east. The site itself is small and densely developed (ill 4.6).

The halls of residence in the University are off campus. They mainly consist of of a few Edwardian houses with large gardens or new multistory ones specially built for

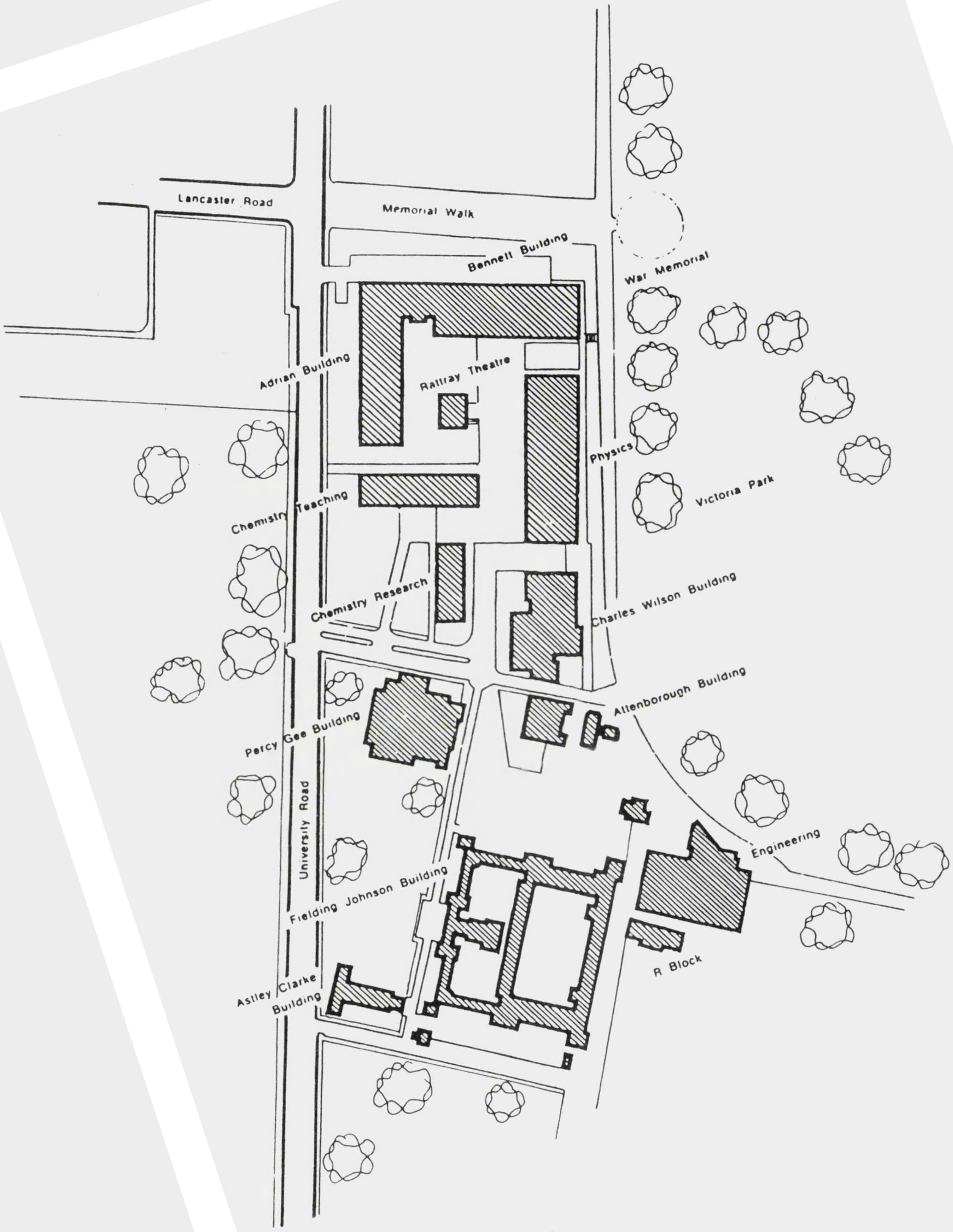


ILLUSTRATION 4.6

LEICESTER UNIVERSITY.
MAIN SITE PLAN.

the purpose. They are not situated on campus but about one mile to the south of it with regular University busses connecting them together. About 60% of the students live either in these halls or University owned student houses which are also situated in the same area of town.

The University is organised into three basic faculties. They are the Faculties of Arts, Science, and Social Science. There is a strong emphasis on the tutorial system of teaching which is often done in groups.

4.2.3 THE CITY OF LEICESTER POLYTECHNIC

Leicester Polytechnic was designated a polytechnic in 1969. In 1971 it had some 2,000 full time students on its register and 4,000 part-time. The part-time students are divided between daytime and evening students. The Polytechnic provides a wide scale of opportunities for the students academically, such as allowing them to study for postgraduate degrees, diplomas, degree courses, and similar levels.

The campus site lies around a quarter of a mile off the city centre. The site is densely packed with a mixture of old and new buildings (ill 4.7). The architecture is modest and the general status of that site in physical terms is a reflection of that situation. Several of the new buildings are multistory, which is a necessity forced by the limitations of the site and gives a feeling of crowdedness.

The Polytechnic is basically a facility to provide for the higher education needs of the people of the surrounding vicinity. Consequently the need for residential spaces is less than that at the University of Leicester. Only around 9% of the full time students live in halls of residence, of which there are three. One of these is on campus, and has a capacity to provide for 100 students. The majority of students live in lodgings and amount to 67% of the number of full time students.

Academically the Polytechnic is organized into five basic divisions. These are the Pure and Applied Science Division, the Business, Computing and Engineering Division, the Design and Textiles Division, the Environmental Design and Construction Division, and the

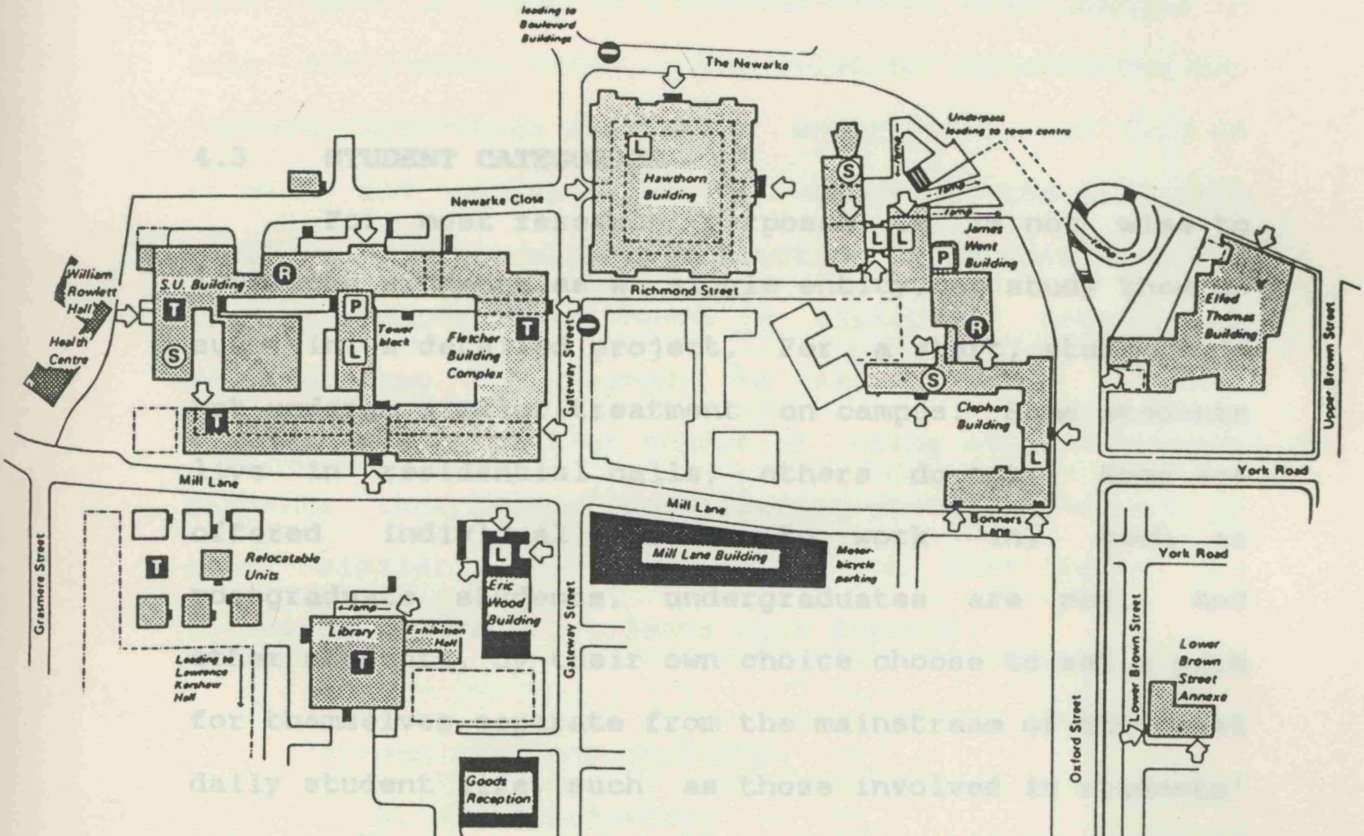


ILLUSTRATION 4.7

LEICESTER POLYTECHNIC.
MAIN SITE PLAN.

Central Division. The last includes Fine Arts, Teacher Training, and Physical Education.

4.3 STUDENT CATEGORIES

For most research purposes, it is not wise to look upon students as a single entity, or study them as such, in a detailed project. For a start, students do not undergo similar treatment on campus. Some students live in residential halls, others do not. Some are offered individual rooms to work in, such as postgraduate students, undergraduates are not. And other students, by their own choice choose to set a path for themselves separate from the mainstream of the usual daily student life, such as those involved in students' union work. In a study such as this, which is concerned with predicting students' behaviour, in order to ascertain the most accurate results, it is necessary to classify students into groups which are influenced by similar enveloping circumstances. This is to ensure that they are surrounded by a certain amount of similarity with respect to pressures and needs, when confronted with similar changes in their surroundings. This is the important factor since the ultimate objective is to find a relation between the student's reactions, in terms of activities performed, and the campus environment. This relation can only be recognized from the surveys if the students observed have reason to react in a similar manner when changes in this environment occur. The relation between the two factors, activities and campus environment, can then be studied and analysed through observing the different patterns. If the students reaction to certain elements of the campus environment is repeatedly constant, a relation can be assumed to exist. This constant reaction has a smaller chance of being noticed between students that belong to different groups, the need to react similarly may not exist. On this basis, the following groups of students were defined:

1. Non resident students.
   A. Undergraduates.
   B. Postgraduates.

2. Resident students.
   A. Undergraduates.
   B. Postgraduates.

3. Part time students.

4. Non conforming students.

The last category is a small group which includes a large variety of students; married students, those that live in areas distant from the one in which the campus is in, and students that follow a highly irregular way of life.

It is obvious from the listing of the categories that each one is in a situation totally different to the rest, thus justifying the separation. However of all the categories, undergraduate resident and non-resident students form the most significant group in terms of numbers on campus. Consequently those two particular groups will be the ones on which this research will have to concentrate. Part time students may also form a large percentage of the total number of students in certain establishments, such as was seen in the case of Leicester Polytechnic. The problem with both the part time and to a lesser extent, postgraduate students, is that they are subject to widely different individual circumstances in their campus life. This depends on the arrangements concerning attendance at the campus for the part time student, and the subject and method of study concerning the postgraduate. Therefore these variables must be taken into consideration when both categories are studied.

4.4 HOW THE SURVEY DATA WAS EMPLOYED

Besides dividing students into groups to apply the survey results on, several other definitions were considered necessary to make the results as compatible as possible with the research requirements.

The results include a summation of each activity that was performed throughout the period of the whole week. Obviously weekends could not be treated the same as weekdays. Consequently the week was separated into weekdays, Saturdays, and Sundays.

The summation of the activities during the course of a single day was also subject to special limitations. The objective of the study is to study student activities in relation to university planning. This excluded the social or special activities that went on after working hours. The daytime hours that were included in the activity summation period started from 800 hours to 1800 hours. These limits were applied on all student categories. However it was also necessary to calculate the activities of resident students on campus. Since these extended to all hours and are related to the subject of campus planning as far as the residential areas are concerned, the period was extended to 800-2400 hours for the activities that were performed by these students inside the residential areas, and only there. This arrangement allows resident students activities to be compared with the rest in terms of total activities, and also allows analysis of the complete situation by revealing which activities they indulged in after working hours on campus, through the use of graphs (chapter seven).

The results of the survey were printed for each individual and checked. Some samples were very far off the average, such as people that lived in a different city and had to commute to the campus, or people who did'nt attend campus for some reason or other. The activities of these students could be misguiding if the attempt is to establish a norm for student behaviour, consequently such samples were discarded. The total number of such cases reached no more than 2% of the samples studied. Singular statistical figures for any other sample, such as reading or social times, which also swayed far off the mean were also disgarded for the same reason, but this was very rare indeed, less than .05% of all cases

The last definition worth mentioning with respect to the employment of the surveys concerned the summation of the scheduled hours. These represent the hours that were actually attended by the students, not the hours that were timetabled by the administration. This is to ensure that any possible correlation which may be found between the student activities and the scheduled hours is not masked by student absenteeism.

The free time which the students have on campus consists of the social, reading, and complementary activities. However it can be argued that since the complementary time consists mainly of circulation time, it is more or less obligatory and not free at all. Consequently it will be omitted from some calculations concerning free time as will be mentioned in due course.

4.5 THE BASIC STATISTICS FROM THE SURVEY

The following represent the basic findings from the surveys. The situations reviewed concern undergraduate students in residence, and off.

The statistics are the first part of the sequence which is to produce the final results. The second is the theoretical outline on which these statistics will be analysed. The third is the application of the theoretical outline.

The variation limits next to the "time per student" values in the tables represent the confidence limits for a less than 5% error probability, ie; more than 95% confidence limit.

The computer was asked to print the results with an accuracy of two digits after the coma for absolute times, and three digits for time per student because the latter requires extra accuracy.

4.5.1 UNDERGRADUATE NON RESIDENT STUDENTS

The statistics on non-resident students are presented in the form of tables plus a statistical identification of each campus.

NAME OF ESTABLISHMENT = UNIVERSITY OF READING

SITE = WHITEKNIGHTS

NUMBER OF STUDENTS IN SURVEY = 52

ACTIVITY	TIME PER WEEK (hrs)		
	TOTAL	PER ST*	
SOCIAL	179.98	3.461	±0.094**
EATING	122.7	2.36	±0.070
LECTURE	359.96	6.922	±0.109
APPLIED	60	1.154	±0.11
TOTAL SCHEDULED	**419.96**	**8.076**	**±0.180**
TUTORIAL	31.33	0.6	±0.028
READING	337.99	6.5	±0.209
READING IN LIBRARY	28.25	0.543	±0.045
READING NOT IN LIBRARY	309.75	5.957	±0.207
CIRCULATION ETC.	249.24	4.793	±0.169
FREE TIME ON CAMPUS	**968.69**	**18.629**	**±0.323**
TOTAL TIME ON CAMPUS	**1388.65**	**26.705**	**±0.354**

TABLE 4.1

TIME SPENT ON ACTIVITIES PER WEEK FOR NON RESIDENT STUDENTS

* Accuracy extended over "Total" time figures.

** Possible deviation for 95% confidence limit.

NAME OF ESTABLISHMENT	= UNIVERSITY OF READING
SITE	= LONDON ROAD
NUMBER OF STUDENTS IN SURVEY	= 9

ACTIVITY	TIME PER WEEK (hrs)		
	TOTAL	PER ST	
SOCIAL	32.45	3.257	±0.620*
EATING	17.6	1.913	±0.459
LECTURE	62.18	6.759	±0.649
APPLIED	109.83	11.938	±1.063
TOTAL SCHEDULED	**172.02**	**18.697**	**±0.945**
TUTORIAL	3.20	0.348	±0.156
READING	13.13	1.428	±0.720
READING IN LIBRARY	0.92	0.100	±0.17
READING NOT IN LIBRARY	12.22	1.328	±0.801
CIRCULATION ETC.	38.02	4.132	±0.929
FREE TIME ON CAMPUS	**107.32**	**11.665**	**±1.858**
TOTAL TIME ON CAMPUS	**279.33**	**30.362**	**±1.863**

TABLE 4.2

TIME SPENT ON ACTIVITIES PER WEEK FOR NON RESIDENT STUDENTS

* Possible deviation for 95% confidence limit.

NAME OF ESTABLISHMENT = READING UNIVERSITY

SITE = DUAL SITE*

NUMBER OF STUDENTS IN SURVEY = 11

ACTIVITY	TIME PER WEEK (hrs)		
	TOTAL	PER ST	
SOCIAL	50.98	4.635	±0.501**
EATING	30.70	2.790	±0.352
LECTURE	85.78	7.798	±0.500
APPLIED	77.47	7.042	±0.497
TOTAL SCHEDULED	**163.25**	**14.840**	**±0.573**
TUTORIAL	9.67	0.879	±0.121
READING	45.98	4.180	±0.836
READING IN LIBRARY	4.22	0.383	±0.960
READING NOT IN LIBRARY	41.767	3.797	±0.957
CIRCULATION ETC.	71.615	6.510	±0.689
FREE TIME ON CAMPUS	**212.75**	**19.341**	**±1.669**
TOTAL TIME ON CAMPUS	**375.99**	**34.182**	**±1.531**

TABLE 4.3

TIME SPENT ON ACTIVITIES PER WEEK FOR NON RESIDENT STUDENTS

* Students that use both the Whiteknights and London Road sites.

** Possible deviation for 95% confidence limit.

NAME OF ESTABLISHMENT	= UNIVERSITY OF LEICESTER
SITE	= MAIN
NUMBER OF STUDENTS IN SURVEY	= 36

ACTIVITY	TIME PER WEEK (hrs)		
	TOTAL	PER ST	
SOCIAL	130.3	3.723	±0.121*
EATING	76.883	2.136	±0.078
LECTURE	314.432	8.984	±0.167
APPLIED	63.82	1.823	±0.166
TOTAL SCHEDULED	**378.252**	**10.507**	**±0.222**
TUTORIAL	37.267	1.065	±0.058
READING	160.949	4.599	±0.197
READING IN LIBRARY	11.150	0.319	±0.225
READING NOT IN LIBRARY	149.8	4.28	±0.195
CIRCULATION ETC.	140.81	4.023	±0.146
FREE TIME ON CAMPUS	**571.593**	**16.331**	**±0.302**
TOTAL TIME ON CAMPUS	**949.841**	**27.138**	**±0.326**

TABLE 4.4

TIME SPENT ON ACTIVITIES PER WEEK FOR NON RESIDENT STUDENTS

* Possible deviation for 95% confidence limit.

NAME OF ESTABLISHMENT = LEICESTER POLYTECHNIC

SITE = MAIN

NUMBER OF STUDENTS IN SURVEY = 65

ACTIVITY	TIME PER WEEK (hrs)		
	TOTAL	PER ST	
SOCIAL	306.75	4.749	±0.088*
EATING	130.32	2.005	±0.061
LECTURE	663.71	10.211	±0.180
APPLIED	385.15	5.925	±0.230
TOTAL SCHEDULED	**1048.86**	**16.136**	**±0.220**
TUTORIAL	58.67	0.902	±0.037
READING	267.27	4.192	±0.177
READING IN LIBRARY	16.70	0.256	±0.022
READING NOT IN LIBRARY	250.57	3.855	±0.175
CIRCULATION ETC.	301.33	4.636	±0.145
FREE TIME ON CAMPUS	1092.36	16.805	±0.236
TOTAL TIME ON CAMPUS	2141.21	32.940	±0.247

TABLE 4.5

TIME SPENT ON ACTIVITES PER WEEK FOR NON RESIDENT STUDENTS

* Possible deviation for 95% confidence limit.

It is noticeable from the tables that there is a regretably small number of student samples in the survey taken from the Reading London Road site, and from students using both the London Road and Whiteknights site. As a result some of the activities have unnacceptable confidence limits. To overcome this problem most of the research was conducted on the results obtained from the other three main sites. Reference was made to the two small groups only when the total sample could be used as a single unit, without being divided into subgroups and were the confidence limits were not objectionable.

4.5.2 UNDERGRADUATE RESIDENT STUDENTS

As explained earlier, the activities in the residential areas are calculated for a time duration between 800-1800 and 800-2400 hours separetely. The activities in the non-residential areas are calculated only between 800 and 1800.

The following tables will indicate when the figures represent the residential areas, or the whole campus. In the absence of any such indication, the figures will represent the non-residential areas of the campus. This is to simplify comparisons with the tables concerning non-residential students. Similar activities, and their location will be presented in a similar way.

No table will be found in this review, for Leicester Polytechnic. This is because the number of resident students there is negligible.

NAME OF ESTABLISHMENT = UNIVERSITY OF READING

SITE = WHITEKNIGHTS

NUMBER OF STUDENTS IN SURVEY = 137

ACTIVITY	TIME PER WEEK (hrs)		TO 2400
	800 TO 1800		
	TOTAL	PER ST	PER ST
SOCIAL	292.33	2.134 ±0.013*	
EATING	69.00	0.504 ±0.005	
LECTURE	1018.71	7.436 ±0.019	
APPLIED	180.88	1.320 ±0.011	
TOTAL SCHEDULED	**1199.59**	**8.756 ±0.020**	
TUTORIAL	79.016	0.577 ±0.004	
READING	447.72	3.268 ±0.024	
READING IN LIBRARY	75.17	0.549 ±0.004	
READING NOT IN LIBRARY	372.57	2.719 ±0.023	
TOTAL IN NON RES. AREA	**4325.5**	**31.57 ±0.032**	**33.741**
SOCIAL IN RESIDENCE	1058.2	7.724 ±0.021	13.815
READING IN RESIDENCE	838.1	6.117 ±0.031	9.717
TOTAL IN RESIDENCE	**1896.3**	**13.84 ±0.037**	**23.532**
FREE TIME; ALL CAMPUS	**5022.3**	**36.66 ±0.022**	**48.516**
TOTAL TIME; ALL CAMPUS	**6221.86**	**45.42 ±0.023**	**57.272**

TABLE 4.6

TIME SPENT ON ACTIVITIES PER WEEK FOR RESIDENT STUDENTS

* Possible deviation for 95% confidence limit.

NAME OF ESTABLISHMENT = UNIVERSITY OF READING

SITE = LONDON ROAD

NUMBER OF STUDENTS IN SURVEY = 9

ACTIVITY	TIME PER WEEK (hrs)		
	800 TO 1800		TO 2400
	TOTAL	PER ST	PER ST
SOCIAL	13.68	1.520 ±0.263*	
EATING	4.25	0.472 ±0.400	
LECTURE	36.52	4.057 ±0.890	
APPLIED	33.47	3.719 ±0.930	
TOTAL SCHEDULED	**69.98**	**7.77 ±1.510**	
TUTORIAL	2.62	0.291 ±0.13	
READING	22.07	2.452 ±0.600	
READING IN LIBRARY	2.33	0.259 ±0.128	
READING NOT IN LIBRARY	19.73	2.193 ±0.640	
TOTAL IN NON RES. AREA	**270.4**	**30.11 ±1.45**	**31.685**
SOCIAL IN RESIDENCE	56.15	6.239 ±0.804	11.680
READING IN RESIDENCE	70.1	7.789 ±0.843	11.652
TOTAL TIME IN RESIDENCE	**126.25**	**14.03 ±1.096**	**23.331**
FREE TIME; ALL CAMPUS	**327.21**	**36.36 ±1.783**	**47.240**
TOTAL TIME; ALL CAMPUS	**397.2**	**44.13 ±0.870**	**55.016**

TABLE 4.7

TIME SPENT ON ACTIVITIES PER WEEK FOR RESIDENT STUDENTS

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* Possible deviation for 95% confidence limit.

NAME OF ESTABLISHMENT = UNIVERSITY OF READING

SITE = DUAL SITE

NUMBER OF STUDENTS IN SURVEY = 19

ACTIVITY	TIME PER WEEK (hrs)		
	800 TO 1800		TO 2400
	TOTAL	PER ST	PER ST
SOCIAL	22.40	1.179 ±0.134*	
EATING	8.17	0.430 ±0.058	
LECTURE	136.53	7.186 ±0.295	
APPLIED	158.17	8.325 ±0.60	
TOTAL SCHEDULED	**294.70**	**15.15 ±0.566**	
TUTORIAL	13.13	0.691 ±0.11	
READING	55.76	2.935 ±0.519	
READING IN LIBRARY	8.813	0.463 ±0.166	
READING NOT IN LIBRARY	46.95	2.471 ±0.433	
TOTAL IN NON RES. AREA	**672.7**	**35.41 ±1.009**	**37.767**
SOCIAL IN RESIDENCE	102.37	5.388 ±0.246	10.423
READING IN RESIDENCE	87.0	4.580 ±0.483	7.400
TOTAL IN RESIDENCE	**189.37**	**9.967 ±0.559**	**17.823**
FREE TIME; ALL CAMPUS	**567.4**	**29.86 ±0.566**	**40.079**
TOTAL TIME IN ALL CAMUS	**862.11**	**45.37 ±0.495**	**55.59**

TABLE 4.8

TIME SPENT ON ACTIVITIES PER WEEK FOR RESIDENT STUDENTS

* Possible deviation for 95% confidence limit.

NAME OF ESTABLISHMENT = LEICESTER UNIVERSITY

SITE = MAIN

NUMBER OF STUDENTS IN SURVEY = 36

ACTIVITY	TIME PER WEEK (hrs)			
	800 TO 1800			TO 2400
	TOTAL	PER ST		PER ST
SOCIAL	72.85	2.024	±0.072*	
EATING	75.30	2.008	±0.080	
LECTURE	324.75	9.021	±0.168	
APPLIED	26.72	0.742	±0.093	
TOTAL SCHEDULED	**351.47**	**9.763**	**±0.209**	
TUTORIAL	52.55	1.460	±0.060	
READING	205.25	5.701	±0.187	
READING IN LIBRARY	18.18	0.505	±0.039	
READING NOT IN LIBRARY	187.06	5.196	±0.188	
TOTAL IN NON RES.	**1334.7**	**37.08**	**±0.302**	**40.947**
SOCIAL IN RESIDENCE	143.55	3.987	±0.127	9.479
READING IN RESIDENCE	147.88	4.11	±0.195	8.109
TOTAL IN RESIDENCE	**291.43**	**8.095**	**±0.220**	**17.588**
FREE TIME; ALL CAMPUS	**1274.7**	**35.41**	**±0.270**	**48.772**
TOTAL TIME; ALL CAMPUS	**1626.2**	**45.17**	**±0.281**	**58.535**

TABLE 4.9

TIME SPENT ON ACTIVITIES PER WEEK FOR RESIDENT STUDENTS

* Possible deviation for 95% confidence limit.

CHAPTER FIVE

THE THEORETICAL BASIS FOR THE STUDENTS ACTIVITY ANALYSIS

The brief summary of the results concerning the campus survey which was shown in chapter four reveals a few interesting points. The most basic is that there are indeed notable differences in the students' activity patterns which are obvious between the separate campuses. The students do not behave in a similar fashion in any two sites. The students in the University of Reading in the Whiteknights site study an average of 6.5 ±0.21 hours per week, while their counterparts in London Road only read 1.428 ±0.72 hours per week. There is also considerable difference in the total time the students spend on campus. The students which used both the sites in the University of Reading Whiteknights and London Road stayed on campus for over 34 ±1.53 hours per week on average, while their fellow students in Leicester University elected to stay no more than 26 ±0.36 hours. More to the point, there is also a difference in the free time both groups of students spend on campus. This is the total time in campus minus the scheduled hours. In this respect the students in Reading stayed over 19 ±1.6 hours on campus per week, while in Leicester they only stayed around 16.3 ±0.3 hours. It follows that there are reasons for these variations. Outlining a theoretical method which deals with how to find out what these reasons are and how much influence they have, from the survey results, is the purpose of this chapter.

The thing which concerns this research most about the variations in students activities between campuses is whether or not they follow a particular pattern. Do they change according to respective changes in the surrounding situation with consistency or are they haphazard. The answer to this question can be found by matching the results of the students activity surveys with the related factors. Obviously the most important part of this job would be the identification of these factors themselves. This point will be discussed in detail later. However, the early signs from the survey results are encouraging. For instance, there appears to be a shift towards spending more time on reading, by the student, in the situations where the courses taught are more theoretically oriented, such as may be the case in Departments of Social Sciences or Humanities. The Whiteknights site in the University of Reading, where the Faculty of Letters with its theoretically inclined content prevails, is a good example of this attitude. The students there spend an average of 6.5 hours of their time reading per week. In the London Road site of the same University, where the courses taught are decidedly Science oriented with a large proportion of laboratory work, the students only spent 1.428 hours per week reading. However even these encouraging signs can not be taken at their face values. For there to be any scientific substance to this theory, the relationship has to hold true throughout all the campuses, and furthermore, it must show mathematical consistency within acceptable confidence limits. It must be identifiable through a mathematical model which can relate to all the situations in a numerically accurate manner. The first step towards building up such a model must be to identify the factors related to campus change which affect the students activity patterns.

It is very important to emphasize that the contents of this chapter do not represent the final theoretical model which is supposed to relate the various factors together. It merely contains the hypothesis that was formed before the survey results were available, and consequently represented the basis upon which these results were examined and analysed. The result of the application of this hypothesis on the results is the process that will produce the theoretical model. This will be done in later chapters. Consequently, no attempt will be made, in this chapter, to prove the theoretical statements that will be made, true or false. This would be unnecessary, for it is the reasoning behind the decisions that are important at this stage.

5.1 THE FACTORS THAT EFFECT STUDENTS' ACTIVITIES ON CAMPUS

The factors that will be discussed must contain two elements to render them necessary for discussion in line with this research subject. Because the subject is about campus planning, the factors must be related to the campus in one way or the other. The second element is that they must be considered to have some bearing on the students activities on the campus.

All the factors which were considered necessary according to the above criteria can be divided into two basic groups. First there are the factors which can be categorized as being essentially physical in nature. These include most of the factors which are directly related to the architectural environment such as the building design and the availability of facilities. The second group are the ones which are considered to be organizational. These include the factors which are more closely related to the academic environment. The complete list of all the organizational factors that were studied includes the following:

1. The academic specialization (later to be referred to in terms of applied scheduled hours to theoretical hours, per week).
2. Total scheduled hours (classes).
3. Teaching methods.
4. Organization of services.
5. Percentage of residential students.
6. Part time and postgraduate students.

As for the physical factors, the following ones were studied:

1. Size of campus in terms of the number of student using it.
2. Location of campus near or far from city centre and residential concentrations.

3. The amount of appeal the campus holds for the student.

4. The availability of facilities.

5. Percentage and number of residential students.

6. Part time and postgraduate students.

It is noticeable from this brief listing that residential, part time and post graduate students appear in both categories. This is because they affect the campus in several ways, some of which may be considered physical, and others organizational. This will be discussed in detail later. It must be mentioned here that a few other factors were also studied and found to have no effect later, such as the establishments' administrative structures, or the number of married students; and although some of the ones mentioned above will prove to be similarly ineffective, they will still be mentioned because they stand out as possible factors and because certain situations were envisaged whereby it would be necessary to consider some of them. The other factors which were discarded did not share this characteristic.

5.1.1 THE ORGANIZATIONAL FACTORS

Of these factors it was thought that the element most likely to affect student activities would be whichever had most affect on their academic needs. Two factors must be considered here. The first is the total time the students have to spend attending scheduled lecture, laboratory, and tutorial classes. This was thought to have a possible dual effect. On the one hand more of it would reduce the total time that the students have free on their hands to spend as they wish, which would probably mean less time spent on both social and reading activities. On the other hand it might mean that more is required of the students in terms of preparation for these classes resulting in an increase in time spent on studying. The second factor is the ratio of applied scheduled work to theoretical. Theoretical work usually demands more preparation and more study from the student. Consequently it can be expected that more of it in relation to the total scheduled time would result in a higher percentage of time spent on campus by the student reading. Apart from what was mentioned earlier in this chapter regarding the difference in reading time between the Whiteknights and London Road sites in the University of Reading, it was difficult to draw any immediate conclusion on this subject from the survey results in tables (4.1-4.9). It follows that detailed analysis must be undertaken (chapter six).

Different academic establishments have different attitudes towards teaching, sometimes resulting in teaching methods which are bound to have an effect on the way the students behave on campus. For instance some establishments prefer to concentrate on a few selective hours of scheduled classes leaving the bulk of the work up to the student to discover. Such a method would undoubtedly lead to more time being spent on campus working in preparation for classes. It may also affect the total time the student spends in campus since with more free time on his hand he could elect to spend it in campus or off. In this respect at least, studying the effect of teaching methods would be restricted to the relation between scheduled hours and the student's activities.

The other effect teaching criteria can have on the student activities, concerns how the teaching hours are distributed through the day. A common practice among academic administrators is to concentrate the scheduled classes, and especially the theoretical ones, in the morning hours and leave the afternoons mainly for laboratory work. The degree in which the scheduled hours are concentrated in any one shift and not in the other would obviously affect the students' activity pattern. The larger concentration by itself should attract more students to the campus at that particular time of day.

If that concentration contained a high percentage of theoretical classes as opposed to applied ones, the more rigid nature of these classes would probably affect the students in a manner opposite that during the afternoon hours if the classes were laboratory oriented then.

Variations in the way services are organized on campus may sometimes have an effect on students' behaviour. The most obvious example is the lunch hour catering services. In some campuses the lunch hour is divided into shifts to reduce the pressure on the catering facilities thus extending the length of the break in some senses when all the students are considered, and also affecting the timetabled activities since some of the students will still be in class when the first shift breaks for lunch. Another example can be seen in the cases where the establishment requires that the meals it serves are paid for in advance over a certain period of time during the academic term. In such situations the student would be obliged to eat at the particular place where he is served that meal and restricting his movement for that period of time. These are only the more common examples and care must be taken to look out for any similar variations in service organization which might affect the student in other campuses. To study this, an hour by hour account of the students activities will have to be provided (chapter eight).

The case for residential students will be discussed separately (chapter seven) because of the dual organizational and physical effect they can have on the campus, and because of the importance of the subject to the performance of all the students on campus. Part time and post graduate students must also be given similar regard where their number qualifies them for it.

5.1.2 THE PHYSICAL FACTORS

Almost all of the factors involved under this heading have one major consequence which influences students' behaviour, and that is that they affect the appeal and attractiveness of the campus site to the students. Appeal and attractiveness in the sense that a student would be more willing to stay longer in a campus which has a high appeal to him than vice versa. Each factor affects this element in a different way. The campus's location, for instance, will not have a direct effect on the attractiveness of the place to the student, but the prospect of walking a shorter distance to reach the area might be an inducement to go there when the matter hangs in the balance. In other words the prospect would be more appealing to him. It may also work the other way around when the student is considering going back home.

It was considered that the size of a campus may be directly related to the attractiveness of the place to a student. A larger campus with more students should have more facilities in it to satisfy the student's needs and also a wider choice of friends to socialize with. Theoretically this should increase the campus's attraction.

The location of the campus must be considered from two points of view. The first is its location with respect to the urban centres. These areas usually contain large concentrations of services which may lure the student away from the campus especially during the lunch break, for instance. However it may make the campus itself more appealing with a wider range of services nearby. The second point of view is its relation to residential concentrations, especially those where its own students are likely to reside in. The prospect of longer or shorter travel distances, as already explained, may have an effect on the student's decision to leave for campus or stay home.

The effect of improved facilities and aesthetics should be obvious. The facilities in particular are generally related to the previous factors although it may be the one with the direct influence. It was thought that the aesthetic values of a campus might be more obvious in the negative sense than otherwise. A campus which imposes an uninviting feeling on its users may be repulsive to them. In the positive sense, it is difficult to envisage a campus so highly regarded aesthetically that it would entice students to stay in it for substantially larger periods, although the prospect is appealing architecturally and is possible. Further pursuit of this subject was not attainable, regrettably, because the variations between the campuses involved were not deep enough to show the differences, ie; they had relatively similar aesthetic qualities.

5.2 RESIDENTIAL STUDENTS

The percentage of residential students in a campus can be considered both as an organizational and a physical factor. On the one hand their existence would mean the reorientation of several services and the reorganization of some facilities to accommodate their different needs. This effect must be considered organizational. On the other hand their existence in numbers and their different way of life on the campus gives them a physical effect on it as well. All this coupled with the fact that they are usually found in large numbers in most universities and polytechnics, gives them considerable influence on any planning attempt.

The activities of the residential students are not included in the campus profile graph. This is because they live in circumstances which are completely different from the non-resident students, as was explained, and because their number as a percentage of the total number of students in the campus is variable from one establishment to the other. Consequently if their activities were combined with the rest of the students, a mathematical conversion would have to be found to accommodate the different percentages of each group to the total. This would produce a complicated representation which is difficult to understand, which is the exact opposite of the whole idea of the graph. A separate graph for resident students was not considered for the same reason. Instead it was thought better to consider the non-resident students' behaviour the reference and plot resident students' activities in the same graph without additional conversion. This would produce a single easy to comprehend graph to represent all the students. But it would also mean that resident students could not be compared with a standard. They could only be compared with other groups of students individually. This would be right and proper. Standards for resident students' activities would be too complicated because of the large number of parameters that would have to be included such as type of residence, if it was on or off campus, and any circumscribing regulations such as obliging all students' to eat lunch in the residence area (Reading University). Comparison with individual groups of students each represented by their own graph would be simple because all the relevant parameters may be attached.

The existence of a large percentage of residential students on campus might cause an increase in its attraction to non-resident students. Two elements contribute to this line of thinking. The first is that non-resident students will always have the knowledge that there is someone on campus at all times. This should contribute to give the campus a more lively feeling which may in itself add to its appeal. The second is that residential students will require a new range of services and facilities to accommodate them. These would include recreational services such as bars and common rooms, and personal services such as launderettes. The fact that these extra facilities would also be available to non-resident students' use again adds to the campus's attraction.

The direct physical effects of the residential students in terms of their numbers on campus is not so easy to judge hypothetically. Having their residence so close to their place of work could mean two separate things in terms of their stay on campus. They might find travelling to and fro between the two places so easy that they immediately retire to their residence after the scheduled classes, thus reducing the number of students on campus and probably reducing its appeal. The place where they spend their free time is also suspect. They may elect to use the campus recreational facilities, or they may feel bored by the campus having to stay there day and night and choose to leave the area as soon as they find suitable. Both choices having opposite effects on the campus attraction.

5.3 PART-TIME AND POST-GRADUATE STUDENTS

The factors that influence part time and post graduate students are similar to those mentioned concerning residential students. Both groups of students work on campus under a different set of rules and needs than the other groups. The effect of both on the campus depends on their number and must be discussed in separate sections (7.2 and 7.3). Furthermore both of them are subject to widely varying individual circumstances on campus. This depends on the days that the student is supposed to attend classes on campus for the part time student, and on the subject and method of study for the post graduate.

Other special groups of students also exist on a campus, but their number is small enough to ignore. They include married couples, special talents in sports, music and other activities, students who live in exceedingly far away places, and similar categories. Care must be taken when planning a campus to check on the existence of any particular group which may exist in abnormally large numbers, although this should usually be rather obvious since it would demand rather unusual circumstances for such a situation to emerge, and it should make itself quite obvious.

CHAPTER SIX

NON RESIDENT STUDENTS TOTAL ACTIVITY PATTERNS

The analysis of the survey results will be based on the broad lines laid out in the theoretical discussion in chapter five. These will be tested for validity, quantitative evaluation, and application. The theoretical implications will be discussed and updated accordingly.

Due to the complexity of the student population's composition, and the diversity of the ways in which the survey results were employed, the analysis of the results will be discussed under three separate headings. The first, this chapter, will be concerned with the total weekly activity times for non-resident students. The remaining chapters will discuss the other categories of students, then the daily hour by hour account of students' activities and how to convert them to spatial requirements.

Before progressing into the actual analysis of the theoretical outline, it must be mentioned that the tests in this and the following chapters were made with the objective of finding indicators which point to students' group behaviour. It must always be realised that deviations will occur on the results because of the inherent difficulties involved in studying group behaviour generally, and doing so through statistical methods particularly.

Apart from statistical errors, which will be defined where possible, there is another strong reason to anticipate such deviations. Group behaviour is affected by a multitude of factors, some more prominent than others. It is not possible to include all of them in the research as it would then become; a) difficult to conduct, and b) too complicated to apply. Hence the study will be concerned with finding the most dominant factors in terms of effect on the students' behaviour. This will leave room for variations due to the possible effect of these unaccounted factors, no matter how small their influence. These will show even on the relationships shown in the following chapters in the form of deviations from the mean. While it may be true that in the range of samples available for this study the "other" factors have a relatively small effect, it must be kept in mind that where the situation changes, their relative influence also changes. Furthermore, as planners have continuously found to their detriment, new unaccounted factors often force themselves on a new situation, sometimes with considerable effect. An example may be given of the University of Mosul in Iraq [ref 28]. The architects had to include common rooms exclusive to the female students so that they could relax on their own, and if they wished, smoke, which they would not do outside. This subject is not included in this study of course, nor would that be necessary for British universities, yet it was a necessity in Mosul. This example may at first seem trivial but it serves to illustrate how any number of academic and non-academic subjects which although not possible to examine in this study, might have a bearing on the planning of other institutions inside and outside Britain.

Where possible, a discussion of what are thought to be factors which may potentially have more influence in situations dissimilar to the ones studied, will be included but as was mentioned, others may also require attention in new cases.

The results of this research are based almost entirely on the study of the four campuses surveyed by the "Martin Centre". There is a large area of similarity between these campuses. This similarity helped to isolate the factors that were responsible for the differences between them in terms of students activities. However it also meant that the factors which were similar, or varied only slightly with respect to their effect on students' activities, could not be evaluated. These included student service facilities, aesthetic appeal, traffic control, etc.. In other situations were these factors are markedly different, the results of this study are not directly applicable.

The reason for starting with non-resident students is that it was found that they represented a fair barometer to gauge the effect of the various elements under study on the general student population. How and why will be explained later in detail. The discussions will be explained using the profile and relative profile graphs. The various aspects related to the theoretical models will be separated into those concerning the organizational factors, and those concerning the physical ones. The aspects which fall under the influence of both categories, organizational and physical, will follow.

6.1 THE ORGANIZATIONAL FACTORS

The complexity of organization in British universities and all the diversity accompanying it meant that the factors involved in shaping the students' group behaviour were numerous and complex. However from studying the survey results there seemed to be a strong reason to group the students according to academic specialization, or "school". There was an obvious variation of behaviour between the students of each school which was less apparent between the students of the same one. This was also found to be the case by Taylor [ref 43] in his statistical analysis of the same data.

The reason for the above phenomenon is that different schools teaching different subjects and utilizing different teaching methods demand different responses from the student. The needs of students of Art or Social Science are different from those that study more technical subjects like Engineering or Horticulture. The latter have to spend more time on applied studies while the former don't. The basic demand that theoretical studies put on a student is that he "read" in preparation for his lecture. Technical studies add scheduled applied hours to his load. Furthermore, the student is sometimes expected to complete the work related to the subject during the scheduled session, which means that he will have to do little or no reading in response. Others such as design classes in studios often require the students to continue work in the studio after the scheduled time is over, which also means he may have to do little reading afterwards. Furthermore because scheduled applied hours usually extend between 2-6 hours, the student has less time left for reading because he is left with less free time to read in. In other words it is possible that the difference between the students' behaviour according to academic specialization may be partially explained by the variation in their types of study. The most obvious of these variations is between theoretical studies (lectures and tutorials) and applied work (laboratory, studio and workshop). Consequently it is necessary to find if there is any correlation between the portion of time the student spends on each type, and his other activities on campus.

It was not possible in this research to study the effect of the students' academic specialization by separating the students into respective groups according to school and observing them independently. By dividing the students in such a way, the number in each group would have been far less than the total in each campus, thus reducing the statistical trustworthiness of the results. Some of the groups would have had less than six students in them rendering the activity times of those groups useless as statistical averages because of the consequent reduction in confidence limits. Secondly the number of specializations available for study is small relative to the total existing in universities and polytechnics. The results of studying the limited number available in the surveyed campuses would not be of high value to a new campus if the specializations were not compatible. Consequently it was necessary to search for a factor, or factors, which explain the behaviour of the students with respect to this subject, and study the factors instead, if possible.

The activity variations relating to academic specialization can take two forms. The first would be the change of "choice" of non-scheduled activity the student performs. The second is a change in the "total time" he allocates to them. A relation between academic specialization and total free time, if it exists, would probably be due to the different number of scheduled hours the student has to attend in each school. However since the factors involved in changing the students free time on campus are suspected to be many, the subject will be dealt with separately later (section 6.3).

6.1.1 THE APPLIED TO THEORY RATIO

It is a well known fact that different specializations require different amounts of private study from the student. According to the theoretical analysis, the problem of identifying these variations may be partially defined by relating them to the ratio between the amount of scheduled applied hours the student attends, and the scheduled theory hours. The theoretical hours consisting of lecture time and tutorials, applied time taking the more general meaning of all the academic work which implies a degree of student's manual participation. This would include music lessons or architectural studio work. The full list of activities can be found in appendix (A). An increase in the ratio would indicate a relative increase in the time the student spends on scheduled applied work or relative decrease in the time spent in scheduled theoretical hours. The applied/theory ratio would thus be an "indicator" which partially explains particular elements of the students behaviour, and as such has potential as a planning instrument.

The applied, reading, and social hours consist mainly of a large variety of activities whose total average in each case could be regarded as an entity. The theoretical hours consist of only two activities, lectures and tutorials. Consequently any significant difference between the effects of the two on the student could lead to a variation in the effect of the whole theoretical factor on him when the ratio of any one of them changed. In other words, the effect of a weeks total attended scheduled theory time would change between two students when one had 30 hours of tutorial during that period for instance, and the other had only 10 hours. It was expected initially that such a variation did actually exist in the form of constantly more demanding tutorials. That is to say that while there are many forms of lectures, demanding a wide variety of responses from the student in terms of preparation and reading, it was thought that tutorials attracted a more even response in the form of more study. This proved not to be the case. When questioned on the subject, the students registered responses that were similarly variable in the cases of both lectures and tutorials. Consequently it was decided that the distinction between the two was unnecessary, and that total theory hours may be treated as an amalgamate of slightly varying elements the same way as applied hours are.

6.1.2 EFFECT OF THE APPLIED/THEORY RATIO ON OTHER ACTIVITIES

In accordance with the theoretical outline, the effects of the applied to theory ratio factor should appear on the time the students allocate for social and reading activities. To find if this relation existed a direct plot was tried between the applied/theory ratio with the social/reading times ratio to see what kind of correlation could be found. The resultant graph can be seen in illustration (6.1) The coefficient of determination, which is an expression of how well a regression line fits the points, was 0.945. The closer to unity (1) the value of the coefficient, the closer the points are to the line. When it is precisely one, all the points are exactly on it.

To evaluate the importance of graph (6.1) it is also necessary to know the limits of confidence for the regression line. This is the area within which the line may fall, due to statistical variations in the data. It is defined by the two concave lines surrounding the mean. The area increases when the sample numbers are less. This implies a reduction in the confidence limits attributed to the smaller number of samples. An increase in the deviation (mathematically represented by the "standard of deviation") from the average also increases the area, ie; decreases the confidence limit. The limits are usually calculated for less than 5% probable error, which means that there is a 95% probability that any new line would fall within the defined area, between the two concave curves.

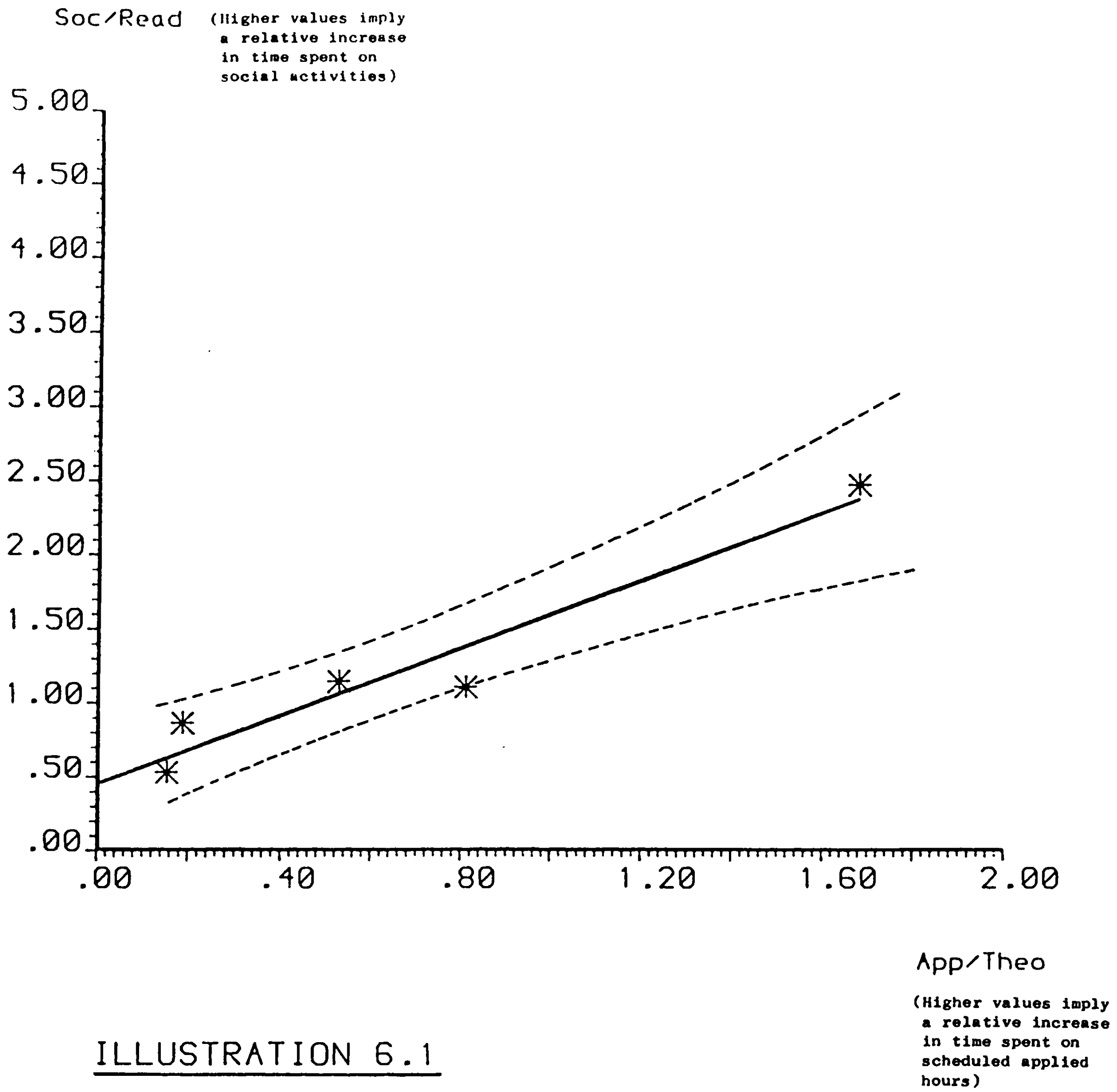

ILLUSTRATION 6.1

A COMPARISON BETWEEN THE CAMPUSES APPLIED/THEORY VERSUS SOCIAL/READING RATIOS

* Coefficient of determination= 0.945

* The results show that students attending relatively more theoretical hours do relatively more reading, and vice versa.

  Or that students attending relatively more scheduled applied hours spend relatively more time on liesure, and vice versa.

On examining both the coefficient of determination and the confidence limits, it appears that a relation between the two elements involved in illustration (6.1), the applied/theory and social/reading ratios, exists. What this means is that the students' reactions in terms of social/reading times, to changes in the applied/theory ratio do follow a trend. The trend being that students with a relatively larger portion of lecture hours to attend, spend relatively more of of their time reading, and vice versa. This is the result which was predicted by the analysis earlier. Relatively more practical scheduled work and less lecture time means that the student would need to do less reading in preparation for his examinations, more of which is required for the theoretical subjects which are taught in the lecture room.

The relationship between applied, lecture, reading, and social activities is also apparent in the relative graph. From observing figures 1, 2, 3, and 4 in appendix (F) the relationship can be observed visually. Subjects which contain more applied scheduled, such as those predominant in London Road and Dual site (figures 2 and 3) show the student spending significantly less of his relative time reading, and more socializing. The other two sites, Reading Whiteknights and Leicester have their students spending a much larger portion of their time in lectures as opposed to practicals and it is obvious that they do considerably more reading especially in Whiteknights.

Since the total time spent by the students on reading and performing social activities represented the bulk of the volatile time which they spend in the campus, it was considered necessary to investigate the subject further to define a theoretical framework that could produce mathematical results which were as accurate as possible. Eventually the following argument was presented. The reason for the applied/theory ratio having any effect on the student's social or reading time was because it changed the burden of work the student had to take on himself. It usually meant that he either had to do more work and study or less. This he had to balance against his more relaxing social activities. Consequently it was decided that all the background relaxing activities which the student performed during the stretch of time through which he was under the influence of the campus had to be included in the social activity group. Because this is the same stretch of time that is going to influence his decision to read or not to read on campus. As a result it was decided that the lunch period, in and out of campus, should be included as a relief period. This meant that it had to be added to the total social time which is supposed to represent the relief activities.

Using the daily activity graph shown in illustration (6.2) the lunch period outside campus was calculated, as shown in the graph. This was designed to include only the students who returned to campus, represented by the shaded area. When all the new times were added to the social time and again plotted, the results in illustration (6.3) showed an improvement in both the coefficient of determination (0.985) and confidence limit. However because of the possible misleading effect of the Reading London Road site, which is both extreme and low on confidence (table 4.2), it was decided that the number of cases used to study the subject should be increased.

In the new graph the students of each campus were divided into three groups. The first was the general average which included all of the students. The second included only those which actually had applied hours to go to. The third, naturally, included only those with no applied hours to attend at all. Surprisingly it was found that there was a very convincing case for considering each campus separately as seen in illustration (6.4). This was a new development which needed to be studied more closely. The graph in

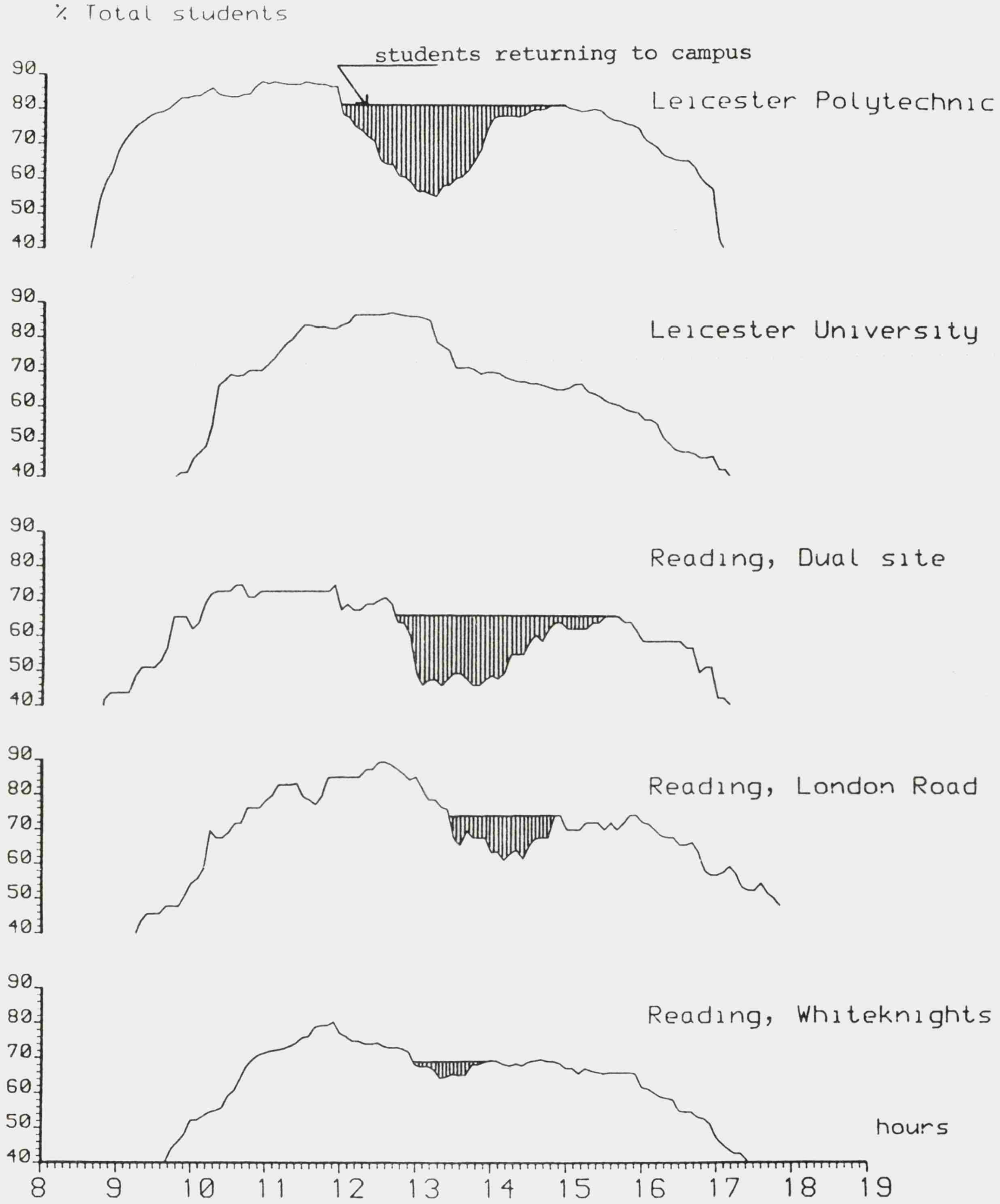

ILLUSTRATION 6.2

NUMBER OF STUDENTS ON CAMPUS DURING THE DAY
SHOWN AS A PERCENTAGE OF THE TOTAL

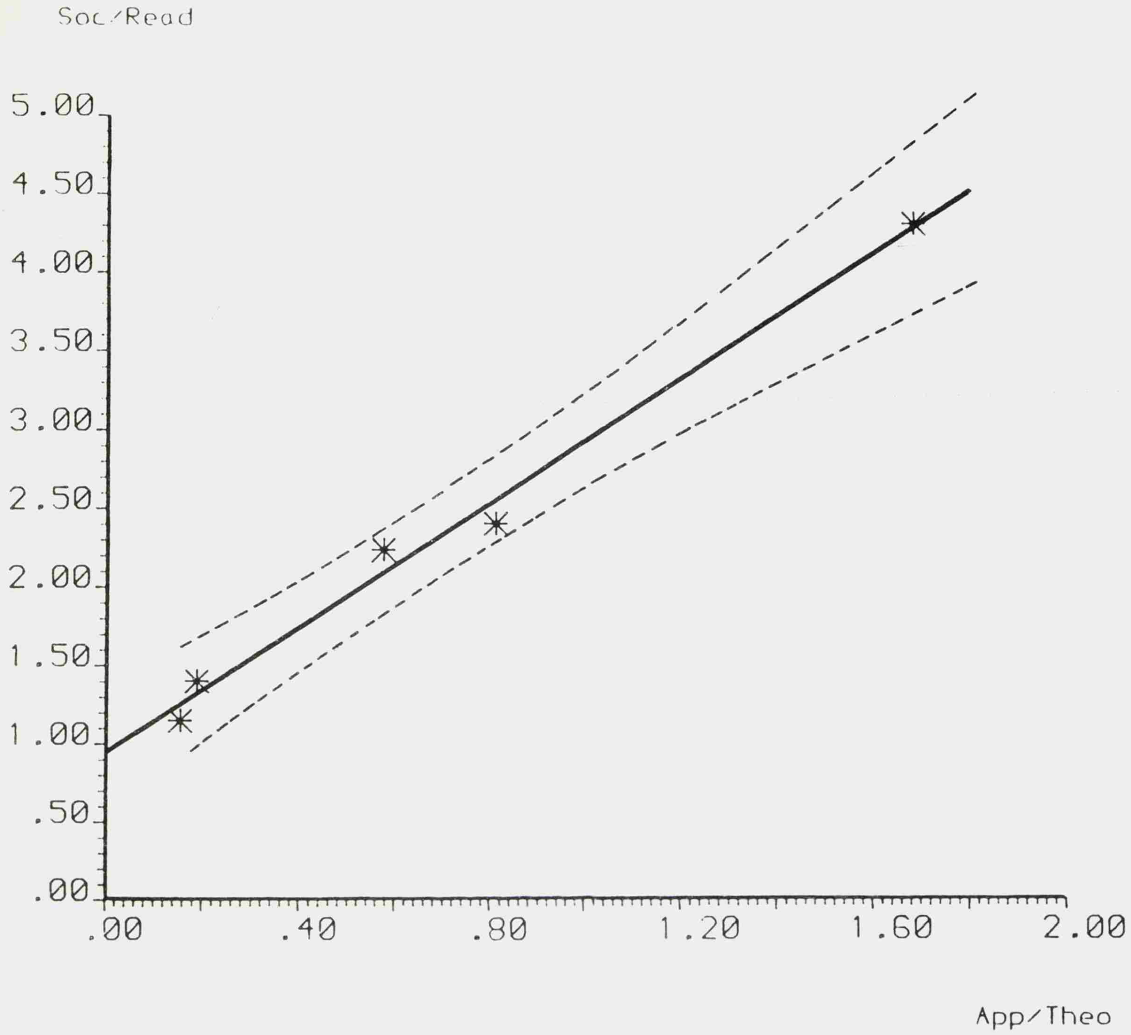

ILLUSTRATION 6.3

COMPARISON OF RATIOS AFTER MODIFYING THE CONTENTS OF THE "SOCIAL" ACTIVITY GROUP

* Coefficient of determination= 0.984

*"Social" now includes all relaxing activity times, including eating.

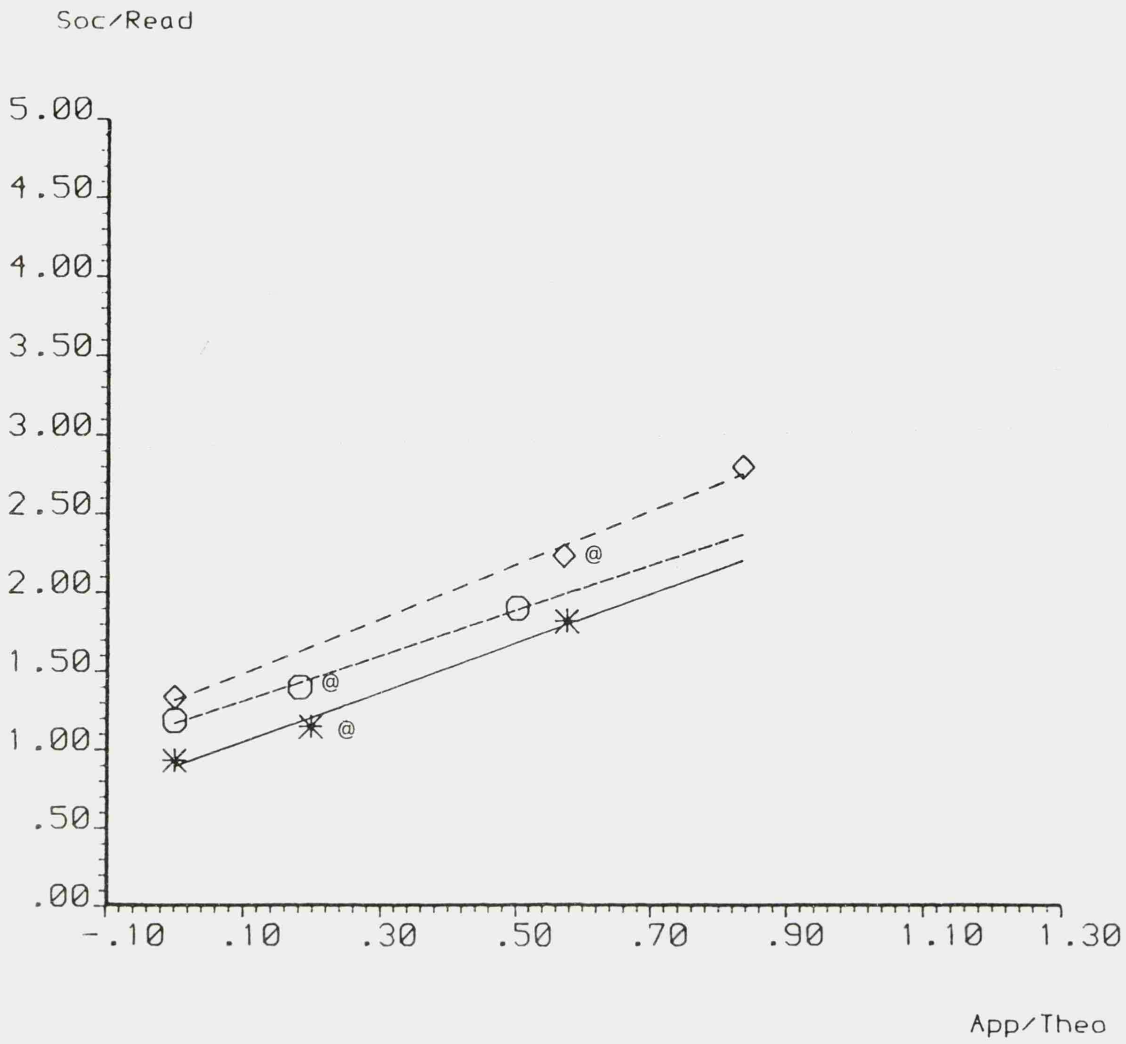

ILLUSTRATION 6.4

COMPARISON OF RATIO MOVEMENT FOR EACH SEPARATE CAMPUS.

______ READING WHITEKNIGHTS

------ LEICESTER UNIVERSITY

_ _ _ _ LEICESTER POLYTECHNIC

* "@" indicates average for each site.

* The extra samples for each site were introduced to increase the number of points in the graph. Separating each campus on its own produces misleading lines because the "middle point" in each case is actually the average value for each campus and includes students from both the other two points representing each campus (see text).

illustration (6.4) is not suitable for separately studying each campus. It would mean that only three points be involved in each line and, more important, they would result in misleading conclusions as the middle point in each case is actually the average for that campus and includes the data from both the other two points, forcing the line towards a straight shape.

To solve the above problems a new graph was plotted, but this time instead of grouping the students to form only three points to draw a line through, all the students were represented as individuals to increase the number of samples and the the statistical trustworthiness of the results. Using computer regression routines, a new line was calculated to indicate the relationship. The results were then recorded and drawn again so that the respective lines passed through the points which represented the total average response of each campus. The final product is shown in illustration (6.5). This procedure produced a line which showed the trend within each campus, and which, having been passed through the average point of each respective case, could be used to calculate the approximate averages for other campuses. As such it is merely a tool formulated through mathematical conversion and no confidence limits may be attached to it. The subject of confidence will be discussed in detail later in this section.

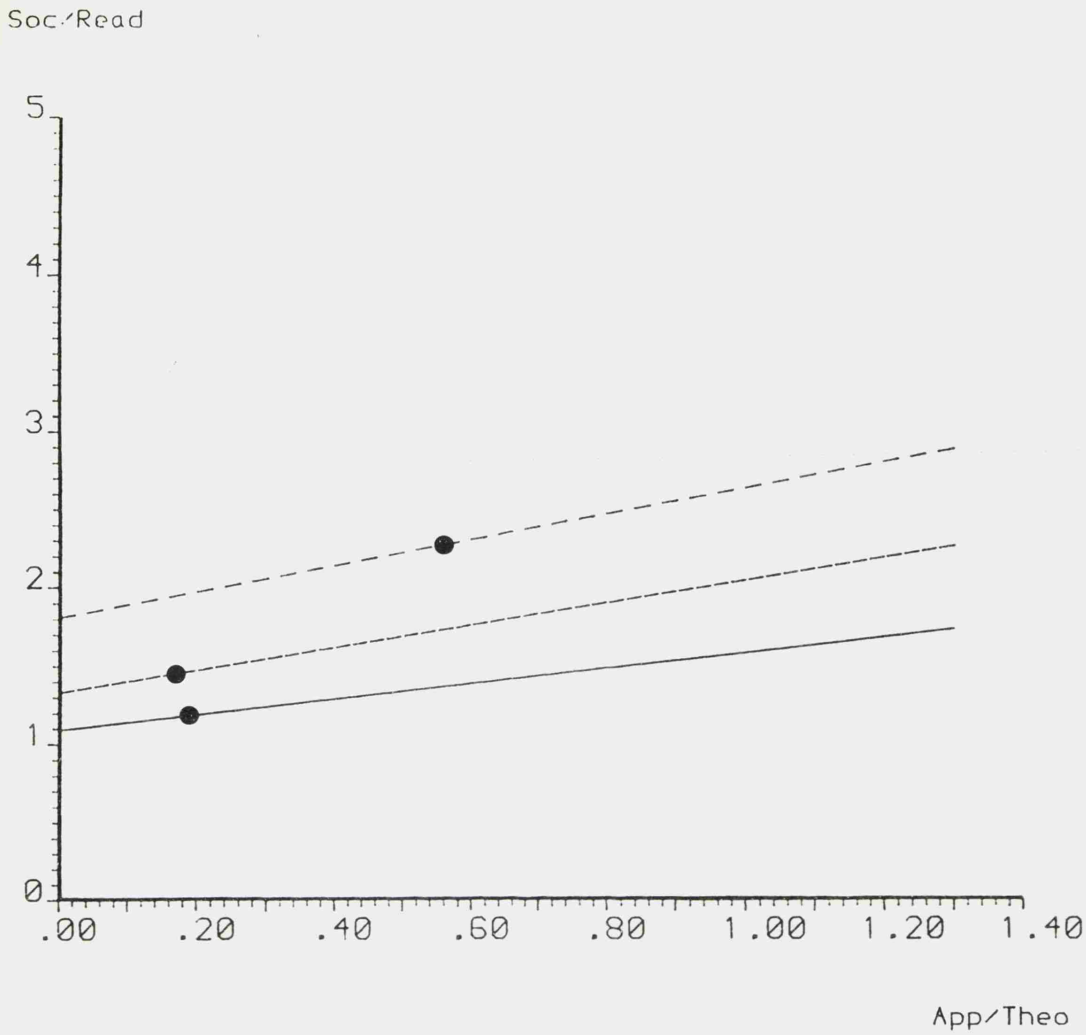

ILLUSTRATION 6.5

REGRESSIVE LINES CALCULATED BY SPECIFYING EACH INDIVIDUAL STUDENT

______ READING, WHITEKNIGHTS

------ LEICESTER UNIVERSITY

– – – – LEICESTER POLYTECHNIC

● Average value of ratio for each campus.

* The slopes of these lines were calculated using regression routines. Each one was then passed through the respective average value of each campus so that it could be used to calculate approximate averages for other campuses.

The reason for using this approximation instead of a more straightforward statistical relationship is that the individual student's reaction to changes in the app/theo ratio proved to be more dramatic than expected, and far removed from the group response expressed in illustrations (6.3 & 6.4). The individual response is shown in illustration (6.6). This graph was derived through employing curve fitting routines with special emphasis on the 0.0-1.0 range, because this is the most important range in ratio calculations. The extra accuracy in this range was obtained through employing a statistical conversion called "arcsine conversion" which increases the accuracy of the calculations within this particular range [refs 40 and 19]. This method "stretches" the distance between the points in the 0-1 range so that the differences are momentarily exagerated and can be noticed. The results are then returned to their original form by a reverse process after the regressive points in the low range are determined accurately.

To obtain the social/reading ratio for a certain campus using the graph in illustration (6.6), it would be necessary to find the applied/theory ratio for each student in the new campus, or at least divide the students into groups with relatively similar ratios, such as individual classes. Then the respective

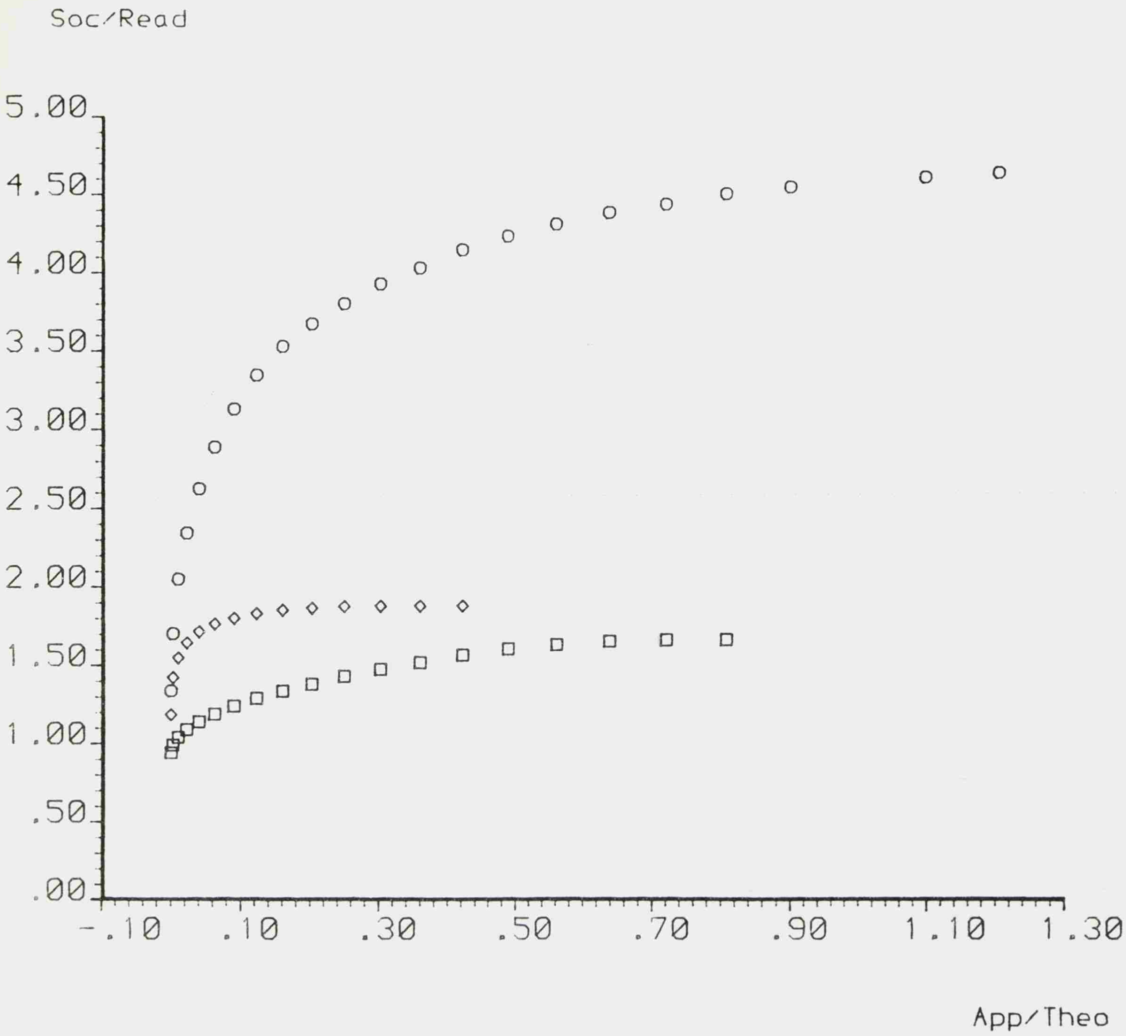

ILLUSTRATION 6.6

SMOOTHED MOVEMENT CALCULATED BY SPECIFYING
EACH INDIVIDUAL STUDENT

□□□ READING, WHITEKNIGHTS
◇◇◇ LEICESTER UNIVERSITY
○○○ LEICESTER POLYTECHNIC

social/reading ratio may be calculated for each case, and the results added together to obtain an average for the whole site. This would produce a more accurate result than illustration (6.5), but the procedure is time consuming to apply. This is because the applied/theory ratio would be very difficult to calculate for each individual student, or small group, during the planning stages of a campus, or even for an existing one, not to mention the remaining tedious calculations involving every case. The choice however does exist should the prospect be viable in any particular situation. But where it is not, or when a quick result is required, the more practical, but less reliable rule employing illustration (6.5) may be used.

The exact statistical significance of illustrations (6.5 & 6.6) is difficult to assess. Confidence limits could not be obtained to determine how much of the findings might have been coincidental. Consequently the possibility of relatively large deviations must be considered, although the graphs may in actual fact be accurate. However it may be stated that the differences between the campuses are likely to be repeated on other campuses, and that this is more the case when comparing universities and polytechnics, because of the larger difference between Leicester Polytechnic and the two universities. This compares with a smaller difference between the two universities themselves (see 6.1.4 2nd para.).

6.1.3 PROJECTION OF THE APPLIED/THEORY RESULTS ON THE PROFILE GRAPH

The three groups of students used in illustration (6.4), namely those with no applied courses, those with, and the total average, can be used to show the effect of changing the applied/theory ratio on the campus profile graph. The result, which appears in illustration (6.7), shows the expected trend. An increase in applied/theory hours shows a decrease in relative reading time, and an increase in relative social time. If the results of the graph in illustration (6.5) were applied to show a continuous movement, the results would be as shown in illustration (6.8). The clarity of the results is an obvious advantage when considering that this graph is envisaged to be used as a communications tool between planners and other people who are not familiar with the subject.

It should be noticed that social time in all of these graphs is calculated to include lunch time and lunch time outside the campus as explained in the previous heading, to allow compatibility with the results produced in illustrations (6.3-6.5). The social

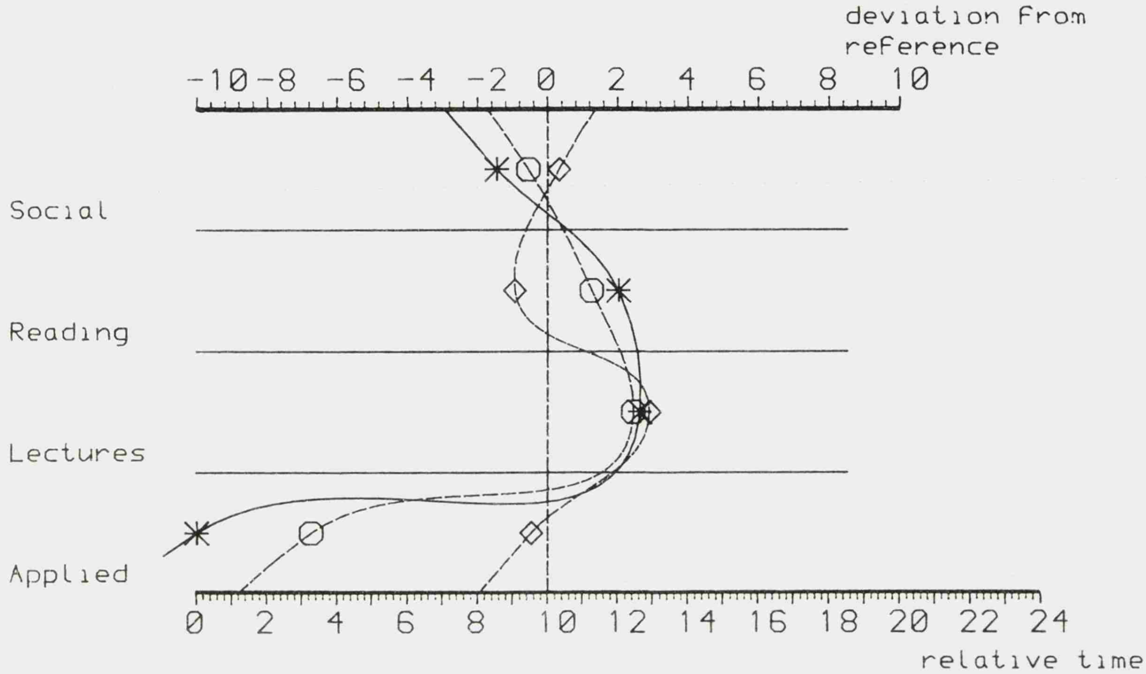

ILLUSTRATION 6.7

CHANGING ACTIVITY PATTERNS WITHIN A SINGLE CAMPUS. AN EXAMPLE FROM LEICESTER UNIVERSITY

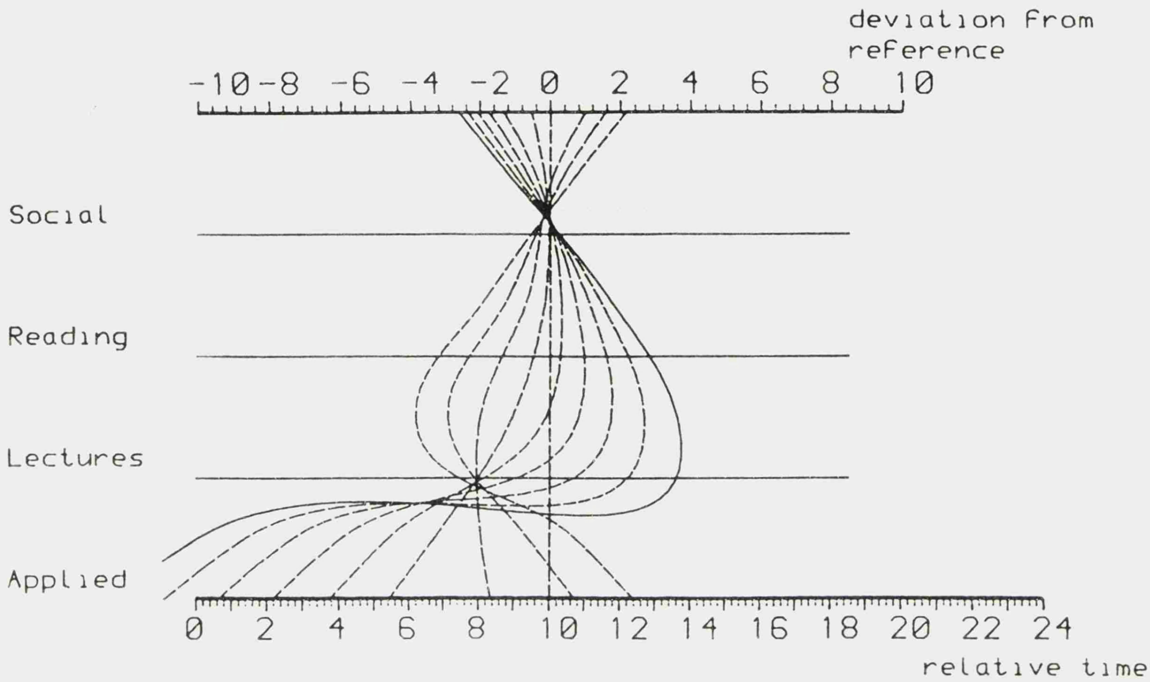

ILLUSTRATION 6.8

CHANGING ACTIVITY PATTERNS IN VARIOUS SITES
IN ACCORDANCE WITH THE FINDINGS OF ILL. 6.5

denominator used to calculate the projection of that activity group is 1.4767. The ordinary relative graphs for all the student categories, without conversion of the social activity group, is available in appendix (F).

6.1.4 ANALYSIS OF RESULTS

The graphs in illustrations (6.4 & 6.5) unveiled an element which had not been taken into account during the formation of the theoretical model, which is that a different response is likely between the students of separate campuses to similarities or variations in the applied/theory ratio. Examination of the difference shows that the students study or read more starting with the university of Reading's Whiteknights site, then the students of the University of Leicester, and the students in Leicester polytechnic read least of all. Several reasons can be responsible for this variation. Briefly, the most prominent of these are likely to be: a) Statistical errors. b) The varying quality of the students entering each establishment through the selective higher education entry system. c) Traditional values in each establishment. d) Different amounts of total free time available to the student. e) Varying demands on the students of each school or specialization.

The possibility of statistical error being responsible for the variation between the campuses is difficult to assess as was mentioned earlier. However although mathematical corroboration is not available, the following may be said in defence of the graphs' accuracy; Firstly a large number of students were involved in the formation of each curve, between 36 to 62 accumulating 175 to 260 student days; Secondly there is a consistency in the results whichever method of calculation is used; and thirdly, the variation between Leicester Polytechnic and the two universities is large and would be difficult to attribute to statistical error. However the scientific resolution to the issue is that the variation is "likely" to be true, and needs to be investigated.

The quality of the students entering each establishment is a strong candidate to shoulder some of the responsibility for the variation. Although students entry requirements into universities is information which is not easy to come by, it was possible to establish that these got more demanding starting from Leicester Polytechnic, Leicester University, and then the University of Reading [ref 1.b]. This sequence is the same as that affecting the relative reading time which is being analysed, which invites a simplistic conclusion; that students who were capable of acquiring higher grades prior to university entry would be prepared to work harder and read more than students who managed lower grades. As usual in human behaviour, exceptions to the rule are relatively frequent, but research has established that there often is a relation between the time a student spends on reading and his eventual grades [ref 19.b]. A further relation between entry grades into higher education and reading time after admission depends on how willing the student would be to continue the habit of hard reading which partially provided him with the higher grades. The possibility of such continuity would seem highly likely, thus supporting the idea regarding the influence of entry requirements on relative reading time in each campus, and the consequent variations between them.

Traditional values in individual establishments can also be considered one of the things which might cause the change in reading times being discussed. Extended over a long period, individual organizations develop standards of their own with respect to several aspects of their life including behaviour [ref 10.b]. It is conceivable that some of these would be related to the amount of private study the student is expected to do. One uncertainty which must be mentioned at this stage is that although a reason for variation between the students of different campuses may be established using this hypothesis, whether the effect will be to reduce or increase the expected reading time is not.

Historical traditions take a lot of time to develop, so it can be said that they would be more likely to occur in older establishments rather than newer ones. A look at a list of British Universities quickly establishes that there is a link between a university's age, its academic reputation, and consequently its "academic appeal"(1) to students. Establishments such as the Universities of Cambridge, Oxford, Edinburgh and University College London, spring to mind. It can be argued that the older the establishment, the more likely it would develop its academic reputation and appeal, the more likely it would attract a higher standard of students academically, and the more likely it would develop a behaviour standard which includes more reading rather than less. If this sequence of events is probable, the opposite cannot be discounted either; that over a period of time an establishment may acquire an ill reputation, resulting in lowered entry levels, and have students that read less. However, if the general sequence outlined above is accepted, then it would carry that whichever the case, the results would show on the entry requirements of the establishment concerned.

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(1) This must be distinguished from a university's "popularity" which may involve other factors, academic appeal being only one.

Consequently if traditional values are one of the factors involved in generating the difference in the social/reading ratio between campuses, then the most positive indicator available to the planner as to how it will affect the student can be found from its entry requirements.

The remaining two possible factors, amount of total free time and the demand of each individual academic specialization could not be found to have any effect beyond that already included in the applied/theory ratio. Both were compared with the data on student's activities and no correlation could be found.

To summarize, it may be said that barring statistical error it would seem that the most probable indicator of variation between campuses, with respect to relative reading time, is the entry requirements into the schools in each one. The validity of this conclusion could not be checked mathematically. The data involved in testing entry requirements was difficult to obtain, and lengthy calculations would have been necessary to separate the data related to each school because status is sometimes associated with a particular one more than another. Further research would have to be conducted to see if the hypothesis can be tested conclusively. As it stands, entry requirements must be considered as a factor whose influence appears likely as a result of deductive argument.

Considering the points revealed in the analysis, it is possible to apply the results of the study for planning purposes on a new campus in a way which takes into account the uncertainties of the situation. Leicester University is relatively new, or rather it was so when the survey was conducted in 1971. Its charter was given in 1957. This leaves a period of fourteen years in between, which is not long compared to older British universities. It is also a suitable period to use for the time required by a new university to become relatively stable and accepted. In other words, the graph which represents Leicester University may be used as an assumed target for a new university during planning. Since it is difficult to determine what kind of appeal a new campus will have, or how it will develop over a period of time, this seems to be a reasonable proposition, especially since Leicester University is not notable for any Strong deviations from the British university norms, which would have made it unsuitable for such a purpose. As for polytechnics, the most reliable guide available at present is the graph on Leicester Polytechnic. The situation for established campuses can be solved through internal surveys, or an approximation may be made on the basis of the analysis, which would not be as accurate.

6.1.5 OTHER ORGANIZATIONAL FACTORS

Although the applied/theory ratio proved to have a recognisable influence on the students activities, this factor must not be allowed to overshadow the other organizational factors despite the fact that little effect could be noticed from most of them on the students in the survey. This must not be taken as proof that they have no effect at all. It merely indicates that within certain limits, those set by the campuses under survey, their effect is limited. It must be envisaged that beyond these limits any of the factors may exert more influence.

The total scheduled time that students attend on campus did prove to have influence on the total free time which the students spend there, and in accordance with the theoretical outline. As it shares this influence with a number of other organizational and physical factors it cannot be discussed on its own but only in conjunction with the other factors. This will be done later in detail (section 6.3).

The level of service facilities on all the sites surveyed was of an almost similar standard. These included the usual refectory services and the provision of some retail outlets plus banking and post office facilities. This meant that it was not worthwhile searching for any effects that service facilities may have because the necessary element of variation was not available. The "effect" that concerns this research being, if variations did exist, would it influence the students activities in campus in terms of staying for longer or shorter periods in it, or a change in activity patterns. Certainly some campuses, especially in other countries, may have a severe shortage which would most probably have an effect.

Had there been a variation in the level of service facilities between the campuses surveyed, then it would have been necessary to find a method of evaluating them. This would have meant associating the effect of each service, or type of service, with units which enable investigating their effect in a mathematically accurate way. This implies that a service worth "2" units should have twice as much value as a service worth only "1" unit. This is important so that if it becomes necessary to enter the information into a mathematical relationship, such as a graph with the services "value" as one axis, the relationship would be valid. The importance of this subject can be realized if the opposite was assumed and in a certain graph campus "A", whose service facilities were valued at 2 units, actually had the same level of services as campus "B" whose services were valued at 1.

The job of calculating units for service facilities was tried before it was realized that it would not be necessary, and found to be very difficult. It is, however, obvious that services may possibly have some effect. City planners have long known that travellers will not usually pass by one shopping facility to go to another identical one [ref 47.b]. Drawing a possible parallel with campus planning, the availability of a shop to supply groceries would mean that few students would leave the campus to shop outside. If the shop was not there, the students would search for one outside. A lack of eating facilities may force students to search beyond the limits of the campus for the necessary service they require during the lunch hour. Once outside the bounds of the site they may choose to return or not, which would affect the number of students there. A lack of sporting and liesure activities would reduce the attraction of the campus and may provide less incentive for the student to stay. The quantitative value of the effect of these arguments, not to mention the validity, cannot be studied without the necessary data, but the subject must be raised as a candidate for further research.

Resident students, part time students, and postgraduates will be discussed later in a separate chapter.

6.2 THE PHYSICAL FACTORS

From an architectural point of view, these were the factors that were bound to arouse most interest since most of the anticipated effects of these factors according to the theoretical outline are expected to be on the total free time which the students spend on campus. The related factors must be studied with the other organizational ones whose effects are expected to be in the same area. However some of the physical factors may be discussed on their own.

6.2.1 LOCATION

A) TRAVEL TIME

The effect of the campus location on the students' total stay in campus during their free time could be partially studied by a direct plot between the two factors, travel time and total free time (ill 6.9 & 6.10), to see if any correlation could be detected. Students of the main campus site of the University of Leicester were studied and also those of the Leicester polytechnic. As the results of the graphs in illustrations (6.9) and (6.10) show, there appears to be no relation between the two factors. The gradient in both graphs is enough to be practically ignored. This means that the campuses involved in the graphs are only marginally affected by the distance between them and the centres of population of their respective locations.

The reason for the apparent lack of influence by travel time may be that there is no correlation between it and the students' free time on campus, but the more likely one is that it is not effective on the sites studied because of the limited range of time, or variables, involved. When analysing the results on travel time, it must be noticed that it was all between 7-60 minutes, and most was between 10-30. It must be conceivable that outside these limits the influence of travel time may be more obvious. This would almost certainly be the case for very short travel times of less than 5 minutes. It would create a situation similar to that of resident students whose residence is on campus. These students, as will be seen in chapter seven, spend little time in the non resident part of the campus

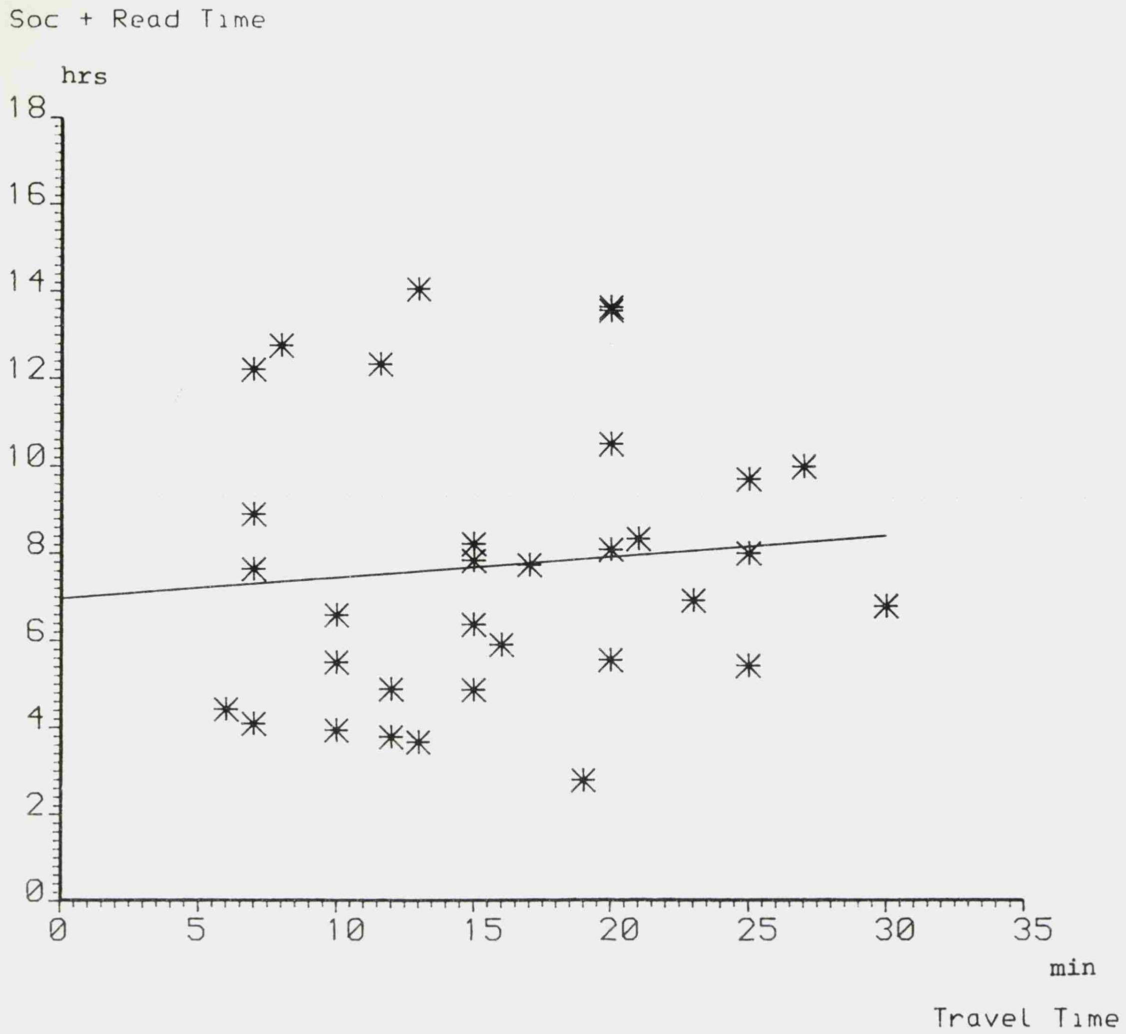

ILLUSTRATION 6.9

TIME STAYED IN CAMPUS VOLUNTARILY, COMPARED TO TRAVEL TIME, IN LEICESTER UNIVERSITY

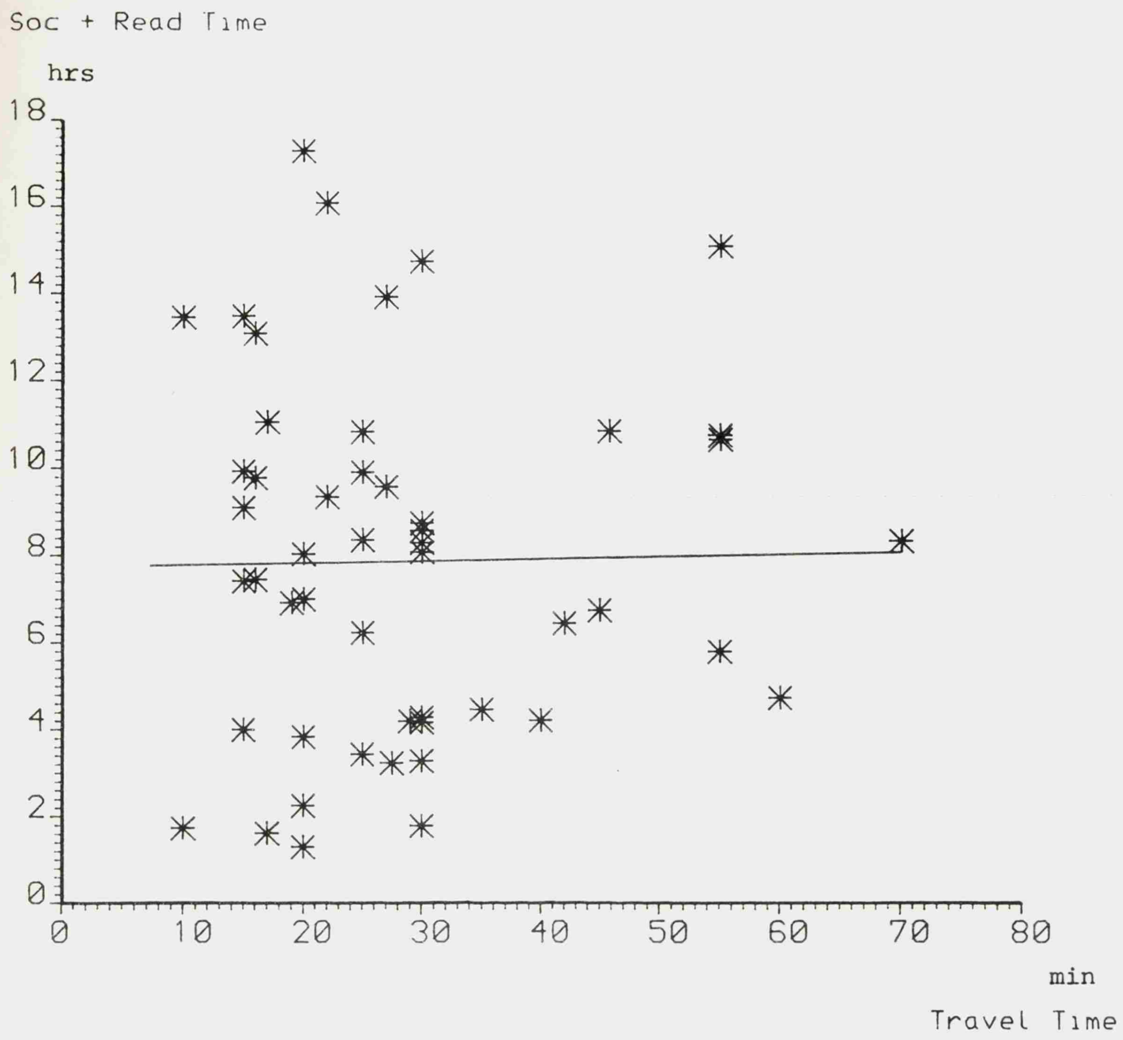

ILLUSTRATION 6.10

TIME STAYED IN CAMPUS VOLUNTARILY, COMPARED TO TRAVEL TIME, IN LEICESTER POLYTECHNIC preferring to leave for residence as soon as it is convenient. If the non resident student also had the ability to reach his home in less than five minutes, his response to leaving for home early may be the same. If the travel time for resident students was also included in the graph in illustration (6.10), the results would be as shown in illustration (6.10b). This graph illustrates the probable theoretical consequences of travel time from less than five minutes to around one hour, although it is unlikely that in practice a campus would be located in an area less than five minutes from a non-resident student's residence.

What the effect may be, if any, of long travel times exceeding one hour are difficult to predict without any data. Students, when on campus, would probably stay longer, but travel less frequently to the site(1) , ie; spend less days there. The ultimate result may increase or decrease the total time per week.

Another subject which could not be studied from the surveyed data was the likely effect the quality of travel may have. Within the limits of the sites involved in this research, there appears to be little difference from this point of view, especially since two of the sites are

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(1) Kenny, G. by word of mouth, on 18th of Jan. 1985.

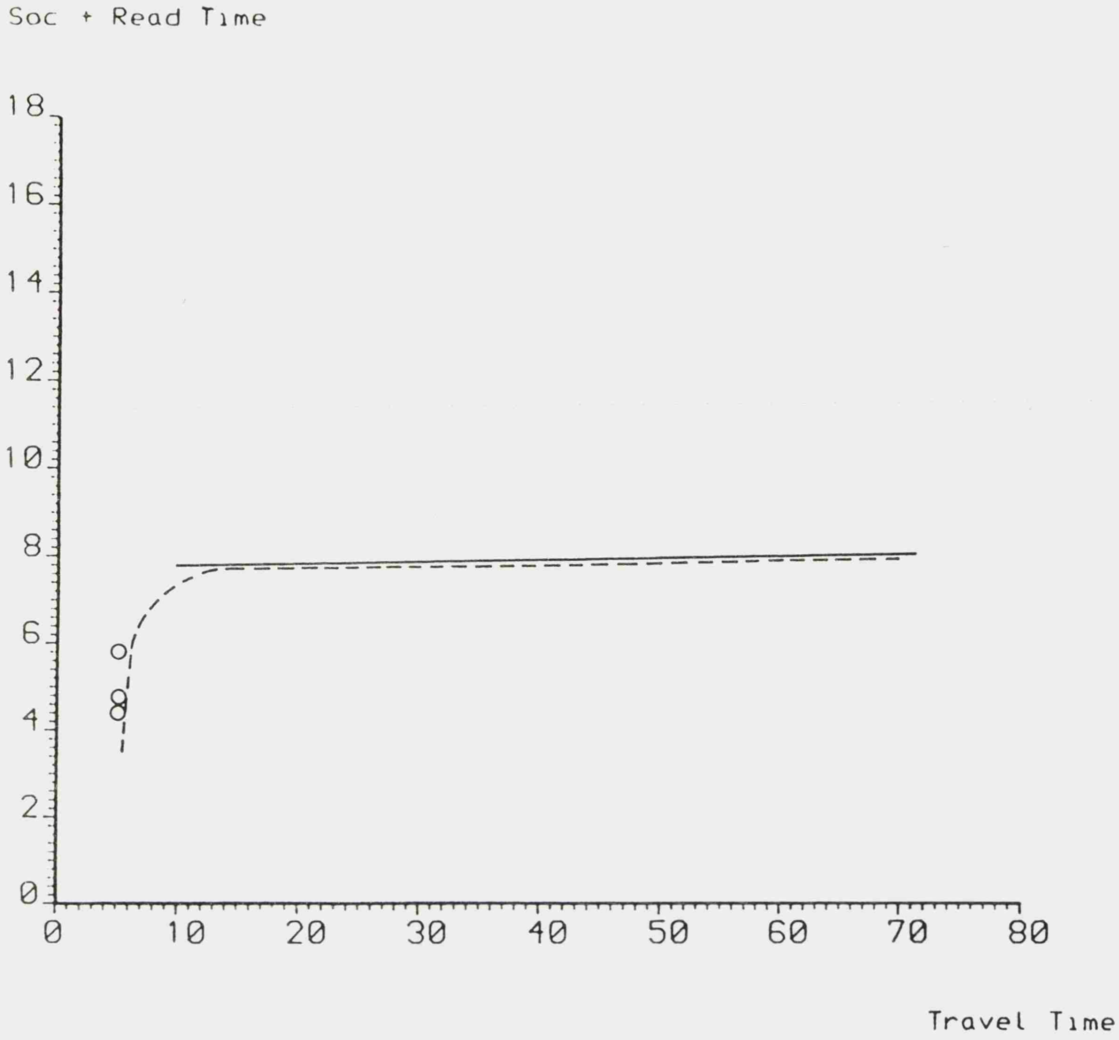

ILLUSTRATION 6.10b

THEORETICAL ASSESSMENT OF EFFECT OF TRAVEL TIME ON THE STUDENTS' FREE TIME

o Resident student groups, from Reading University

---- Theoretical assessment

_____ Actual relation from 10 minutes onwards for non-resident students. Data for Leicester Polytechnic students in the same city. But in other situations, in other countries for instance, with a less efficient traffic control system involved, or public transport, either may have an influence, not only due to the effect of the time factor but also comfort. The possibility of running into severe and aggravating traffic jams, or catching a bus which at other times may be full, would have to be considered. Each of these two factors could convince the student to leave at a certain time which could mean his staying a longer, or shorter, period in the campus. The ability to hitch-hike, or cycle to the campus may carry similar influence, especially if finance is a restriction.

Further research on the subject of travel time must be suggested, especially for longer distances which may occur more frequently in the larger cities. When this is done it may be necessary to include the new elements in the study such as the quality of public transport and private car ownership [refs 5, 5.b]. It would be pointless to discuss these presently when no effect from travel time can be established.

B) LOCATION OF CAMPUS

The effect of location with respect to the city urban centres was obvious on the students. A large number of them chose to leave the campus during lunch breaks and some during coffee breaks too as shown by the graph in illustration (6.11). The shaded area represents the difference between the number of students that left the campus and the number returning. This represented around 25% of the students in Leicester Polytechnic. Around 18% did the same in the London Road site in Reading University and the strong fluctuation of the number of students on campus between scheduled hours indicates a tendency for the students to leave the campus frequently during their stay on it. The students using both the sites in Reading University show a drop of 19% of the students leaving and then returning during the lunch hour. The increase in the number of students leaving the site during the lunch break was roughly in line with the sites location relative to the urban centre. The closer the distance to the centre, the more students left. As for the sites which were more distant from urban centres, none of the students in Leicester University returned after leaving during the lunch hour, as did only 5.5% in the Whiteknights site in Reading University.

Clearly there is a relationship between the time it takes a student to reach a facility in the city, and his actually going to those areas. Bullock et. al. [ref 5.b] attempted to create a model to predict students movement within the campus, and in relation to the city facilities. The model was based on the probability of

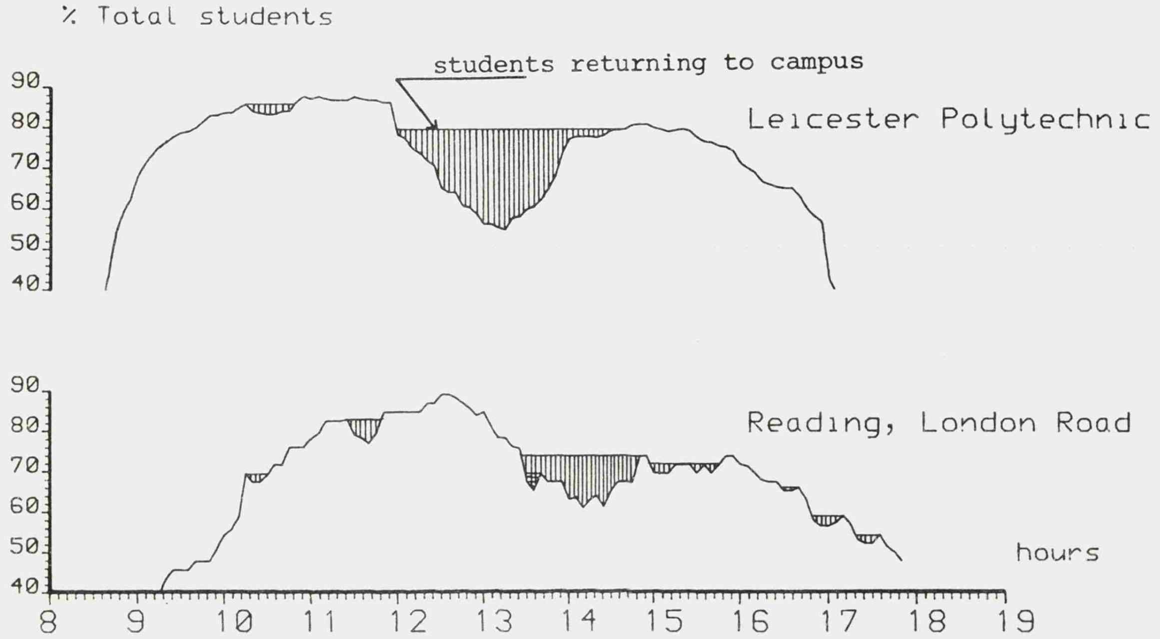

ILLUSTRATION 6.11

EFFECT OF PROXIMITY TO URBAN CENTRE ON THE STUDENTS IN A CAMPUS students' choice of activity and location. When applied on a sample of student population, the results confirmed the relationship between the campus and the city facilities noticed from illustration (6.11). It may be possible to use such a model to predict the extent of the relationship between a campus and its surroundings, providing the necessary data is available.

C) LOCATION OF SPACE

It was not possible to investigate the relationship between the location of a space within the campus, and the students' activities due to the loss of the information on the spatial coding system employed in the campus surveys. It is doubtful that the subject has a great effect on the total activity times of the students as a group. Bullock et al. [ref 5.b] took a similar view in their work on simulating student activity patterns and made the assumption that "the broad division of time between different activities will remain constant independent of location". Having found the activity times and the amount of area needed to house them, it would be helpful to see if the location of a space affected the number of students using it in the actual design of a campus. It would be of little value to know exactly how much space is needed for reading in a campus if the area allotted to this activity was not utilized by the students because of its location. Bullock suggested a method to investigate this subject. The model developed for this purpose had choice of location to perform an activity as a primary factor and could be used to study individual campuses. Its application on a few test cases revealed some interesting points.

The most notable of these was the heavy access to the campus library by the students, while the survey results showed very low usage of that space. Kenny confirmed this particular phenomenon in a survey on a polytechnic [ref 27].

> "..nearly 2000 visits were made to the library on a day believed to be typical. This surprised the librarians, particularly when coupled with the information that an en suite 'reading room' (with no book stacks in it) was barely used. The library was being used almost entirely for short reference seeking visits."

These facts mean that a subtle distinction must be made between what, in this research, is termed "utilization" of a space, and "access" to it. The latter means a quick visit, while utilization, the way it is calculated in this research through the use of diaries, requires the student to spend some time in a space so that he can then find it worthwhile to record in the diary. A quick visit in and out of a space will usually not be.

A rise in either the utilization level or need to access a space requires a more central or easy accessible location. The spaces that demand most attention with respect to access, besides the library, are shops, banks, post offices, and probably social meeting areas.

The second point noticed from Bullock's model concerns the heavy movement of students in the campus. This fact is not directly comprehensible from the survey results, but when displayed in terms of change of location, as the model can, it becomes quite obvious. This inevitably emphasizes the importance of the campus design, whether linear, centralized, decentralized, compact, spread, etc.. The subject of the relation between campus design and space has been the subject of several studies [refs 1.c, 3, 18, 24, 30]. Each type of campus design can influence the students' movement and make particular requirements on the location of a space.

To conclude, the location of a space must take into account the need to access for short visits, and the movement patterns of students throughout the day. However it is not obvious that the spaces' locations inside a campus, or the campus design, have any effect on the total time spent on each activity or activity group by the students.

It is conceivable that not only location is responsible for the relative increased use of a space, but also its "popularity", to which location may be a contributing factor but possibly not the only one.

No clear effect on the students activities could be detected from any variations in the aesthetic appeal. This may be because non of the campuses had any drastic deficiency in this area. This means that an effect may be noticed when the aesthetic appeal is changed beyond the limits set by the surveyed campuses.

6.3 THE TOTAL FREE TIME WHICH THE STUDENTS STAY ON CAMPUS

This is one of the most important subjects of this research. The percentage of the total number of students actually arriving and staying on campus has considerable influence on the architectural decisions to be made concerning the campus. A larger number would demand more space, and if it stayed for a longer period, it would put a heavier strain on the campus resources.

Based on the theoretical outline and the disclosures of the surveys, indicators for students staying longer on campus may be found from studying two factors. They are the number of scheduled hours that the students have to attend, and the total number of students on campus at any one time. Both of these factors have been discussed in the theoretical outline (5.1.1 & 5.1.2). An increase in the total number of students on campus at any one time should lead to an increase in the attraction of the campus. On the other hand an increase in the number of scheduled hours was thought to have a negative effect on it by decreasing the free time available to the students (section 5.1.1).

The students' free time consists of social, reading, and complementary activities time. Judging from the survey results the complementary activities time is fairly constant regardless of varying campuses. It appears that there is a level of need for these activities, circulation, administration duties, etc., which fluctuates only slightly in the campuses involved. Consequently it may be said that the actual free time which the student has at hand and which he is completely free to dispose of is restricted to the remaining activity groups, social and reading. Since eventually these are the times for which calculation is required, it was thought that the free time in the following analysis be restricted to these two activities to ensure the most reliable, and at the same time, convenient outcome. Thus the social plus reading group activity time will be referred to as the "actual free time".

The influence of changing the number of scheduled hours non-resident students attend can be noticed from studying its effect separately. Illustration (6.12) shows that it is in line with the theoretical assessment. More scheduled hours decreases the free time available to the student. The confidence limits are reasonably acceptable considering the relatively largish deviation from the mean by the samples which is reflected by a coefficient of determination of 0.54. This indicates that while the negative relationship between scheduled hours and actual free time is significantly true, as indicated by the confidence limits, the possibility of deviation from the mean leaves room for improvement. The maximum recorded deviation amounts to around 25%(1) for the samples in the graph, and is due to the influence of other factors. The interaction with resident students could be one of these. The next step must consequently be the formulation of a relationship which includes the elements that are suspected to be involved, and test it to see if the results are an improvement on the graph in

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(1) The graph in illustration (6.12) does not start from zero in the Y axis. This gives the misleading impression that the deviation may be higher when it is actually not.

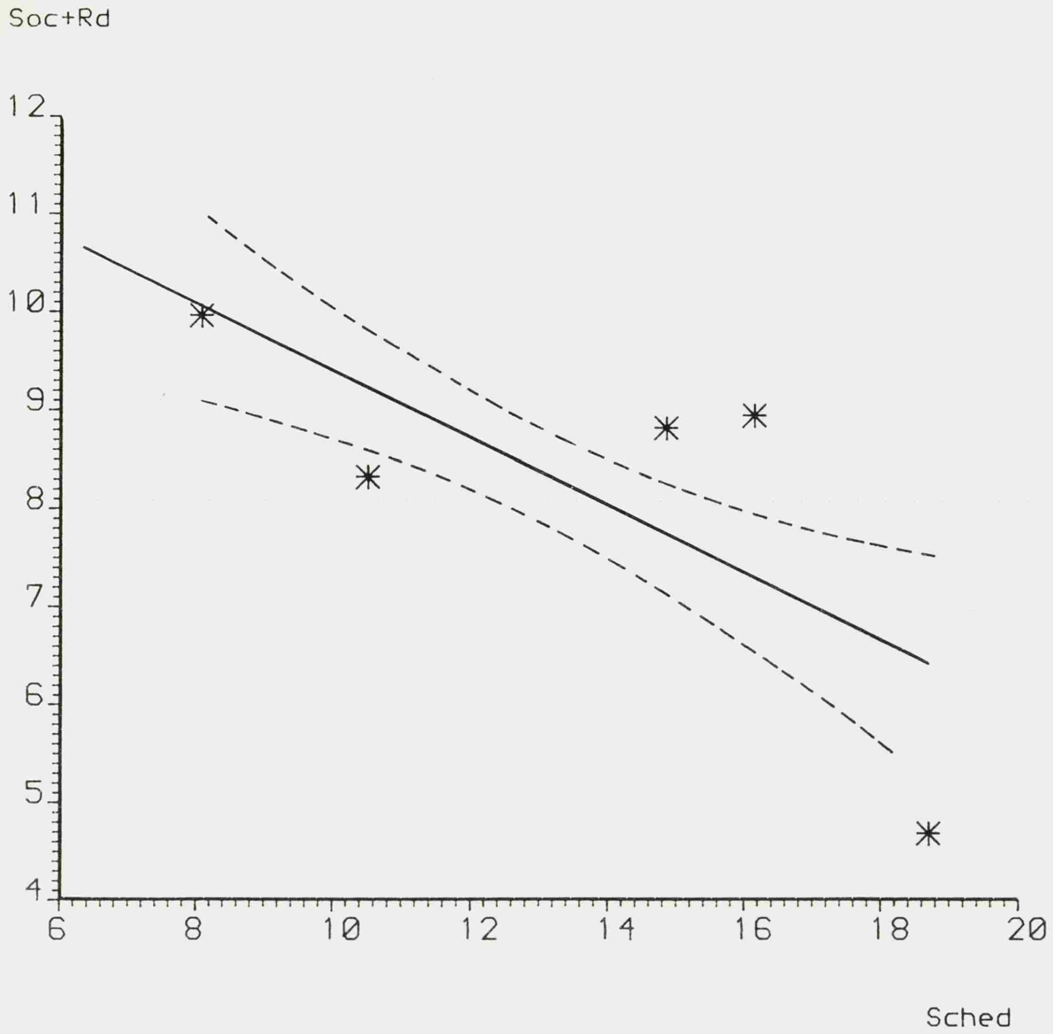

ILLUSTRATION 6.12

RELATION BETWEEN SCHEDULED AND ACTUAL FREE TIME FOR NON-RESIDENT STUDENTS

* Coefficient of determination = 0.54

illustration (6.12). The remainder of this section will be devoted to this operation.

To sum up the situation so far briefly, it is necessary to remember that scheduled hours affect the students free stay on campus negatively, and the number of students affects it positively. ie;

Soc+Read (Actual Free Time) = Number of non-res/Scheduled

This relationship, as yet untested, meets the demands of the theoretical outline. At this stage it is necessary to introduce a constant to the right side of the equation to convert the result into hours.

Soc + Rd = Nres/Sched x c

This is necessary as the right hand side of the equation is presently in "students/hours" units, while the left hand side is only in hours. The value of the constant could be found by applying the equation on one of the campuses, and the result may be checked on the others for accuracy.

This equation might have been sufficient if non-resident students were alone on campus, but they are not, they interact constantly with resident students.

Consequently it is necessary to add this group of students to the equation. The final form would be:

$$\text{Social} + \text{Rd} = (\text{Nres} \times c1)/\text{sch}1 + (\text{Resident} \times c2)/\text{sch}2$$

Social + Rd = Total actual free time which the students have on campus (Total for all students, not "per" student).

Nres = Number of non-resident students.

Resident = Number of resident students.

c1, c2 = Constants for resident and non-resident students respectively.

sch1, sch2 = Scheduled hours for each group of students.

In this case the value of each constant would numerically represent the value needed to convert the variables for each student group to the appropriate unit, hours, in line with the relative effect of that group on the total result. In other words if c1 was larger than c2, non-resident students would prove to have a larger influence than non-residents. This in fact is the expected case as will be seen later in chapter seven, resident students spend far less free time than non-residents in the non-resident area of the campus, ie; c2 should have a smaller value than c1.

In order to find the value of the constants it was necessary to fill in the variables with data taken from the surveys on two campuses, in this case the University of Leicester and the Whiteknights site in the University of Reading will be used. This resulted in the following:

For Reading Whiteknights,

$$32352 = (1345 \times c1)/8.667 + (3509 \times c2)/9.345$$

$$32352 = 155.186 \times c1 + 375.5 \times c2$$

$$c1 = (32352 - 375.5 \times c2) / 155.186$$

$$c1 = 210.89 - 2.4197 \times c2$$

And for Leicester University,

$$26411 = (1676 \times c1)/10.502 + (1724 \times c2)/9.763$$

$$c1 = 165.494 - 1.1065 \times c2$$

By comparing the constant (c1) with its equivalent from Whiteknights:

$$210.89 - 2.4197 \times c2 = 165.494 - 1.1065 \times c2$$

$$210.89 - 165.494 = (2.4197 - 1.1065) \times c2$$

$$c2 = 45.396/1.3132 = 34.569$$

$$c1 = 127.2434$$

Consequently the final equation should look as follows:

$$Soc+Rd = (Nres \times 127.24)/sch + (res \times 34.57)/sch \qquad ..eq(1)$$

The only way to find if the previous equation is viable is to check it against the other two campuses available for this purpose in Leicester Polytechnic and the University of Reading's London Road site. In the case of London Road this was a straightforward process:

$$318 \times 127.24/17.25 + 828.0 \times 34.569/10.68 = 5024.7 \text{ hrs}$$

This result is only 4.9% off the actual number for London Road which is 4,779 hours. Checking the result for Leicester Polytechnic was not such an easy issue. First of all it has an insignificant number of students in residence, around 8%. Secondly, it has a large number of part time students on its register. The number of part time students had to be converted to a "Full Time Equivalent". This was done by comparing the number of scheduled hours that both attended and converting the number of part-time students to one which would allow them to match the full time students with respect to the scheduled hours:

prtm sch / fltm sch x No of prtm student = FTE

Where "prtm sch" is the number of scheduled hours that part-time students attend, "fltm sch" is the same for full-time ones, and "FTE" is the "Full Time Equivalent". Applying this equation to Leicester Polytechnic produced the following result:

0.3878 x 1592 = 617.37

Where 1,592 is the number of day time part-time students. The total number of equivalent full time students in the polytechnic is:

617.37 + 2438 = 3,055.38 students

Where 2,438 is the number of full time students. The number of scheduled hours that this number of equivalent students were supposed to attend was not difficult to calculate by dividing the actual total hours with the equivalent number of students in each survey, which was 29 for the part time students. The result showed that they attended around 16.2 hours per week per student. If all this was applied in the equation, the result would be:

3055.38 x 127.2434 / 16.2 = 24,090 hours

This number is very close to the actual number which is 24,036. However it must be mentioned that this procedure does not necessarily compare with those applied to the other campuses. The original equation was derived to include the effect of residential students, and none are included in this case. Furthermore, it would be necessary to check on other examples to make sure that the equation, as it currently stands, can be applied, as was done in this case, on part-time students.

Regrettably it was not possible to find the statistical confidence limits for the equation due to mathematical limitations. Consequently the numerical significance of the tests on equation (1) must be discussed. Although the maximum deviation detected from its application did not exceed 4.9%, there are other factors involved. First there are the statistical deviations for each activity time listed in the tables in chapter four. These were not included because they were so small for most of the activities that it was thought the result of including them would be misleading as the actual faults in the relationship itself can be expected to be higher and quoting such small deviations(1) would give a false sense of accuracy which is actually not there. Hence the tests on the equation were conducted to give an impression of how much deviation may be expected.

To illustrate the problem consider the following equation:

3 (+0.2) + 2 = 5 (+0.2)

This is a relationship were the left hand side is exactly equal to the right hand side, and any deviations are immediately reflected. Equation (1) is not such a relationship. The elements of the left hand side merely produce an approximate result. The other factors involved in the forming of the students free time would add to the deviation to produce a total larger than that of the statistical ones. For this reason a margin for error must be considered when using equation (1) which will have to be larger than the maximum error of 4.9%. This is because it is probable that larger ones may occur. The exact magnitude of this margin cannot be calculated on present data, as was suggested earlier. As such it is best to consider equation (1) as providing a

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(1) It is possible to find approximate error limits through a process called the "Propogation of error" [ref 8.a]. When calculated it was found to be around 01.33%.

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(1) It is possible to find approximate error limits through a process called the "Propogation of error" [ref 8.a]. When calculated it was found to be around 01.33%.

partial explanation of a relationship affecting students behaviour, rather than a rigid mathematical equation which determines what it may precisely be. Its use in calculations must take into consideration the possible effects of any other factor which in a situation different from those available in the surveyed campuses, may have a different effect.

The second factor concerns the relation between human behaviour and the surrounding circumstances. As was mentioned earlier in this chapter, a multitude of factors are involved in this subject and in order to simplify the calculations the objective of this part of the research is to find "indicators" that can provide approximate answers. Hence the few factors involved in equation (1) cannot wholly account for the students' free time.

It was not possible to apply equation (1) on the students that use both the Whiteknights and London Road sites in the University of Reading (Dual site), as their situation was more complex than the usual case. This is because they come in contact with the students of both sites, and not only with their own group. Consequently according to the theoretical model, the number of actual free time hours calculated should be far less than the surveyed figures. This was in fact the true case as the calculated figure was 3,758, while the actual one was around 6,066 hours. However the fact that the result is so strongly in line with the theoretical expectation does add strength to it.

Besides from the numerical value of equation (1), the value that it shows is attached to the number of resident and non-resident students, in the form of the constants, is also interesting. C1 (non-resident students) is almost four times larger than c2 (resident). Accordingly, each non-resident student has almost four times more effect on the actual free time (Social + Reading) of the rest of the students than his resident colleague. This is the expected result as was suggested earlier. Resident students spend far less time in the campus proper, the non resident area, than do non residents, as may be seen in the table from chapter four. This subject will be discussed in detail in chapter seven. It indicates that relatively larger numbers of non-resident students require more space to accommodate in the non-residential part of the campus than resident students.

The number of scheduled hours that the students attend had the expected effect on their free time. The more scheduled there was, the more the student's free time was squeezed. This is probably because most students set certain limits for themselves for their stay on campus. As the daily activity graphs in illustrations (6.2 and 6.11) show, the number of students on campus starts to drop shortly after lunch, so this is possibly the time that most students prefer to return home. The less scheduled they have to attend before this period, the more time they will have left free.

The influence of size can be highlighted from the case of Dual site Reading University students, as stated in the analysis. The deviation between the calculated result, which should have been close to the truth had the students been alone, and the actual one which includes the influence of both the Whiteknights students and the London Road ones, is high indeed and in agreement with the theory (see text). This leads to an important conclusion which is that in equal circumstances, the larger campus will be the more attractive to the students socially. This is contradictory to the findings of early higher education authorities which suggested a limit on the size of a university because they thought that larger ones reduced social interaction [ref 5].

To conclude this analysis, it may be said that the results of the tests conducted on the equation relating resident and non-resident students (eq. 1) to calculate the actual free time non-resident students spend on campus do show an improvement on the graph in illustration (6.12), but the limited number of tests that were possible do not allow for a conclusive scientific assessment to be made as to its actual potential. However it is possible that such an improvement actually exists. Its use is recommended in favour of the graph in illustration (6.12) for calculations including universities that have generally similar characteristics to those in Reading Whiteknights, Reading London Road, or Leicester University, because it takes the effect of interaction with resident students into consideration. In other cases, or if in doubt, the graph in illustration (6.12) may be used keeping in mind the possible deviations.

It must be concluded that this part of the planning procedure, calculating the non-resident students' free time, will not produce very reliable results. However considering that the difference between the campuses surveyed extended to around 100% between Whiteknights and London Road, and that it is not accounted for in present planning methods, the maximum recorded deviation of 24% appears relatively small, although it must be remembered that larger deviations are likely. Consequently, due to the importance of the subject further research must be recommended.

6.4 THE SEQUENCE OF ACTIVITIES

The sequence of activities for an individual student can be expected to have some effect on the time he spends performing certain activities. This would probably also be influenced by the location of the spaces or facilities in which the activities he chooses to perform are located in [ref 5.b]. The eventual result would be a time budget which displays large fluctuations from day to day. Group behaviour however tends to even out sharp changes and a general trend can usually be noticed especially in larger samples. Studying the activity surveys with this point in mind, with the aid of the activity graphs in appendix (C), it was possible to identify a certain sequence which dictated how the students, as a group behaved. This was observed to be the following:

1. Scheduled classes start between 9:00-9:30 am.

2. The morning shift lies between 9:00-9:30 to 12:00-12:30, and consists mainly of a concentration of lecture classes, as opposed to applied work.

3. The lunch break lies between 12:00-1:30 pm.

4. The afternoon session lies between 1:30 to 4:00-5:30 pm, and consists of a larger concentration of scheduled applied time than the morning shift.

5. The working day ends at between 4:00-5:30 pm with a rapid decline in scheduled classes.

This general sequence of events was obvious in all the campuses and is assumed to be constant. Should any part of it change, then the basis of the computational model described in this chapter would not be directly applicable. Other solutions would have to be developed such as conducting a pilot survey on the new situation and comparing the results with the relationships in the model to adjust the figures.

CHAPTER SEVEN

RESIDENTIAL, PART TIME, AND POSTGRADUATE STUDENTS

The three categories of students that will be discussed in this chapter vary widely in the magnitude of their influence on campus planning. This usually changes in accord with the relative size of each group. In this respect, the residential students often prove to deserve most attention. In universities in particular, they sometimes represent 50-70% of the total student population [ref 10].

Part time students are not commonly admitted into universities in large numbers, while in polytechnics it is the other way around. Consequently it is not surprising that the only group large enough to be surveyed and studied in this research was available in Leicester Polytechnic.

Postgraduates usually constitute between 10-30% of the total number of students in both universities and polytechnics.

7.1 RESIDENT STUDENTS

The procedure for studying the activities of resident students are not similar to those of non-resident ones. Resident students live, as well as study, in a campus environment. Their lives are almost totally dependent on the university establishment even when they do not actually live inside the campus site itself. It usually offers them most of the services they need, besides the more immediate and obvious working and living accommodations. Such a situation should have considerable influence on the relative activity patterns. Where the non-resident student has to choose between performing certain activities on campus or at home, the resident student is frequently restricted to the choice of where in the university or polytechnic environment he should perform it. This usually dwindles down to a choice between the academic part of the campus and the residential one, and it is this choice which is of most interest from this research's point of view. Accordingly it will be possible to find where the space is in most demand.

Because the residential part of the campus is an integral part of it, even when not accommodated in the same site, any reference in the text hencewith to the "campus" inherently includes reference to the residential area. When specific discrimination is required it will be mentioned.

As can be seen from the survey results in chapter four, the resident students spent almost all of their time on campus (residential and non-residential, as mentioned above). This built up to around 89-91% of their time for the period between 800-1800 hours, regardless of accommodation types. Because of this, the study of their activity patterns is less complicated, compared to non-resident students. This is due to the reduction in the number of variables involved that influence them. The resident student has to accept the campus as it is, there is a limited scope for any possible change in the factors which influence him. The external variables outside campus, which a non-resident student is subject to, are replaced by internal constants such as similar housing arrangements, and social environment. All of these things narrow down the number of factors which can possibly induce variations between resident students' group behaviour.

The samples available for review are exclusively from the Universities of Leicester and Reading. Leicester Polytechnic had too few resident students to be included.

Before entering into a discussion on resident students' activities, it is necessary to define the day time limits, during which the activities will be considered. This is necessary because resident students' relationship with the campus goes beyond that of formal teaching hours. The survey results for non-resident students was calculated for the period between 800 and 1800 hours because this is the relevant working period of the day. To make it possible to sum up the spatial needs for both resident and non-resident students, it was necessary to make the survey results for both groups compatible. The non-resident students do not use the residential part of the campus so eventually when the activities of both resident and non-resident students are added up to qualify the spatial requirements, this must be done exclusively for the non-resident parts of the campus. The activities of the resident students must, in such a situation, represent only those performed in this area, the non-resident, and for the same respective period of time. To that end the two parts of the campus will be analysed separately, the residential part where the residential accommodation lies, and the academic part, which represents the rest of the campus. In other words; the activities in the academic part of the campus will be analysed for the period between 800-1800 hours with respect to all the students, resident and non-resident.

The length of time for which the activities of resident students was calculated was extended over two overlapping periods. The first was for the period between 800-1800, as explained above. The second included the whole of the day, because resident student's relationship with the campus extends throughout that period. It is helpful to have their activities fully displayed to understand and study them. However, reference to activity times for resident students will be made with respect to the 800-1800 period except where specific mentioned is made to the contrary.

The summarized results of the survey on resident students may be seen in chapter four. The corresponding results for part time and postgraduates are available in appendix (B).

7.1.1 RESIDENT STUDENTS' FREE TIME

The results of the surveys on resident students show that they do behave differently from non-resident ones. For a start it is obvious that they spend less time in the academic part of the campus than do non-resident students. Non-resident students spent an average of 8.14 hours per week on free time activities (social+reading) in the non-residential area of the campus, while resident students spent only 5.3. That is reflected in the corresponding social and reading times, each of which is also significantly less than the corresponding figures for non-resident students. In this respect then, it may be cuncluded that from a planning point of view, less space is required for each resident student than is necessary for a non-resident one, in the academic part of the campus.

The activity distribution of resident students between the main activity groups is shown in illustration (7.1), which contains comparative relative graphs for the resident and non-resident students in the Whiteknights site in Reading University. When comparing the curve for resident students to the reference in illustration (7.1), it should be remembered that the reference referres to an average of non-resident students only.

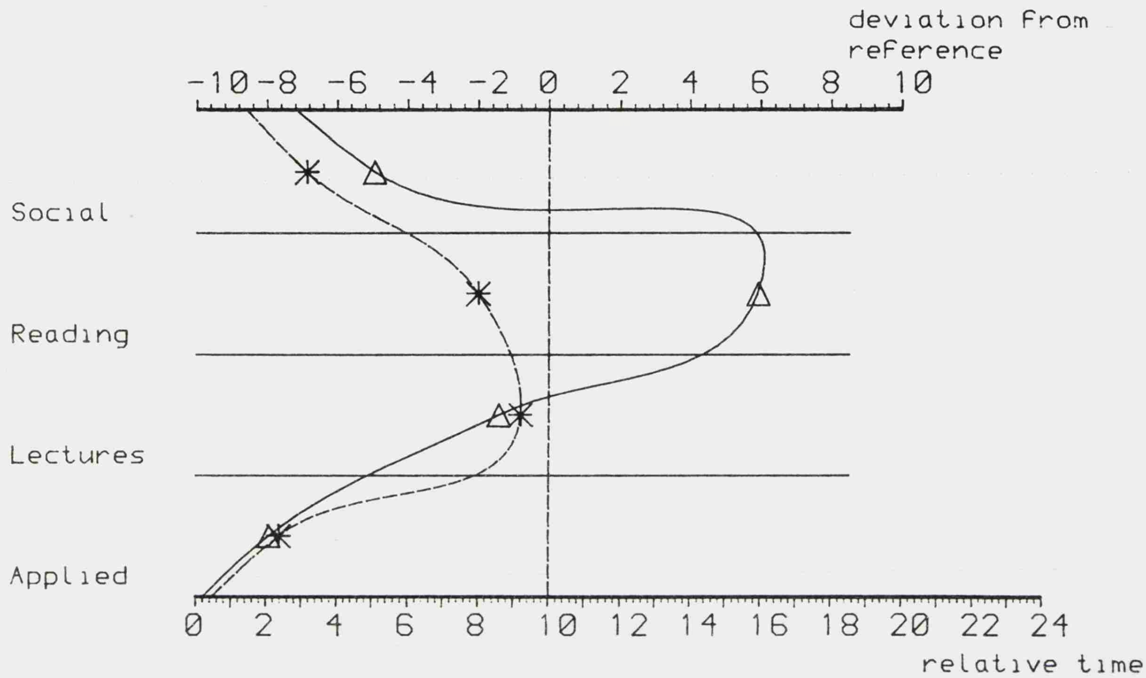
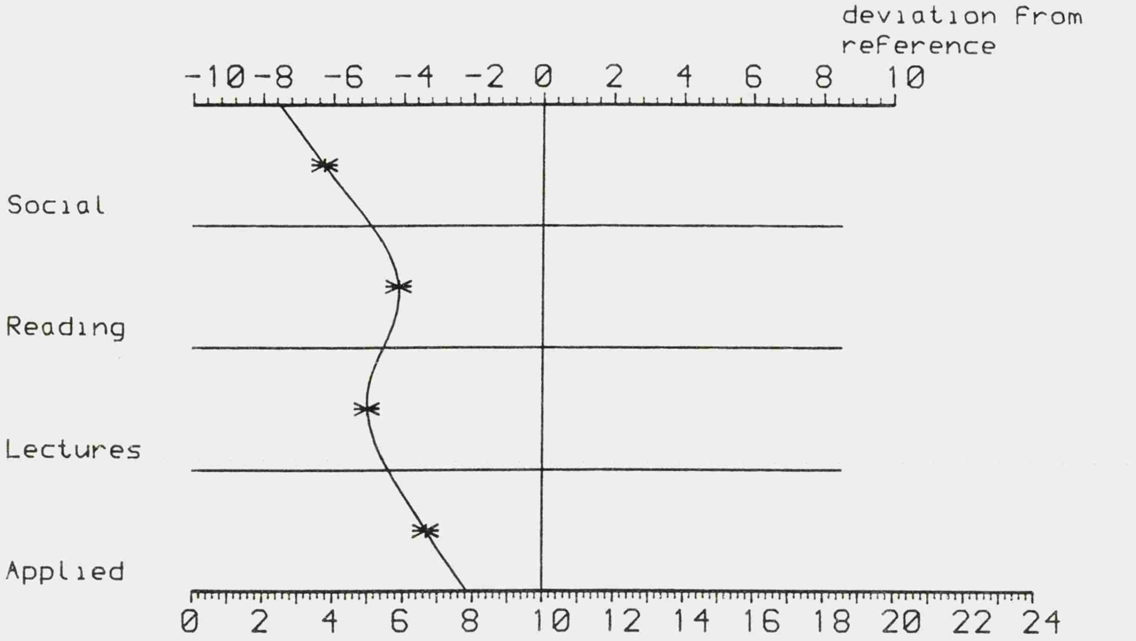


ILLUSTRATION 7.1

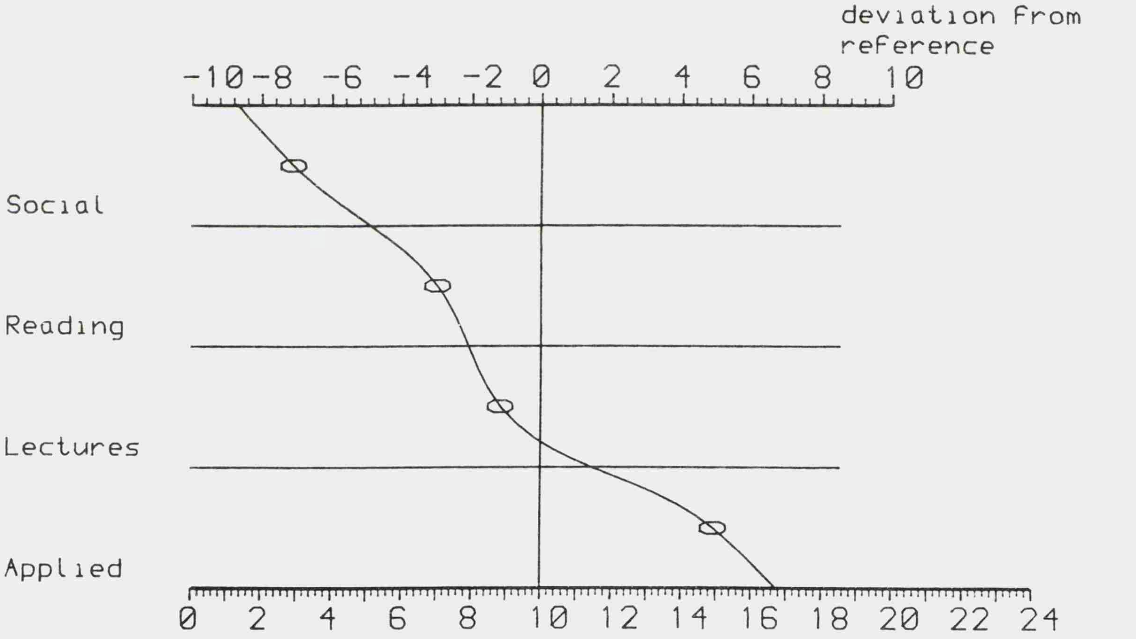
RESIDENT AND NON RESIDENT STUDENTS IN THE ACADEMIC AREA OF WHITEKNIGHTS. RESIDENTS DOTTED LINE.

The reduction in the free time resident students spend in the non residential area of the campus gives them a special relative graph. This can be observed in the graphs in illustration (7.1b). he upper half of the graph which represents the relative social and reading activity group times, is depressed. The case is not so obvious for Leicester University resident students because their resident site is not in the main campus and the students need to travel to reach it. Section (7.1.7) will deal with this issue in more detail.

The survey results also show that for the working period of the day (800-1800), the students of the different campuses reviewed stayed on campus for an almost similar amount of time. The times only varied within 0.87% of an average of 45.023 hours per student per week (90.046% of their time). This is a very small deviation relatively, and for all intents and purposes, the total time on campus may be considered constant. This consistency stands to good reason because the students have a limited choice of places to go to. Generally speaking, the students can either stay in residence, go to the academic area for work or fun, or they can go outside campus for whatever they cannot find in it. During the period being considered, they will most probably be either in the academic area or in residence. The time during which they would most likely



LONDON ROAD



DUAL SITE

ILLUSTRATION 7.1b

RELATIVE GRAPH FOR RESIDENT STUDENTS

leave the campus and residence is the evening, after 1800 hours, and that is not included in this spell.

The actual free time (social + reading) available to resident students can be obtained simply by subtracting the scheduled and complementary time from the total time on campus. Table (7.1) shows the corresponding information and results.

CAMPUS	TIME SPENT ON ACTIVITY			
	TOTAL	SCHEDULED	COMPLEM-ENTARY	ACTUAL FREE TIME
Wtnts	45.415	8.243	15.730	20.629 ±0.021
Dual	45.374	15.500	14.055	15.814 ±0.326
Lndn Rd	44.133	7.776	15.685	20.699 ±0.960
Lstr Unv	45.171	9.763	15.694	19.714 ±0.105

TABLE 7.1

DISTRIBUTION OF RESIDENTIAL STUDENTS' TIME BETWEEN THE MAIN ITEMS OF ACTIVITY IN ALL THE CAMPUS.

From examining the figures from table (7.1) it was obvious that the main factor responsible for variations in the output, the actual free time, was the scheduled time. It also seemed to have an effect on the complementary time, although more restrained, squeezing it along with the free time by different proportions when it rose. This was apparent in the case of Reading University dual site students who had more scheduled time and consequently less free time, and slightly less complementary time. It seemed reasonable that a direct relation was possible between the total free time on campus and the scheduled time. To increase accuracy and trustworthiness, a few more samples were added by including random groups of ten students from Whiteknights with higher and lower scheduled hours. The students were chosen from Whiteknights because of the large number available for selection. The results, shown in illustration (7.2) showed a positive relation with low deviation from the norm. The higher the number of scheduled hours attended by the students, the less free time they had to spend. The low deviation adds further weight to the statement that was made earlier that the activities of resident students are more predictable due to the smaller number of parameters that influence them.

7.1.2 USE OF CAMPUS OFF WORKING HOURS

The period after 1800 hours was expected to reveal some variation between the Universities of Leicester and Reading because of the difference in resident accommodation. The residence site in the University of Reading is the same as the academic one, both residential and academic facilities are contained in it.

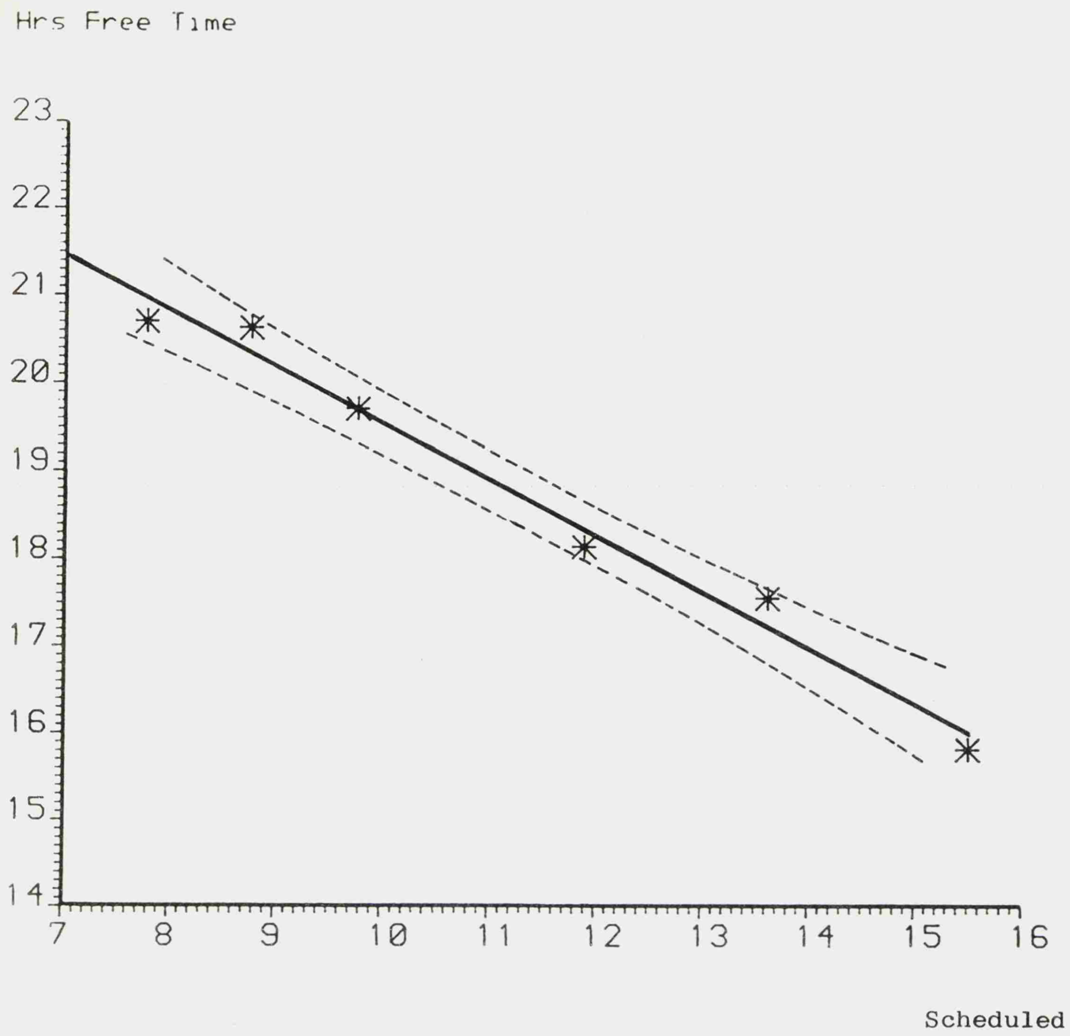


ILLUSTRATION 7.2

RELATION BETWEEN SCHEDULED AND ACTUAL FREE TIME FOR RESIDENT STUDENTS IN ALL CAMPUS

* Coefficient of determination= 0.982

Consequently, the site has more appeal. Firstly it is "alive" with inhabitants all the time, secondly it can support more facilities to accommodate them, and thirdly it is easier to access for resident students. This encourages them to stay in it when they are looking for somewhere to go.

The students in Leicester University live in a residential site which is about ten minutes walking distance from the academic part of the campus. Consequently it does not have the advantages explained above in Reading University, and the students may as well go elsewhere than walk the distance to the campus when they have a choice, as they usually do after 1800. This argument was substantiated by the survey results. When the time resident students spent on campus was calculated for the whole day in all locations, attendance time in Leicester University dropped bellow those of the three student groups of Reading University. The students in Leicester totalling 78.967 hours per student per week, while the Reading University student groups ranged between 82.762 to 85.07 hours. It must be mentioned that these variations happened off peak activity hours and should thus have no effect on the spatial planning figures. However there are usually one or two spaces on campus like bars, that need more space for evening activities than daytime ones. Consequently, in light of what has just been disclosed, such areas must be given special consideration especially in campuses such as Whiteknights where the residence site is in the main campus.

It must also be mentioned that the situation in London Road is not totally similar to Leicester although the students work at a site which is not in the main campus. The residential site still surrounds the main site with all its attractions, and the time that was spent in the main campus was considered the same as the time spent in the London Road site. This means that their position is more similar to that of Whiteknights, than that of Leicester.

7.1.3 SEPARATING THE TIMES SPENT IN EACH PART OF THE CAMPUS

The ratio between the time spent in the academic part of the campus to the time spent in the residential part varies between 1.23 in Leicester University to 0.317 in the London Road site of the University of Reading (table 7.2). A look at the results for all the sites from table (7.2) shows that there is a big gap between the ratios of the Reading University campuses and the Leicester University campus. This can be laid down to two particular reasons.

ACADEMIC AREA

CAMPUS	SOC+EAT	READ	FREE TIME	ACDMC/RES
Whiteknights	2.642	3.268	5.910	0.427 ±0.003
Dual	1.609	3.262	4.871	0.488 ±0.098
London Rd	1.993	2.452	4.445	0.317 ±0.126
Leicester Unv	4.157	5.701	9.958	1.230*±0.052

RESIDENTIAL AREA

CAMPUS	SOC+EAT	READ	FREE TIME
Whiteknights	7.724	6.117	13.842
Dual	5.338	4.579	9.967
London Rd	6.239	7.789	14.028
Leicester Unv	3.987	4.108	8.095

TABLE 7.2

DISTRIBUTION OF THE FREE TIME SPENT BY THE RESIDENTIAL STUDENT IN BOTH THE ACADEMIC AND RESIDENTIAL PARTS OF THE CAMPUS, AND THE RATIO BETWEEN THEM.

* When calibrated for a lunch time arrangement similar to that of Reading University, the corresponding figure was 0.844 (see text).

The first reason is the difference mentioned earlier in accommodation arrangements between the two universities. The residence site in Leicester University is not in the main campus but lies some ten minutes walking distance from it, while the residential area in Reading University lies inside the main campus in the Whiteknights site, surrounding the academic area. This leaves the students in Leicester in a situation which is, in terms of travel time, partially similar to non-residents. Consequently they prefer to finish their work on campus before leaving. Thus they are obliged to stay there for a longer period of time than the students in Reading who can pop into their residence as soon as they finish whatever business they have in the academic part. The students in London Road are not in a situation similar to that of Leicester University as they still have the academic area in the main site to go to for social reasons or for services as explained earlier.

The second reason is the eating arrangements for the lunch period. Because the residential site in Reading is so close to the academic area, the University has arranged for the students to have their meals in residence. These are paid for in advance, so the student would obviously rather eat there than elsewhere. Such an arrangement is not possible in Leicester, and because of the distance problem, most students eat on campus (see chapter eight). This, of course, distorts the ratio between time spent in the academic area to the residence area. Consequently a procedure was performed to adjust the figures. This was done by comparing the time the students spent on eating in both areas in the University of Reading, Whiteknights, and calibrating the eating time for the students in Leicester to match them, as if they had a similar lunch time arrangement. This produced a new ratio for Leicester of 0.844. The fact that it is still considerably higher than that of Reading which was 0.317, shows the true undistorted effect of the location of the residence site. These figures are the proper ones to use for comparing the student's performance in the two universities mentioned.

A reference to tables (7.1) and (7.2) for the Reading sites shows that there also appears to be a relation between the scheduled time and the time that the students spend in the residential part of the campus. By plotting the two factors together using additional samples from the Whiteknights site, it was possible to confirm that such a relation did exist, and that the students followed it quite closely (ill 7.3). This is probably due to the fact that the time they spend in the academic area is so low that it is very near a threshold of an absolute minimum that can be allowed. When more

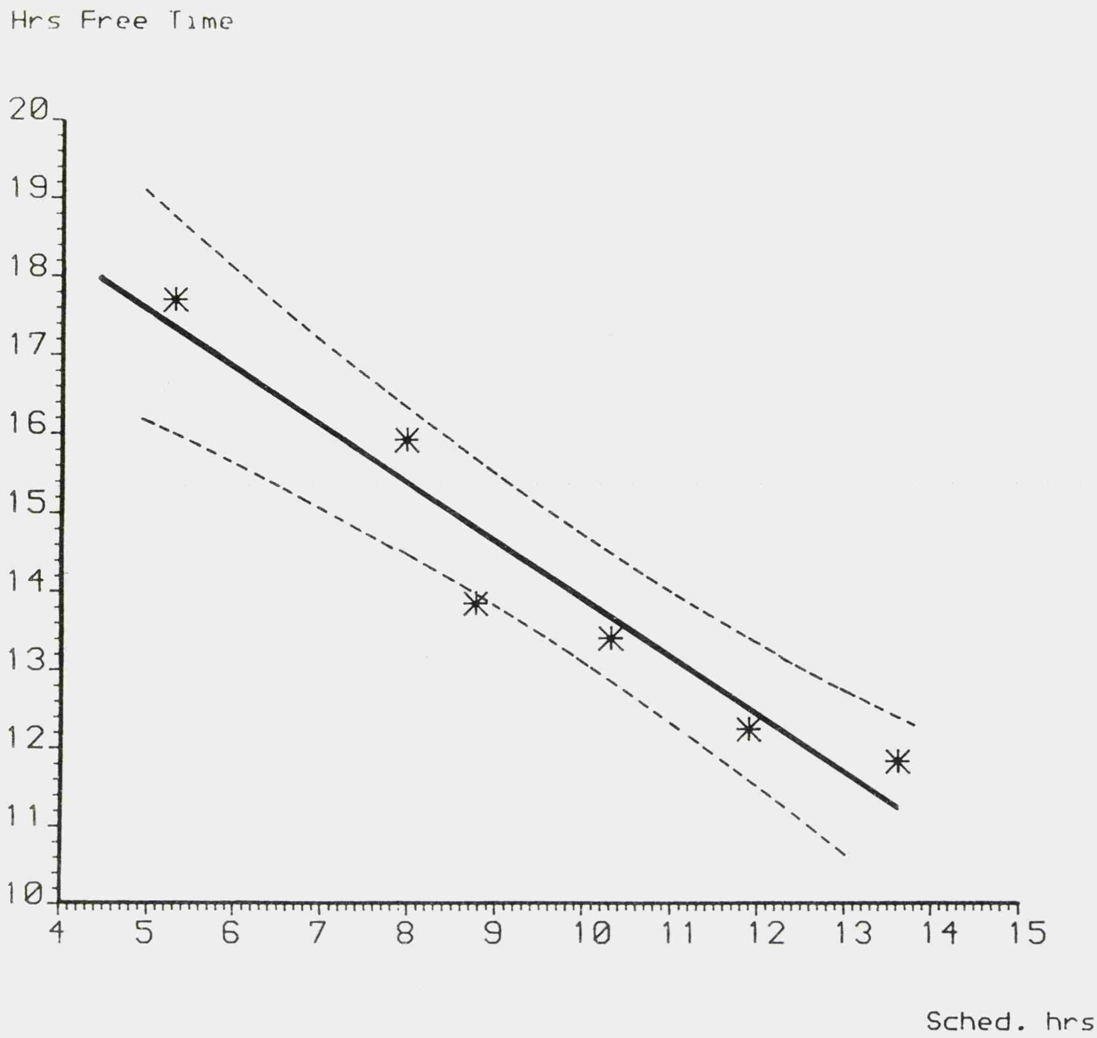


ILLUSTRATION 7.3

RELATION BETWEEN SCHEDULED AND FREE TIME IN THE RESIDENTIAL AREA FOR WHITEKNIGHTS STUDENTS

* Coefficient of determination= 0.929

time has to be provided for other activities, it must be taken from the time in residence.

It was also noticed that the time the students spend in the academic part of the campus seemed to be affected, not surprisingly, by the attractiveness of that part of the campus and the number of facilities available, with the students of Whiteknights staying most, those in London Road staying least, and the students that used both sites in between. This factor, pulling the students away from residence, is probably the reason for the small deviations from the regressive line in illustration (7.3), and needs to be compensated for. The graph in illustration (7.3) shows that the deviation may amount to around 8% of the mean at the extreme ends of the confidence limit. This must be added to, or subtracted from the time in residence that is calculated. This deviation, although small in terms of time in residence, may constitute up to 13% when it is transferred to the time in the academic area, as the latter is a result of a straightforward subtraction of residence time from total free time, and is also a smaller figure, thus more vulnerable to change. Hence the larger relative effect from the same deviation figures.

Taking a close look at the site plans of Reading University in illustrations (4.4) and (4.5), the difference between its two sites is obvious. Whiteknights is modern, spacious and planned, while London Road is just the opposite. Putting both sites on an opposite hypothetical scale of attractiveness, of eight units for example, the planner can find an approximate evaluation of the site he is considering and reflect the results in his calculations by comparing this latter site with the first two. The difference between the two sites is obvious and it should'nt be difficult to make an evaluation which is within 20-40% of the truth. Assuming the worst from this range, 40% would still reduce the probable error from 8 to 3.2% with respect to the free time in residence, and from 13 to around 5.2% of the more important free time in the academic area. This range would be acceptable.

The process of calculating the relevant statistics for resident students is now obvious. An example of how it may be used can be found in appendix (D). It would start by finding the total free time from illustration (7.2). If the residential arrangement is similar to that of Leicester University, with the residential accommodation off campus, then the ratio of free time spent in the academic area, to the total free time spent in all the campus, should be around 0.49 (±0.013), excluding eating times, and barring any major variations from the usual situations available. If the residential arrangement is similar to Reading University with the students living on or close to the campus, then the time that is spent in residence must be found from illustration (7.3). Approximate compensations for the attractiveness of the campus must then be made. Since there is only one case to study for each arrangement, it is not possible to evaluate how much deviation may be expected in other cases, and the figures must be used cautiously.

The whole process whatever the accommodation arrangement, may be summarized as follows:

1. Total Free Time on Campus, from (ill 7.2).
2. Free Time in Academic and Residential area.

   A. Residence off Campus.

      Time in academic area = Free time x 0.49 (±0.013)

      Time in residence = Free time - Time in academic area

   B. Residence in Campus.

      Average time in residence, from (ill 7.3).

      True time in residence = Average x X

      ("X" from 1.08 to 0.92 according to evaluation of attractiveness, with higher number representing more of it)

      Time in academic area = Free time - Time in residence

7.1.4 THE APPLIED TO THEORY RATIO

A direct correlation between the two ratios, "social/reading" and "applied/theory", produced no obvious consistent relation (ill 7.4). The small gradients that were detected are well within statistical error limits. All the samples in illustration (7.4) were taken from Reading University and the social/reading ratio averaged around 1.1 whatever value the applied/theory ratio took.

These findings are somewhat in contrast to the findings of the same comparison which was done for non-resident students. In the case of non-resident students, the activities included were those that were performed in the campus for the continuous period between 800-1800 hours. For resident students, the same was applied, and this meant of course, that time in residence was also considered. The fact that no movement in the social/reading ratio could be found for corresponding changes in the applied/theory ratio, indicates that it has little effect on the resident students study or social time.

Although the reason behind this change is less significant to this study than the fact that it is actually there, it would be helpfull if it was possible

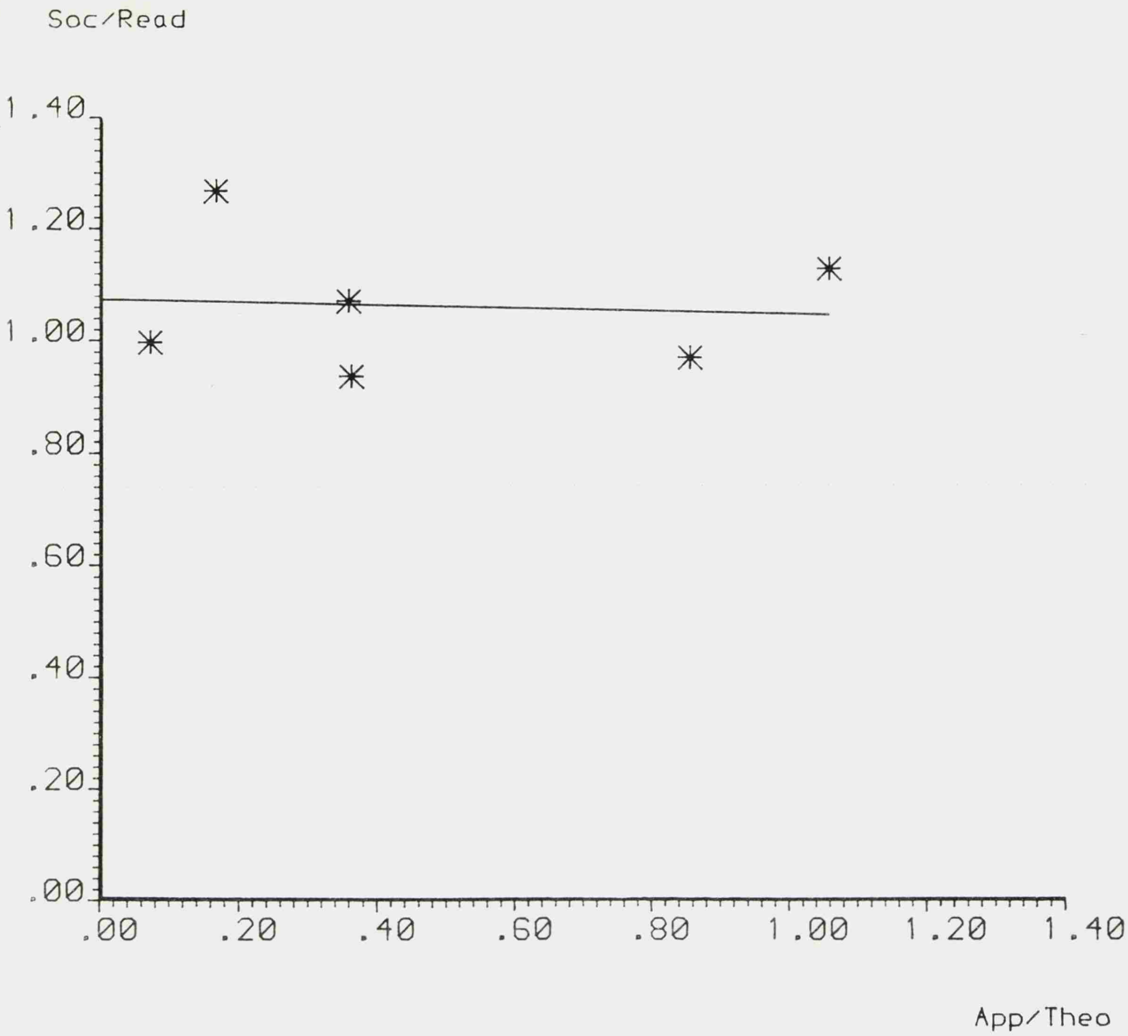


ILLUSTRATION 7.4

RELATION BETWEEN APP/THEO AND SOC/RD, FOR RESIDENT STUDENTS IN ALL CAMPUS AREAS to explain it to add to the credibility of the disclosure.

Considering the small deviations from the norm that were observed on most resident students in the subjects that were studied earlier, it was reasonable to believe that the students had developed a certain set of standards which they mostly conformed to closely. Social scientists and psychologists have acknowledged the fact that people seek to belong to groups, and that these groups then evolve a set of values which influence the individual's judgement, usually to conform to the groups' standards [ref 10.b].

Asch researched the subject of conformity to group opinion and proved that individuals will conform to them, sometimes even when they are contrary to the facts [ref 1c].

Groups are formed through several channels; social, hobby, or work. It is only natural that students living in residence, who belong to the same university, live in similar surroundings, are of a similar age, and are bound together over a period of time, should develop a "mini-society" of their own. With a relationship stretching over most of the day, sometimes every day of the week, the groups' influence should be particularly strong.

If there is a level of conformity which is established between students in one residence, then it should be obvious at a certain level in that campus through certain similarities which may be different in an independent group in another campus. Each would develop their own standards independently according to the internal and external influences. Taking the social/reading ratio as an example, if it has established itself at a certain level in resident group "A", a different level may be noticed in resident group "B", although internally the level is fairly constant in both. The emphasis on resident group and not campus is because the influence relates to the residential area not the academic site. The distinction is important as can be seen from the case of the students of London Road and Whiteknights, two separate campuses that share the same residential facilities and thus belong to the same residential grouping. The resident students in both campuses generally followed the same trend with respect to the social/reading ratio as can be seen from illustration (7.4), all of which justifies the use of residential grouping in preference to campus. When applying the same relationship test to Leicester University, it was noticed that this time the average social/reading ratio was indeed different from that of Reading's, settling at around 0.6(1) compared to Reading's 1.1(2) average. The confidence limits did not overlap so the difference is significant statistically. In other words, while all the students of Reading University who live in the same residential area showed little change in their social/reading ratio, whatever the campus they worked in, and whatever the number of applied and theory hours attended, the same does not apply when there is a change to another site with a different residential quarters. This new fact adds considerable weight to the conformity hypothesis.

There can be no doubt that conformity does have an effect on the behaviour of resident students, as it would on any group of people. Referring back to the same subject with respect to non-resident students, it was also argued that it may be involved in the development of traditional values inside separate campuses. It is also feasible that its effect would be stronger on resident students, as earlier arguments suggested, because they live closely together. Consequently, in view of all that has been presented so far, it must be seriously considered as the likely reason for the lack of

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(1) Confidence limit for 95% probable accuracy is approximately ±0.0195.

(2) Confidence limit for Whiteknights approximately ±0.0067.

correlation between the applied/theory and social/reading ratios within the same residential groupings observed in illustration (7.4)(1) earlier.

7.1.5 RESIDENT STUDENTS ACADEMIC PERFORMANCE

It could be argued that resident students' group cohesion and conformity means that the usual academic pressures which the student on his own as an individual is under, and which are often the driving force behind him that make him work extra hard, may have less effect on the resident student due to the feeling of security which he derives from conforming to the group standards that influence him. A lot of the pressure on the individual student stems from not knowing how much everybody else is working. This could be the reason why the resident student, who does know, does not react to increases in the ratio of lectures by reading more, as do non-residents.

If such an argument was true, it would follow that the success rate of students in residence should not be as high as those of non-resident students. Table (7.3) shows a comparison between the academic performance of resident and non-resident students [ref 4]. The survey

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(1) Mrs Weinreich-Haste and Dr Veldman by word of mouth in January 1985.

DEGREE	RESIDENCE	
	IN CAMPUS	OFF CAMPUS
Good	37.0 ±5.88	43.5 ±4.5*
Mediocre	59.0 ±5.82	53.5 ±4.35
Fail	3.0 3.0	

TABLE 7.3

DEGREE PERFORMANCE ACCORDING TO RESIDENCE.

TIME SPENT	RESIDENCE	GOOD DEGREES
3 years	in campus	30.0% ±4.2
	off campus	33.5% ±2.96
2 years	in campus	27.0% ±4.88
	off campus	29.0% ±4.88

TABLE 7.4

PERCENTAGE OF STUDENTS SITTING FINAL EXAMINATIONS WHO GAINED GOOD DEGREES, ACCORDING TO RESIDENCE AND TIME SPENT IN IT.

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* Margin of error for 95% confidence limit.

on which the figures rely on were based on information gathered from 1034 students from different universities, It shows that resident students do less well than non-resident ones by a margin of 5.5-6.5%, however the statistical confidence limits show an overlap which means that the results could have been the product of chance, despite the large number of samples. Consequent chi square tests confirmed this possibility.

Interviews with resident students did not help to clarify the situation (app E). Most of them stated that they preferred reading on campus but that it was sometimes hampered by interference from fellow students. Regrettably this leaves the question of a relationship between residence and academic performance as a possibility which requires further study to confirm.

7.1.6 THE MOVEMENT OF RESIDENT STUDENTS ON CAMPUS

From all that has been explained so far the forces governing the movements of resident students on campus seem to have materialized clearly. As expected, most students behaved according to a pattern from which there were relatively small deviations. In the case of the students in Leicester University, they were put in a position in some ways similar to non-resident students by having the residential site off the main campus. This led to them behaving like non-residents in terms of their use of the academic part of the campus, but not with respect to their working and studying patterns. The social and habitual elements that effect the latter were not changed by the location of the accommodation quarters, ie; they behaved like other resident students in this respect.

In Reading University the case was different. It would appear that when the students accommodation is inside the main campus, two factors dominate the way they behave. The first is the number of scheduled hours they have, the second is the will to retreat to their private accommodation in the residential area at the earliest opportunity. The students generally stay in residence unless they have scheduled hours to attend. When that is over, they will remain in the academic area for a minimum of time before going back to residence. Their stay in the academic area varies slightly according to the attractiveness of that site, which probably depends on the same parameters that influence non-resident students. Mainly its size, and the corresponding availability of facilities in it.

7.1.7 RESIDENT STUDENTS' RELATIVE GRAPH

The relative graph of students whose residence is within the campus site reflects the little free time they spend in the non-residential part of the campus, and the relatively constant proportion spent on social and reading time. This gives them a very distinct profile in which, whatever the situation with the scheduled hours, which are in the bottom half of the graph, the free time, in the top half, is depressed, especially for social activities, (see figures 12, 13, and 14 in appendix (F)).

Since Leicester University resident students do not live on campus, they spend more of their free time there and consequently have a different looking profile graph which is not very distinguishable from non-resident students' except for the relatively low social time.

7.2 PART TIME STUDENTS

There was a limited number of part time students in the Universities of Leicester and Reading. Consequently the study had to be limited to the samples of students from Leicester Polytechnic.

Part time students only stay on campus for a limited period of time each week (see appendices (C) and (F)). Usually they choose certain days of the week to attend formal studies, and work in the remaining ones. Some also attend evening classes. These will not be included in this study since their number is usually smaller than daytime students, and the space allotted to daytime students, part and full time, is usually more than enough to satisfy their needs.

The survey results for part time students are not directly comparable with those of full time students in terms of time spent per week, for the reasons explained above. Indeed a check on the figures from appendix (B) shows that the activities per student are considerably lower than those of full time students, as can be expected. The best way to represent part time students activities, in order to make them comparable with full time ones for use in the planning process, is to show them in terms of time per scheduled hour attended. This is because scheduled time is directly related to the number of days attended, and as was apparent from the findings in chapter six and the first part of seven, also related to the free time on campus. Furthermore, it relates to part time and full time students in the same way. Such a representation, along with a comparison with full time students from Leicester Polytechnic, can be seen in table (7.5).

The figures in table (7.5) show that even using this new method of representation, the free time spent by part time students in campus is very limited. The reason is

ACTIVITY	TIME PER SCHEDULED HOUR	
	PART TIME	FULL TIME
Social	0.1235	0.299
Social+Eating	0.165	0.428
Reading	0.099	0.26
Complementary	0.245	0.295
Total Free	0.56	1.069

TABLE 7.5

PART TIME STUDENTS ACTIVITIES PER SCHEDULED HOUR, COMPARED TO THOSE OF FULL TIME STUDENTS, IN LEICESTER POLYTECHNIC.

probably due to them not being a part of the everyday life in the campus, they are more detached from it than are full time students. Their friendship circles are probably smaller too for the same reason. As the daily activity pattern will show in chapter eight, their behaviour is strongly affected by their working background. For instance their attendance is high even for first hour classes (Chapter eight, Appendix C) because of the dominance of employment habits. Consequently since the factors just mentioned would apply to all part-time students whichever the campus, it can be expected that variations in behaviour between different campuses will be small since these habits are not related to particular sites.

The method for calculating activity projections for part time students is simple. It only requires multiplying each activity time per scheduled hour, from table (7.5), with the projected schedule time, as follows in the following example:

Reading time = Scheduled x Reading/Scheduled

Reading time = Scheduled x 0.099

The relative profile graph which represents part time students is quite distinct because of the very small amount of time spent by these students on social and reading activities. Consequently the upper half of the graph is extremely depressed as can be seen from illustration (7.5). The bottom half, the relative scheduled time, may change according to the courses being studied by the students.

7.3 POSTGRADUATE STUDENTS

The number of postgraduate students in most higher education establishments is relatively small compared to undergraduates. This means that less accuracy can be tolerated in calculating their activity times.

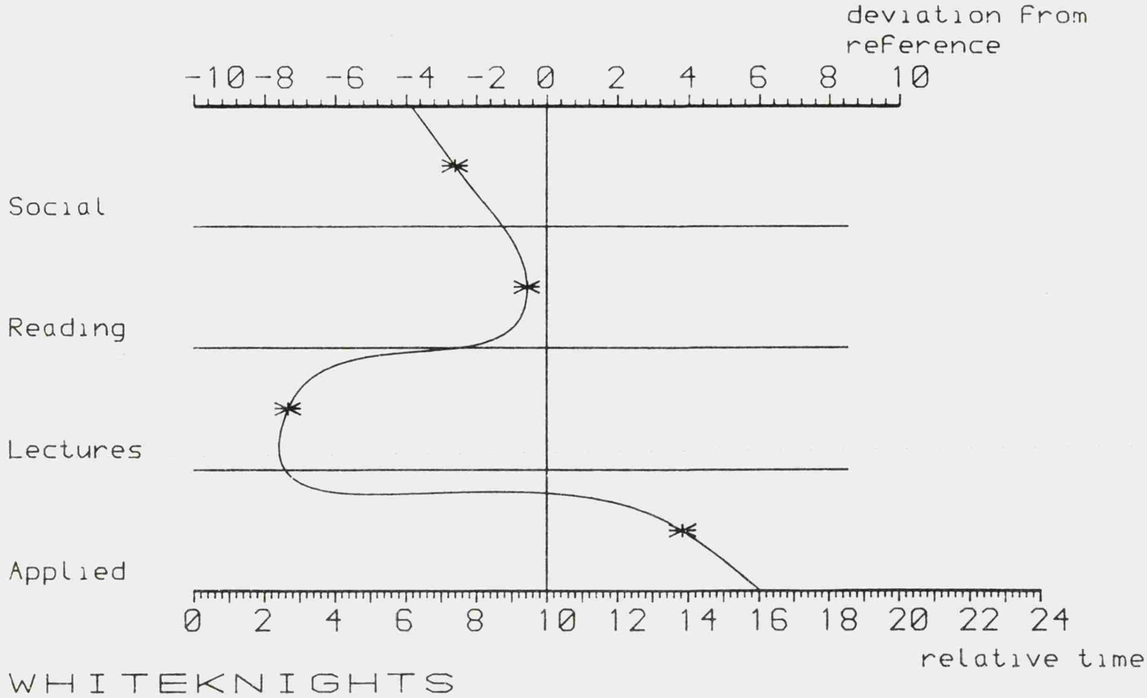
Despite their small numbers, postgraduate students can be divided into four groups. Firstly according to method of study, there are those that study by course, and others by research. Secondly there are resident and non-resident students. These variations pose a problem for the planner, since it is almost impossible for a new university to establish even an approximate grouping of its future enlistment of postgraduates into these categories. Consequently, an empirical approximation of how to calculate the spatial need will have to suffice.

The information needed regarding postgraduate student's activities is also different than those of undergraduates. Most postgraduates have their own working posts or offices. They do most of their reading in these private spaces and not in the public common rooms where the undergraduates do. These private spaces are calculated according to the requirements of office spatial standards and not activity requirements as they make no difference in such circumstances. Social time on the other hand is spent in the same common spaces that the remaining students use, which means that it must be included in the calculations of the relevant areas in the campus. using the same criteria.

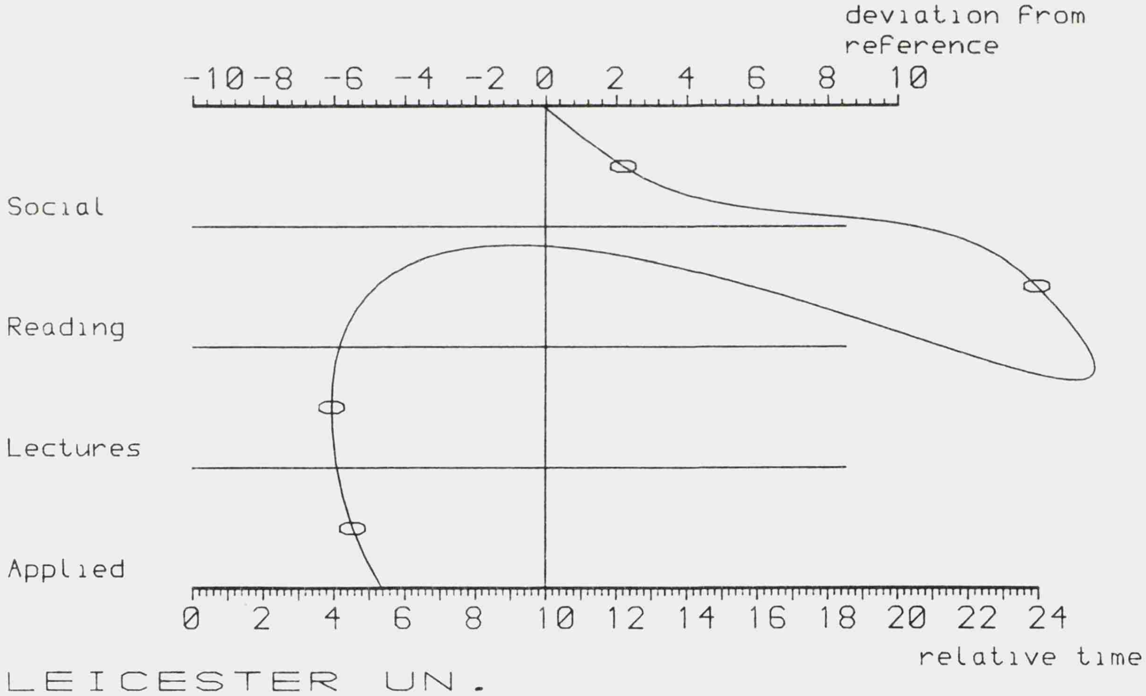
As can be seen from the tables in appendix (B) regarding the postgraduate students from the Universities of Leicester and Reading, the social time per student varies from three hours in Whiteknights, to 4.6 in Leicester. Since the number of samples from Leicester are larger, a round figure of four hours per week per student will be used for calculation purposes. Such an approximation means that in an average university with a 20% content of postgraduate students, the maximum probable error in the total time figures for the campus that might arise from using the above rounded figure, assuming a free time total of ten hours per week per student, should be no more than 1.2%, which is tolerable.

As can be seen from the relative graphs in illustration (7.6), postgraduate student groups can be recognised from the relatively large amount of time they spend on reading. This is apparent from the bulge in the graph with respect to this activity. An examination of all the postgraduate groups in appendix (F) shows that those with less scheduled hours do the most reading. This is probably due to the fact that those who study by course attend scheduled classes and are closer to the situation prevalent with undergraduate students who have less time for reading than that observed for research students. On the other hand, those that study by research have reading and sometimes applied work as their main tool of study. This explains why a larger content of scheduled hours reduces the time spent on reading, and vice versa. This means that a campus with a larger proportion of postgraduates studying by research will show them doing more reading, such as the case of Leicester University.

Residence appeared to have less effect on postgraduates than it did on undergraduates, arguably because research students, who usually have their own private office area, find it agreeable to work there as opposed to studying in residence the way undergraduate resident students do. In other words postgraduates have a choice of two private areas to study in, one on



WHITEKNIGHTS



LEICESTER UN.

ILLUSTRATION 7.6

RELATIVE GRAPHS FOR POSTGRADUATE NON-RESIDENT STUDENTS residence and the other not, while the only private area the resident students have is in residence. Inevitably the competition reduces the probability that the postgraduate would study in residence.

CHAPTER EIGHT

ALLOCATING SPACE FOR ACTIVITY TIMES

The total time spent on an activity can be considered as an indicator to the space required to house that activity in the campus. It does not, however, genuinely reflect the actual need. This is because the activities that are represented are performed through the course of the day in a variable degree of intensity. The graph in illustration (8.1) shows the students' performance throughout a typical day in the Whiteknights site in the University of Reading. As can be seen, each activity rises from zero early in the morning, to reach a peak sometime later in the day. It is this peak which most directly represents the need for space to accommodate the activity in question.

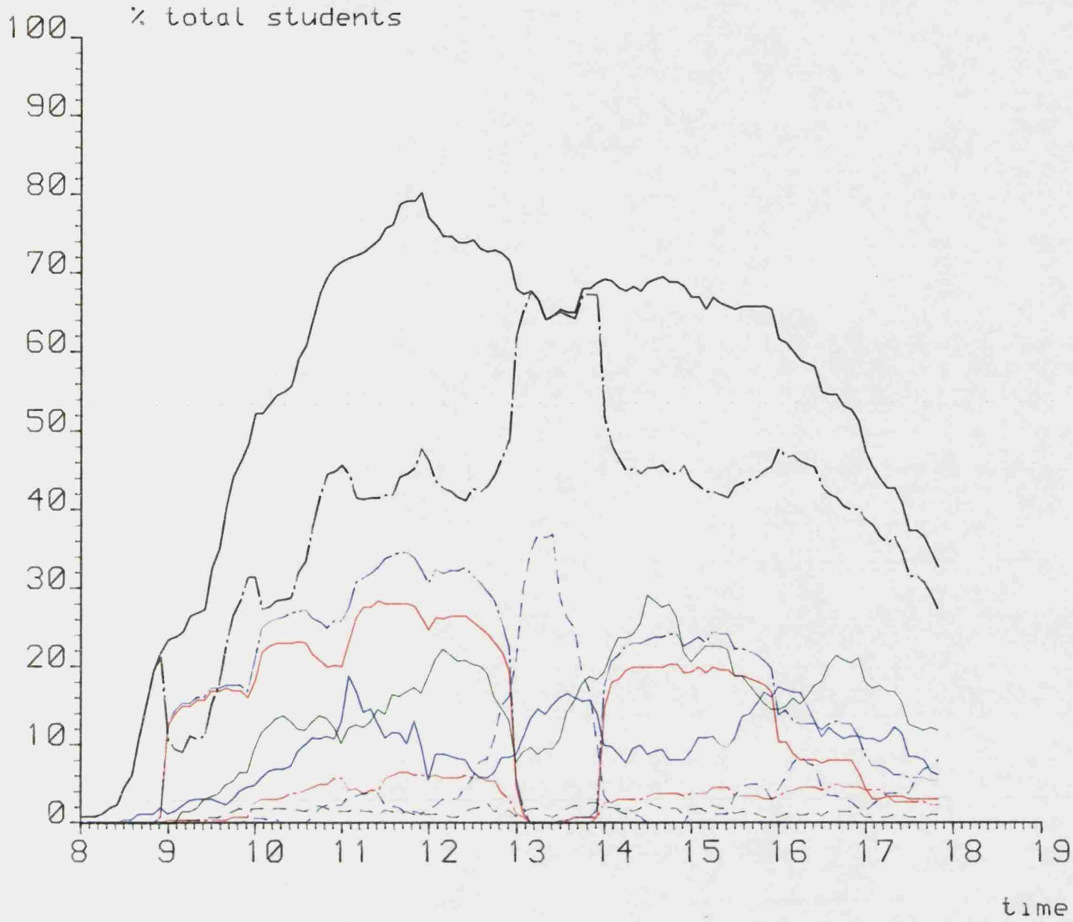


ILLUSTRATION 8.1

READING UNIVERSITY WHITEKNIGHTS SITE
DAILY ACTIVITIES OF NON RESIDENT UNDERGRADS

- Total
- Reading
- Social
- Lectures
- Applied
- Scheduled
- Total minus scheduled
- Reading in library
- Eating

This chapter will concentrate on translating the total activity times which were discussed in earlier chapters, to effective spatial needs depending on daily activity interpretations and their peak values, such as those in illustration (8.1). An attempt will be made to explain how to take advantage of such indicators to correspond with the planners requirements, and the Architects designs.

8.1 RELATION BETWEEN ACTIVITIES AND SPACE

Before a spatial allocation can be made for a certain activity's needs, it is necessary to find in which kind of space the activity will take place. Some activities are performed in more than one kind of space, while some spaces accommodate more than one kind of activity. Fortunately, the original activity grouping in this study was devised to take this into consideration.

Some of the activities are fairly straightforward. Eating is done in special refectories or coffee rooms, and reading in the library is done, of course, in the library. The most interesting aspect of this space-activity relationship was found between social and reading activities and the corresponding space. It was found that when students did not conduct their reading in the library, it was done in the same spaces that were designated for social activities. Basically common rooms, and resting spaces, or lounges. This conclusion was deduced from reviewing the survey diaries and confirmed through on the spot questioning of students in the University of Bath, the results from which agreed with those from the survey. It appears that this reading usually takes the shape of short concentrated reviews before class, relatively light reading, or groupwork which is often noisy in itself and quite suited to these spaces. Furthermore, because of the availability of space in the campuses surveyed, and the discrepancy between peak social and reading times, students are often able to find quiet common rooms to read in if they want to (54 students were questioned).

The other part of the campus worth mentioning here is the buffer area which constitutes the free common space, whether indoors or out. A lot of time is taken up by the students performing activities which are not academic, or social. These include circulation and roaming around basically, for non-resident students, and things like doing the washing or shopping, for resident students, as well as circulation and roaming around. Some of this requires obvious specialized space, but a lot of it needs some simple extra space to wander in. This buffer space usually exists inevitably in any layout in the shape of outdoor spaces, or enlargements of corridors or entrance space. It offers multiple usage patterns for several activities such as social ones.

Flexibility of use is one of the objectives of using activities to calculate spatial requirements. This includes being able to assign one activity to several spaces on campus, and several activities to a single type of space. Consequently the planner must take the decision on how much of each activity to house in each space, where, by how much, etc. No attempt will be made in this chapter to restrict this flexibility by suggesting particular routes of action, or methods of calculation or distribution of activities.

8.2 ALLOCATING SPACE TO PEAK USAGE PERIODS

Theoretically it should be sufficient to allocate the necessary space for each activity during its peak period of the day to have a proper space allocation system. However there are a few practical considerations that need to be heeded first.

For a start, peak periods usually occur only once throughout the day, and then only for a brief one. Allocating space to satisfy that very maximum usage period could be wasteful when it might suffice to offer slightly less. This is all the more obvious in cases when the activity fluctuates strongly throughout the day reaching rather high peaks for brief periods, and then dropping to a much lower norm. This is obvious in the case of Leicester Polytechnic with respect to social activities (app C, fig 5). These follow a somewhat lowly norm, which rises dramatically during the long coffee breaks and lunch period. In such a case the planner must decide where in between these two extremes should he consider planning for. Furthermore, it may be feasible to depress the space deliberately in some cases so as to force a more even spread of activities throughout the day and thus increase the efficiency rate for the use of that space.

On the other hand, if it is necessary to allocate enough space to satisfy all the need for a particular activity, it is necessary to remember that the figures discussed in the daily activity graphs in this chapter represent an average over five days. They were taken for a normal period of the year. It is almost certain that there are variations between individual days, and during some periods of the year some activities would increase, others would decrease. If the absolute maximum is required for the week, it would almost certainly be higher than the average presented.

Four routes are suggested for the individual user to take when he try's to implement the information here. Firstly he may agree with the approach of a "reasonable maximum". In this case he may agree with the values used here, or he may suggest his own. Second, he may agree with the reasonable maximum approach but decide to add a certain "safety margin" to compensate for daily, or seasonal variations. Thirdly, he may calculate for the average maximum, in which case he may still wish to add a safety margin for daily or seasonal variations. Fourthly, he may decide to compress the peaks to spread the activity over a wider period and thus increase the efficiency of the use of the space.

After finding the desired peak for each activity in terms of number of students, the planner must assign an area for these students to perform this activity, such as allocating 'X' area per student for social activities, and 'Y' for reading, etc. This subject is a well trodden issue [refs 12, 35, 47, 48] and need not be discussed in detail, however an example on how to use these spatial standards can be found in appendix (D).

8.3 COMMON SPACE

Before entering into the subject of allocating areas to peak times, it is necessary to mention the special case of "common spaces". These are the spaces that are usually implanted in the design to take up the students' social activities and group meetings and such. They are often dispersed throughout the campus and can take the form of simple enlargements of corridors and entrances, or even outdoor open areas. It was found during the course of this research that when the student does not do his reading individually in the library, that is usually because he is doing it in the common rooms mentioned. In other words, these spaces have to accommodate 30 - 40% of the students activities on campus according to the survey results. This is the single largest proportion of the student's time taken up by any single type of space. Exceeding even that of lecture time.

What must also be taken into consideration is that while common space used for social activity can be very flexible in shape form and location, as was mentioned, the same type of space used for most types of reading demands a few requirements beforehand. It must, for instance, be covered and contain proper seating arrangements. In other words, depending on the design, the students will sometimes seek out certain common spaces to study in, while they will sometimes not be so fussy on which ones to use for socializing. This must be taken into consideration by the planners and architects.

CAMPUS	MAXIMUM	REASONABLE MAXIMUM	TOTAL WEEKLY	TIMES FACTOR (x4.5)
WTNTS	17.5%	15%	3.461	x4.5= 15.57%
DUAL SITES	30.0%	20%	4.635	x4.5= 20.85%
LNDN RD	21.0%	16%	3.527	x4.5= 15.90%
LSTR UN	20.0%	16%	3.630	x4.5= 16.30%
LSTR POLY	38.0%	15-26%	4.750	x4.5= 21.37%

TABLE 8.1

CONVERTING TOTAL WEEKLY TIMES FOR SOCIAL ACTIVITIES INTO APPROXIMATE PEAK EQUIVALENTS FOR NON RESIDENT STUDENTS

CAMPUS	MAXIMUM	REASONABLE MAXIMUM	TOTAL WEEKLY	TIMES FACTOR (x6)
WTNTS	16%	13%	2.138	x6= 12.8%
DUAL SITE	10%	8%	1.179	x6= 7.1%
LNDN RD	12%	10%	1.520	x6= 9.1%
LSTR UN*	11%	10%	2.065	x6= 12.4%

TABLE 8.2

CONVERTING TOTAL WEEKLY TIMES FOR SOCIAL ACTIVITIES INTO APPROXIMATE PEAK EQUIVALENTS FOR RESIDENT STUDENTS

* Resemble non resident students, so maximum is smaller. See text.

8.4 SOCIAL AND READING

These two activities are discussed together because they have so much in common. Not the least of which is the use of the same spaces, common ones.

8.4.1 SOCIAL ACTIVITIES

Social activities' rise and fall, follows almost exactly the same movement of the total time on campus minus the scheduled time, excluding the lunch period. This can be seen from the graphs in appendix (C). This means that they usually peak about half an hour before lunch time. The respective method of calculating the peak time's magnitude, for non-resident and resident students can be seen in tables (8.1) and (8.2). The information, of course, was taken from the respective graphs in appendix (C). Comparing the "reasonable maximum" which is included in these and the following tables, to the original graphs will show how flexible this derivative is. This is described to emphasise the alternative courses of action that were described in section (8.2).

Two things in tables (8.1) and (8.2) are worthy of notice. The first is that the multiplication factor for resident students is higher than that for non-resident ones. A reference to the original graphs in appendix (C) will show that the reason is because the distribution for resident students is less uniform throughout the day, with higher emphasis on the early morning part of it, and less on the afternoon, where it seems the resident students prefer to retreat to their private accommodation areas. The second is that the same multiplication factor for Leicester University resident students should be lower than the same for Reading University. This fact is related to the same reasoning concerning the difference between resident and non-resident students. The resident students in Leicester, because they do not live on campus, behave more closely like non-resident students on this affair, thus requiring a smaller factor as a consequence.

8.4.2 READING ACTIVITIES

Reading time variations throughout the day are generally smaller than those for social activities, usually building up slowly to a climax slightly after lunch for non-resident students, or slightly before for resident ones. This imposes a peculiar problem since it means that the total peak for the campus on the whole will vary according to the percentage of resident students on campus, with it more likely to be in the morning if the percentage is large, or the afternoon if it is small. Consequently it is necessary to calculate both peaks separately, the morning peak for both groups of students, and the afternoon peak for them both too, and use the higher of the two resultant times. The factors for both peaks for both groups of students, resident and non-resident, are approximated in tables (8.3, 8.3.b, 8.4, and 8.4.b), and an example on how to use them can be found in appendix (D). The same problem is not apparent in other activities because the peaks for both groups of students overlap during the same period of the day, ie; they either occur in the morning together, or the afternoon.

Part of the reading time is taken up in the library. This will be discussed separately later to calculate the need for library space (see section 8.6). After this is subtracted from the total reading time, the remainder is the time that is spent in the common areas.

8.4.3 SOCIAL PLUS READING TIMES

Since it is the combined activities of social and reading that are performed in the common spaces, it is necessary to find the maximum combined peak period. This is not a direct summing of the two separate peaks. The reason is that they occur at different times. Summing the two together would produce an inflated figure, as can

CAMPUS	MAXIMUM	REASONABLE MAXIMUM	TOTAL WEEKLY	TIMES FACTOR (x3.4)
WTNTS	27%	20%	6.50	x3.4= 22.1%
DUAL SITE	24%	14%	4.18	x3.4= 14.2%
LNDN RD	11%	5%	1.43	x3.4= 4.86%
LSTR UN	20%	18%	4.60	x3.4= 15.6%
LSTR POLY	14%	14%	4.19	x3.4= 14.2%

TABLE 8.3.a

CONVERTING TOTAL WEEKLY READING TIMES INTO APPROXIMATE AFTERNOON PEAK EQUIVALENTS FOR NON RESIDENT STUDENTS.

CAMPUS	MAXIMUM	REASONABLE MAXIMUM	TOTAL WEEKLY	TIMES FACTOR (x2.9)
WTNTS	21%	20%	6.5	x2.9= 18.85%
DUAL SITE	13%	10%	4.18	x2.9= 12.10%
LSTR UN	15%	12-13%	4.6	x2.9= 13.34%

TABLE 8.3.b

CONVERTING TOTAL WEEKLY READING TIMES INTO APPROXIMATE MORNING PEAK EQUIVALENTS FOR NON RESIDENT STUDENTS.

CAMPUS	MAXIMUM	REASONABLE MAXIMUM	TOTAL WEEKLY	TIMES FACTOR (x3.7)
WTNTS	15%	12%	3.268	x3.7= 12.1%
DUAL SITE	15%	13%	3.262	x3.7= 12.1%
LNDN RD	12%	10%	2.452	x3.7= 9.07%
LSTR UN	25%	20-23%	5.701	x3.7= 21.1%

TABLE 8.4.a

CONVERTING TOTAL WEEKLY READING TIMES INTO APPROXIMATE AFTERNOON PEAK EQUIVALENTS FOR RESIDENT STUDENTS

CAMPUS	MAXIMUM	REASONABLE MAXIMUM	TOTAL WEEKLY	TIMES FACTOR (x2.8)
WTNTS	9.5%	9.3%	3.268	x2.8= 9.15%
DUAL SITE	9%	9%	3.262	x2.8= 9.15%
LNDN RD	8%	7.7%	2.452	x2.8= 6.90%
LSTR UN	17%	16%	5.701	x2.8= 15.9%

TABLE 8.4.b

CONVERTING TOTAL WEEKLY READING TIMES INTO APPROXIMATE MORNING PEAK EQUIVALENTS FOR RESIDENT STUDENTS.

be seen from examining the graphs in appendix (C), figures (1-5).

The results of combining the two activities to show a separate line in the activity graphs can be seen in appendix (C), figures (6-10). The fortunate development that appears in these graphs is that allocating space for the combined activities allows greater efficiency rates to be achieved because the spread of the two activities is more uniform than any single one on its own. The results of the evaluation of the space needs of the two combined activities can be seen in tables (8.5) and (8.6).

The problem that may appear most concerting to some planners is the case of Leicester Polytechnic. This institute has long coffee and lunch breaks so the social times rise rapidly during these periods, as was explained earlier. This rise is copied through to the combined activity performance. It is the planners duty to decide how he will handle this case. In the example shown in tables (8.5 and 8.6), a reasonable maximum was assumed which would suit a certain logic which may not apply to some cases. The planner has to decide the merits of each individual case.

CAMPUS	MAXIMUM	REASNBLE MAXIMUM	TOTAL WEEKLY	LOW FACTOR	HIGH FACTOR
WTNTS	34%	29%	10.106	x2.9=29.3%	
DUAL	36%	29%	8.815	-	x3.3=29.0%
LNDN	20%	17%	4.956	-	x3.3=16.4%
LSTR	30%	25%	8.300	x2.9=24.1%	-
LCP	45%	29%	8.831	-	x3.3=29.2%

TABLE 8.5

CONVERTING TOTAL WEEKLY TIMES FOR SOCIAL PLUS READING ACTIVITIES INTO APPROXIMATE PEAK EQUIVALENTS FOR NON RESIDENT STUDENTS. IT WAS FOUND THAT SITES WITH HIGH APPLIED HOURS, OR LONG COFFEE BREAKS, NEEDED HIGHER MULTIPLICATION FACTORS. THE APPROPRIATE VALUE OF THE FACTOR FOR ANY SEPARATE CAMPUS SHOULD LIE SOMEWHERE BETWEEN THE PARAMETERS SET HERE.

CAMPUS	MAXIMUM	REASONABLE MAXIMUM	TOTAL WEEKLY	TIMES FACTOR (x4)
WTNTS	25%	22%	5.406	x4= 21.6%
DUAL SITE	20%	18%	4.441	x4= 17.8%
LNDN RD	18%	16%	3.972	x4= 15.9%
LSTR UN	30%	28%	7.766	x4= 31.1%

TABLE 8.6

CONVERTING TOTAL WEEKLY TIMES FOR SOCIAL PLUS READING ACTIVITIES INTO APPROXIMATE PEAK EQUIVALENTS, FOR RESIDENT STUDENTS. THERE WAS NO NEED FOR A HIGH MULTIPLICATION FACTOR HERE BECAUSE THE MORE RAPID FLUCTUATIONS APPEARED TO AFFECT CIRCULATION RATHER THAN SOCIAL ACTIVITIES.

An added dimension is attained when discussing the combined activities of social and reading together. Because of the increase in the efficiency rate, it is possible to use higher safety margins than before and still allow for good economic distribution. This could be added as another method to calculate the need for space for these activities. In other words, calculate to attain a certain rate of use which is acceptable, instead of working for an acceptable maximum activity usage peak.

8.5 EATING TIME

The spaces which are being studied in this heading include all areas in which food and snacks may be bought in and eaten for lunch. The number of students eating in a campus's refectories during the lunch time depends on a number of factors all of which must be studied. The most important of these is if the student is a resident or not.

8.5.1 EATING ARRANGEMENTS FOR NON RESIDENT STUDENTS

Non resident students have to eat in the refectories on campus because that is usually the only way they can have lunch, if they want to. An examination of the survey results revealed that between 90% to 95% of the non-residents students ate their lunch in the campus's refectories . Otherwise they either skipped lunch altogether, or ate outside, which was rare.

An examination of the daily activity graphs in appendix (C) show that the maximum peak values vary considerably. The thing that is immediately obvious from these graphs, is that the duration of the lunch break is strongly effective in this respect. More so when it is possible to accept two shifts rather than the single one. A direct comparison between the duration of the lunch period and the total average weekly time spent on eating was found to be acceptably lineal (ill. 8.2). Since the total time should obviously be linked with the peak period, it was thought that a correlation might also exist between that and the duration of the lunch break. Another comparison between these two elements did indeed show a correlation (ill 8.3). The maximum deviation from the norm appeared not to be more than (5%), in the graph in illustration (8.3). This was considered to be acceptably accurate.

The correlation in illustration (8.3) was further improved when only the number of students actually in campus during the lunch period was included. The results of this last conversion is shown in illustration (8.4). Logically, it would appear sensible that the time taken by the students out of campus during the lunch break

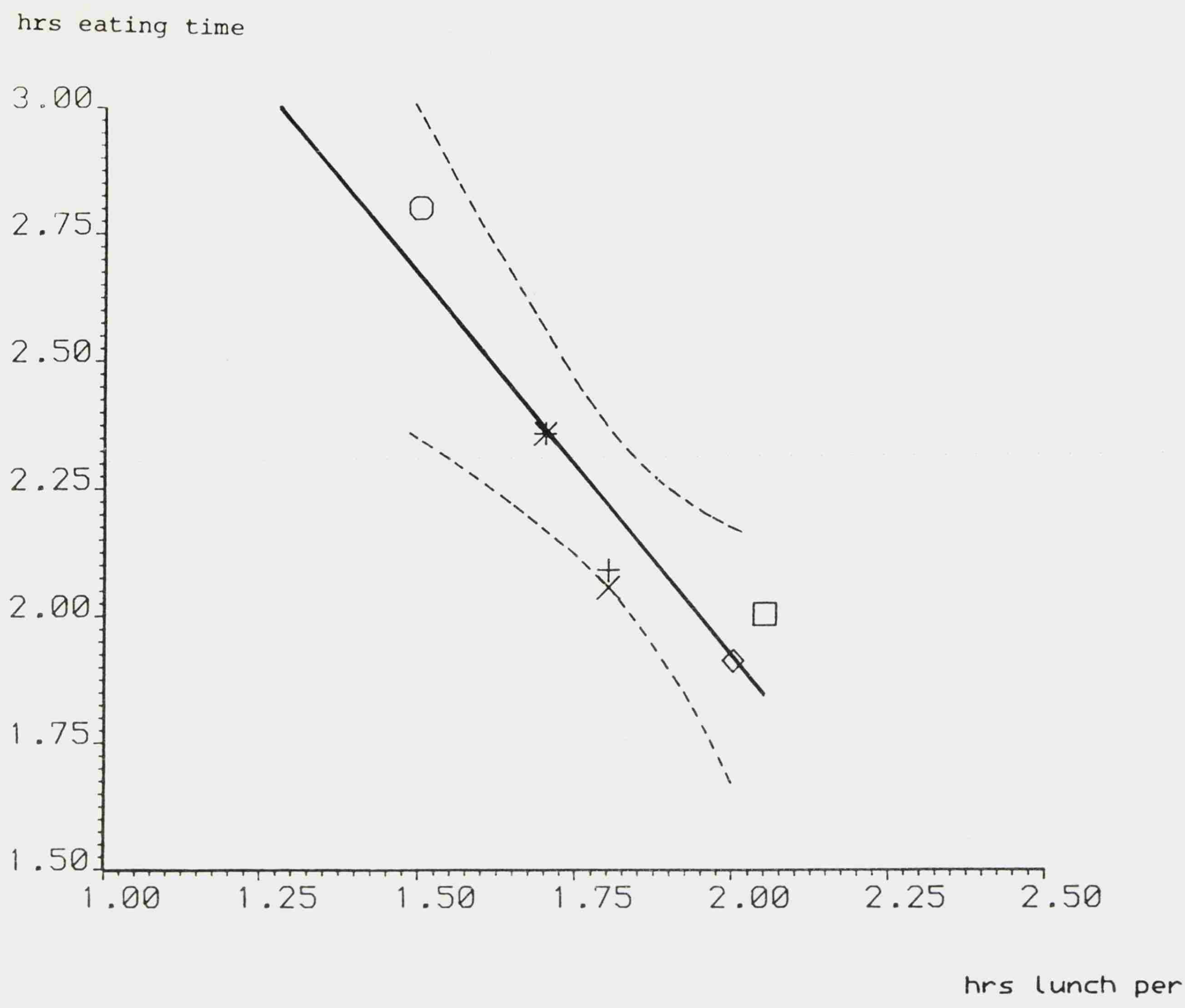


ILLUSTRATION 8.2

RELATION BETWEEN THE DURATION OF THE LUNCH PERIOD AND TOTAL TIME SPENT ON EATING

✳ Whiteknights

○ Dual site

◇ London Road

□ Leicester Polytechnic

× Leicester University

+ Leicester Un residents

* Coefficient of determination= 0.9

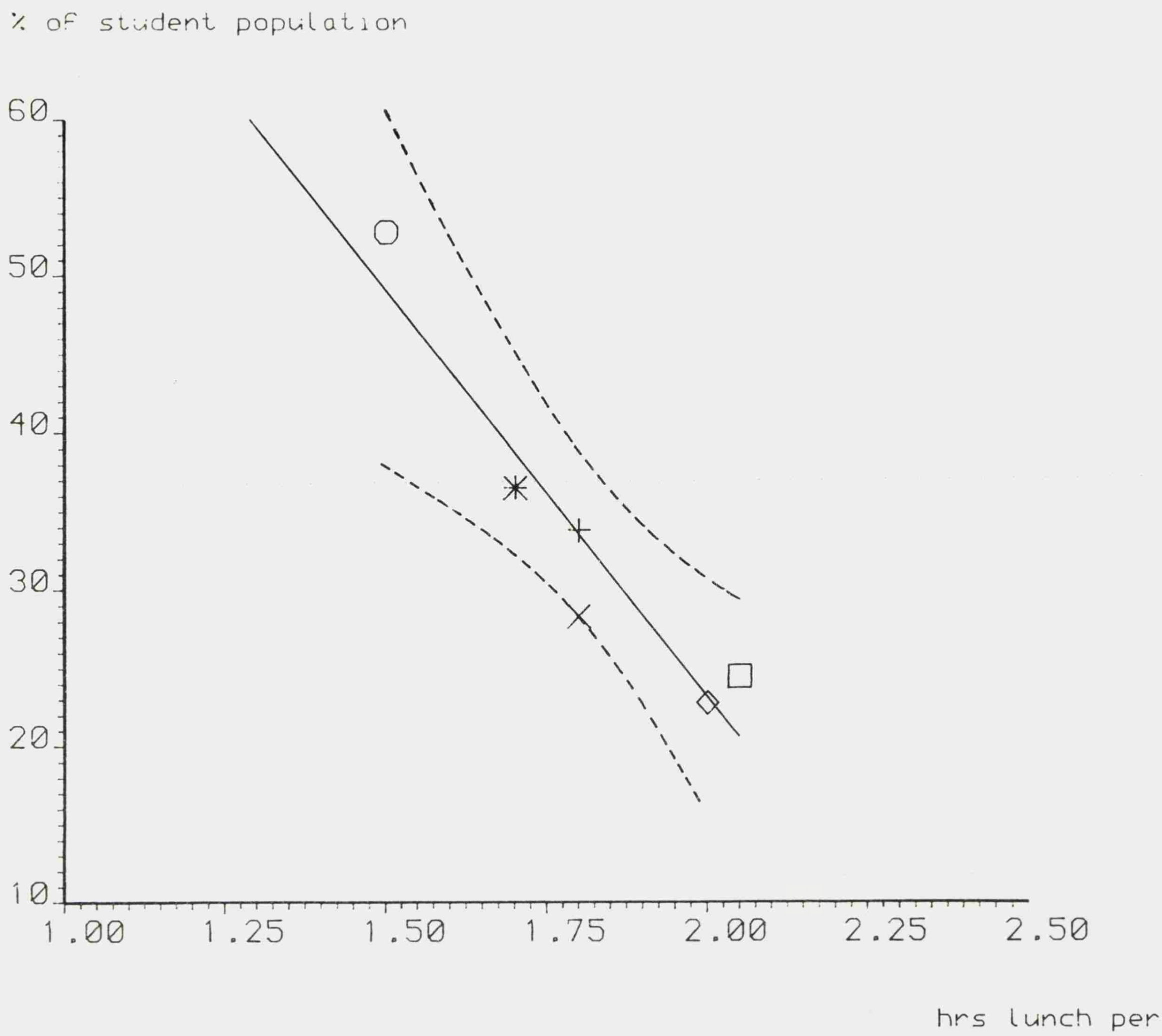


ILLUSTRATION 8.3

RELATION BETWEEN DURATION OF LUNCH PERIOD AND PERCENTAGE OF STUDENTS EATING AT PEAK TIME

✳ Whiteknights

○ Dual site

◇ London Road

□ Leicester Polytechnic

✕ Leicester University

+ Leicester Un residents

* Coefficient of determination= 0.901

should also have an effect on the peak eating values. However upon inspecting this subject, it was found that when the number of students leaving the campus where considered to have had their lunch there, the correlation between the factors involved, the duration of the lunch period and the eating time, weakened. Furthermore the small deviation shown in illustration (8.4) also suggests a limited influence. This leads to the obvious conclusion that most of the students leaving the campus during this period do not do so to eat outside. A follow up on the survey diaries confirmed this.

The actual duration of the lunch period depends on the time between its most restricting denominators. Students actually start lunch either after the end of their lectures or the opening of the refectory service, depending on which is later. They stop when lectures start or when the refectory stops serving, depending on which is earlier.

8.5.2 RESIDENT STUDENTS' EATING ARRANGEMENTS

Studying the attitude of the resident students towards the use of refectories in the Universities of Reading and Leicester from the surveys proved to be a thankless job. The students in Leicester do not live on campus, and thus their reaction was similar to those of

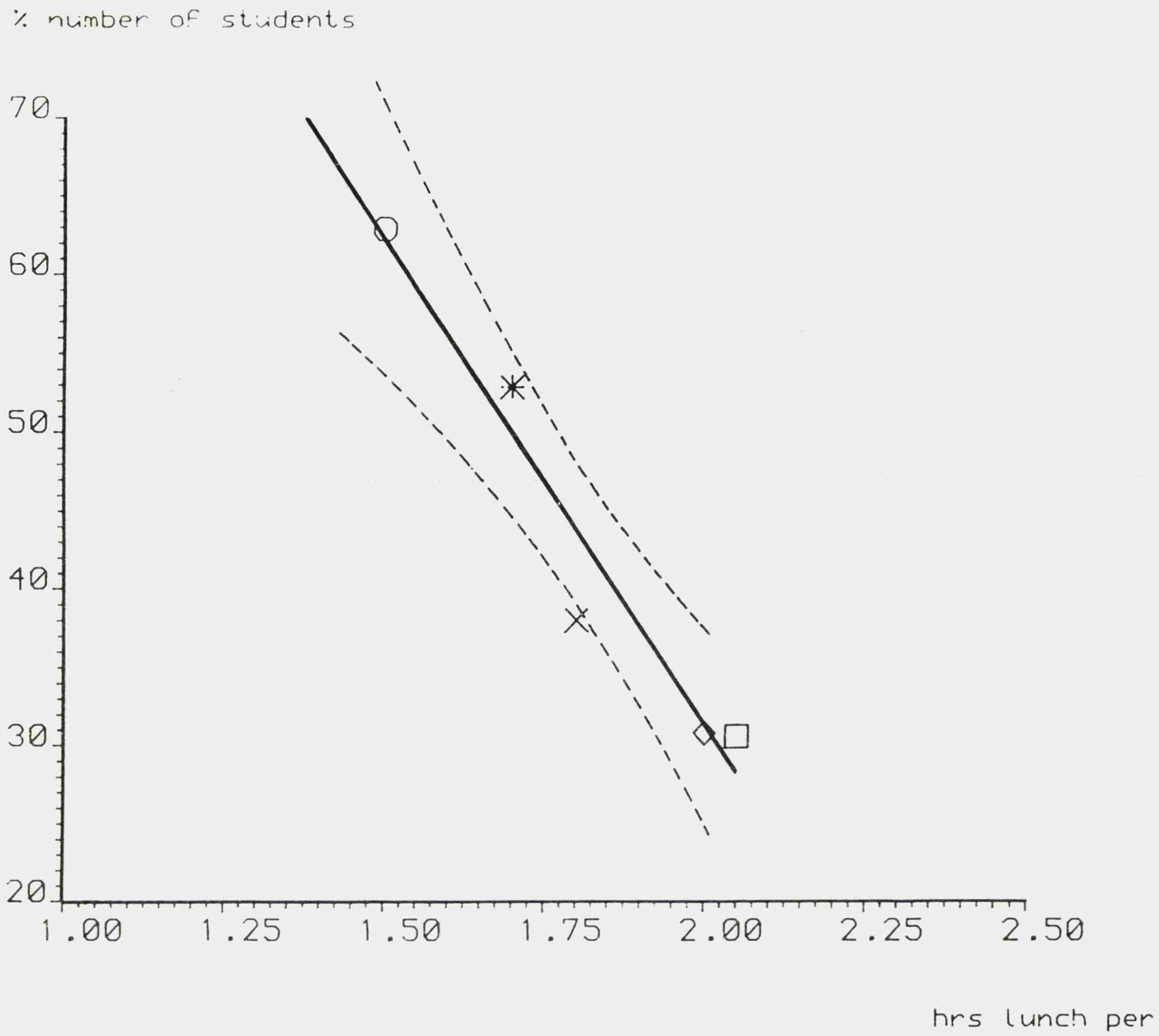


ILLUSTRATION 8.4

PEAK EATING PERCENTAGES WITH RESPECT TO THE NUMBER OF STUDENTS ACTUALLY IN CAMPUS

✳ Whiteknights

○ Dual site

◇ London Road

□ Leicester Polytechnic

✕ Leicester University

* Coefficient of determination= 0.94

non-resident students. Indeed it complies with the findings of the graphs for non-resident students in illustrations (8.3) and (8.4) quite well. The students in Reading University on the other hand, had to eat in residence for the reasons explained earlier, and thus could not be surveyed to find how much use they made of the campus's refectories because they didnt use them at all. Consequently a separate survey had to be made on another campus to find the required statistics.

The new survey was done in the University of Bath, where the resident students live on campus and are under no obligations to eat lunch in any particular place, and they have their own kitchens (app E). Around 75 resident students where surveyed to find how much use they made of the campus's refectories at the lunch hour during weekdays. The results were that the male students used the refectories 35.9% of the time, preferring to eat in residence, and cooking their own food. The females used the refectories even less, not exceeding 10% of the time. The actual results were 63.5/177 for males, and 19.5/196 for females. No difference could be discerned between undergraduate and postgraduate students in this respect.

To convert the findings of the survey in the University of Bath into tangible spatial requirements, they had to be compared with another similar situation for which all the relevant parameters were included and results could be found. This was not difficult, since with the new information, the resident students could be compared with non-residents. The latter use the refectory 95% of the time, and when compared directly with the findings of the survey produced the results found in illustration (8.5). These were then converted into peak time values, similar to those for non-resident students, and can be found in table (8.7).

To find the area needed for eating space in a campus, according to the above, the following steps should be taken. First find how long the distribution of meals will take. Secondly calculate, from the graphs in illustrations (8.4) and (8.5) the peak value for each group of students. Finally the results should be converted into numbers of students, which can then be added up directly to find the number of required eating stations (see app. D for example).

8.6 READING IN THE LIBRARY

Not many students appeared to use the library for reading during the course of a normal day (See graphs in appendix C). In fact the number was so small that it was not possible to acquire reliable figures for daily activity graphs except for the resident students in Whiteknights, were the sample contained 136 students.

CAMPUS	HOURS DURATION	PERCENTAGE OF STUDENTS	
		% MALE	% FEMALE
WTNTS	1.7	18.04	5.03
DUAL	1.5	21.45	5.96
LNDN RD	2.0	10.50	2.92
LSTR UN	1.8	12.96	3.61
LCP	2.05	10.43	2.91

TABLE 8.7

CONVERSION OF FIGURES FOR NON RESIDENT STUDENTS TO FIND THE PEAK VALUES FOR EATING TIME IN RELATION TO THE OTHER RELEVANT FACTORS.

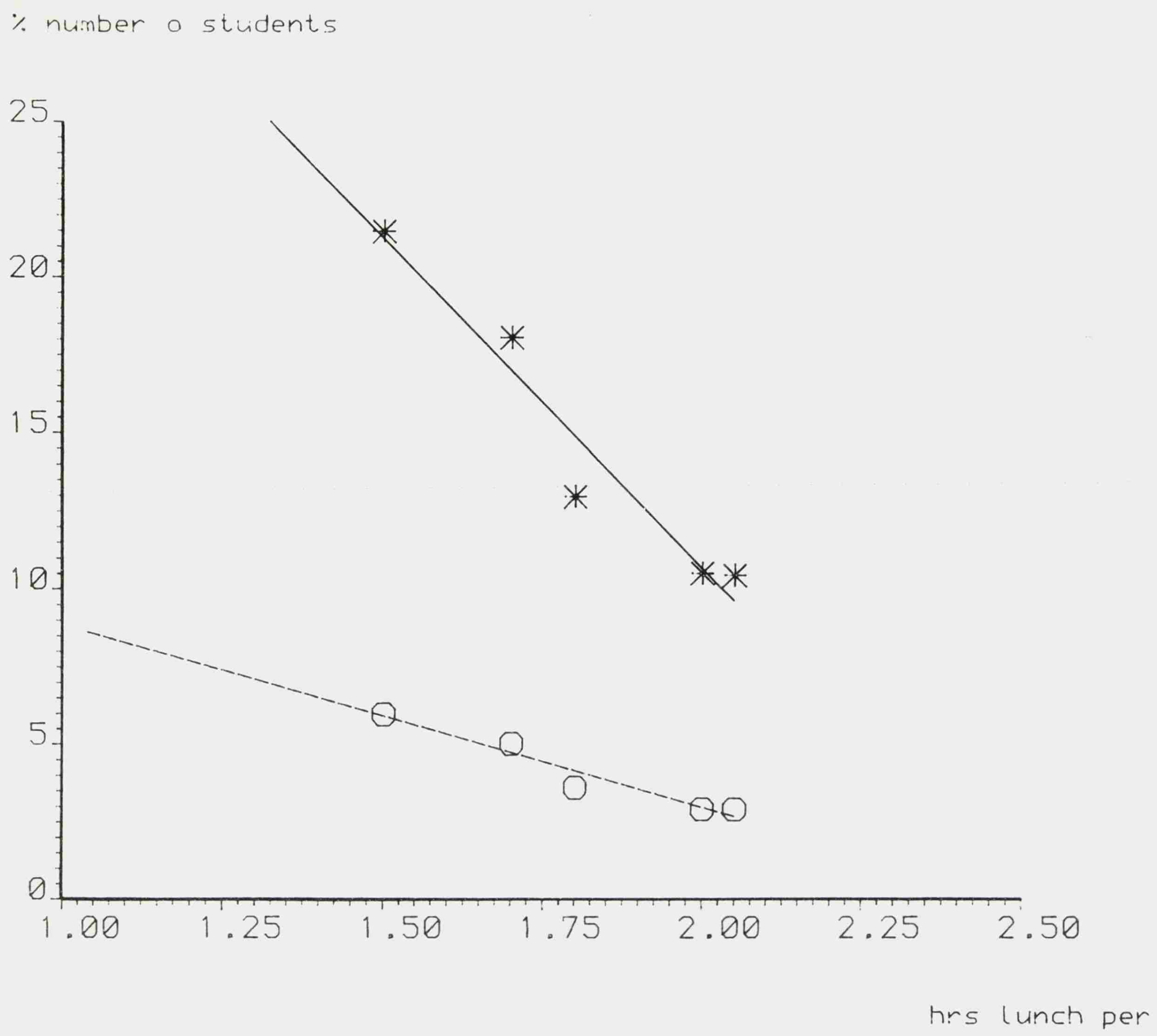


ILLUSTRATION 8.5

CALLIBRATION FOR NUMBER OF RESIDENT STUDENTS
USING REFECTORY IN A PARTICULAR SITUATION

______ Male students

_ _ _ _ _ _ Female students

Otherwise the numbers were so low that small changes of even one student, caused large deviations in the figures. Consequently it was necessary to disregard the daily activity graphs and concentrate on using the weekly total times. Nevertheless, the cases with smaller student numbers in them, Dual site non-residents and both of the London Road cases, had to be disregarded because the results obtained from their respective results were considered to lack trustworthiness. The remaining results can be seen in illustration (8.6). These show that the resident students use the library more than the non-residents as explained earlier in chapter seven. Furthermore the ratio dropped from Whiteknights to Leicester University because of the increased similarity with the non-resident situation, which is almost complete in of Leicester. The overlap in the confidence limits between Whiteknights and Dual site students indicates that the differences between them may be a result of chance. As for non-resident students, the variations were limited. The small difference between Leicester University and the other two campuses may be a product of chance as the confidence limits show. The slightly higher portion of non-resident students using the Library in Whiteknights compared to Leicester Polytechnic may be because of the location of each facility. The Library in Whiteknights is in the very centre of the academic site, while in Leicester Polytechnic it is on the outer edge (ill 4.5 and 4.7). This may convince some students to

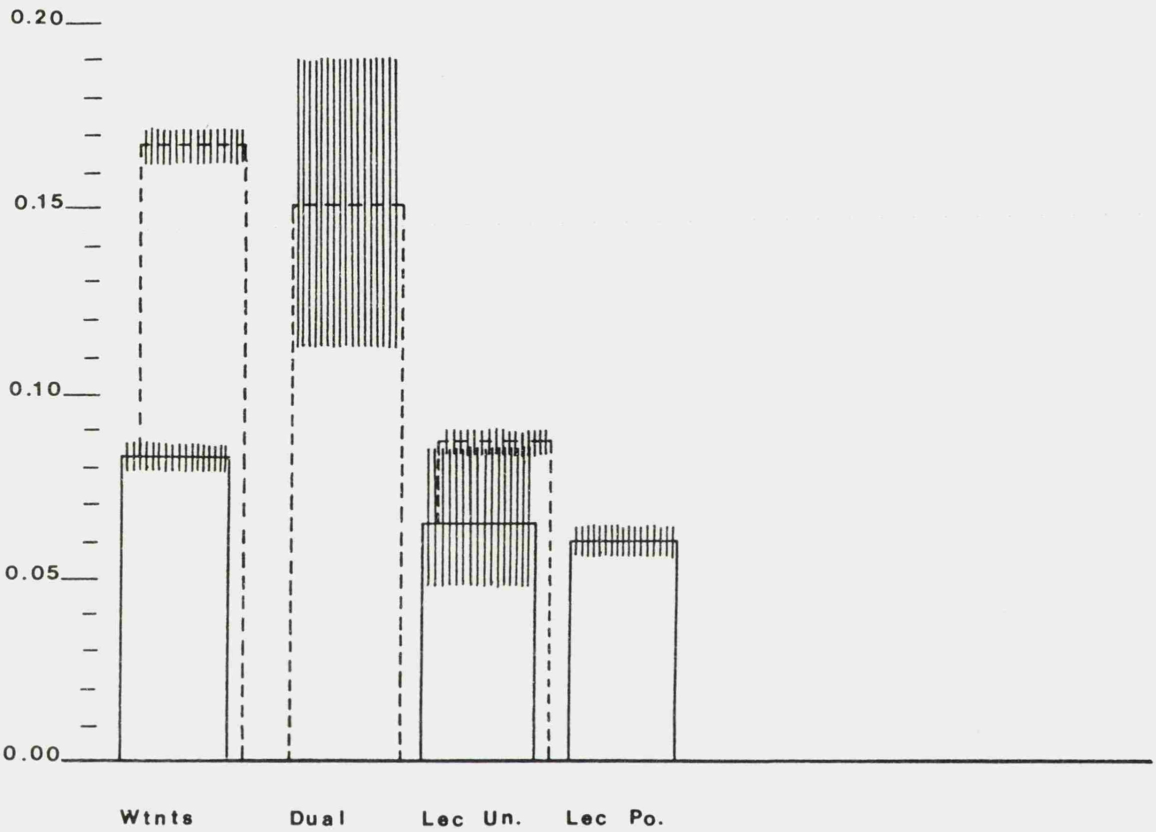


ILLUSTRATION 8.6

READING IN LIBRARY TIME AS RATIO OF TOTAL READING TIME. DOTTED LINE IS FOR RESIDENT STUDENTS.

|||||| Statistical confidence limit for 95% probable accuracy

study in the more popular common rooms than undertake the trip. However the difference of 12-20% would not produce more than 0.1% error on the the total non-scheduled campus areas, and can be ignored for practicle reasons.

The daily activity graph for the resident students in Whiteknights, which was the only one large enough to show acceptable results for library use, revealed that the daily use of the library rose and fell in accordance with the same results for general reading (app C, fig 23). This meant that the multiplication factor used to convert general reading into peak values could be used for reading in the library as well. With this in mind, it is now possible to calculate, with acceptable accuracy, the number of reading station needed in a campus (app D). This can be explained as follows:

1. NON RESIDENT STUDENTS
   a. Multiply total reading by 0.07225 to find reading in library.
   b. Multiply by 3.4 to find peak value as a percentage of total number of non-resident students. This figure 3.4 is the same as that used for general reading as was explained above.
2. RESIDENT STUDENTS

I. Library Reading
   a. If residence is in campus, multiply total reading

by 0.168 which is the ratio for Whiteknights.

b. If residence off campus, multiply total reading by 0.107 which is the ratio for Leicester University.

II. General Reading

c. Multiply result by 3.4 for peak value.

8.7 PART TIME STUDENTS

As was stated earlier in chapter seven, part time students spend very little of their free time on campus. This can be further emphasised by examining figure (19) in appendix (C). It shows clearly that the behaviour of these students is very "lecture minded". They basically come to the campus to attend these lectures and consider doing little else there. Indeed even eating in the site is limited.

Of the free time activities, social activities are the ones most frequently done by part time students. Unfortunately Leicester Polytechnic has long coffee breaks which distort social activity patterns with respect to other campuses. Nevertheless, because the quantity itself is so low, a large margin of error is tolerable. A conversion to equivalent values for shorter coffee breaks can be managed by comparing the figures for part time students to those of full time students, who also had the same problem. The respective multiplication factors for shorter coffee breaks, to be used for other campuses to convert social per scheduled (This is the unit of measurement for these students, not time per student (chapter seven)) to reasonable peak values would thus be 5.58. For the existing long coffee breaks, it is 7.692. These numbers when multiplied by the total social time per scheduled hour, would result in an approximate figure for the peak percentage of part time students performing social activities per day.

Reading in campus was not an activity favoured by part time students. However for the small quantity observed, the multiplication factor per scheduled hour was around 30. The peculiar thing about the reading habits of these students was that it appeared that almost all of there reading on campus was done in the library. However it is logical when considering their somewhat isolated position, and that reading done outside the library usually has a group and social appearance.

Social plus reading need not be calculated for part time students. The reason obviously is because since reading is rarely done in common areas, the two activities need not be combined.

The most surprising phenomenon concerning part time students was their eating habits. They rarely ate on campus and when they did it appears that very little of that was in the refectories or similar areas. To find out why, it was necessary to investigate the original diaries again. There appeared to be several reasons behind this phenomenon. First some of these students only attend morning or afternoon sessions and have lunch before they arrive or after they leave respectively. Secondly some are housewives who are willing to prepare their own meals at home (sandwiches) before they come, and since they only attend about once a week, they don't find the habit restricting. Thirdly some have their own cars and can take advantage of the long lunch break to go home and eat with their families. Fourthly some simply eat outside the campus, which could even be in the same place where they usually eat in a normal working day.

The students from the group mentioned above left very few to add to the load on the refectories. Of the small figure appearing in the graph in appendix (C), only about one third were actually eating in the refectory. Consequently it seems reasonable that complicated calculations to find how much space is needed to accommodate them in such spaces are unnecessary, and a simple general additional area may be deduced from the graph in appendix (C). The maximum of 2-3% of the number of part time students, from that graph, can be achieved by using a multiplication factor of 50-70 to convert the total eating time per scheduled hour, which was 0.041, to the peak value, ie; (50 to 70) x 0.041= 2-3%. This means that in the case of Leicester Polytechnic, only 50 to 70 seats are required to seat all the part time students (it is only a coincidence that 50-70 corresponds to the multiplication factor). It must be kept in mind that with shorter lunch breaks, the demand should rise slightly.

8.8 POSTGRADUATE STUDENTS

The behaviour of postgraduate students on campus was erratic. This follows their flexible daily programme which presents few restrictions on their schedule. By observing the graphs in appendix (C) concerning postgraduates (figs 20-22), the differences between the several kinds of study are obvious. Especially were study by research or course is concerned, and if the study by research is through applied work or private study. Without a large enough number of samples to study the variances, it is only possible to find approximate general rules, remembering that due to the relatively small number of postgraduate students in the campus, the margin for error can be expanded without undue cause for concern.

Social are the most important activities concerning postgraduate students. These are often done in the same spaces as those used by the undergraduates. The peak times from the graphs show a reasonable maximum range of 20-25%. The higher percentage should represent a mixture of students with a larger share of scheduled hours, the smaller peak their opposites, those with less scheduled. This is compatible with the behaviour pattern found for undergraduate students also, more scheduled means more social entertainment needed. Some of the time spent on this activity is done in the private offices, but it was not possible to find out how much.

Reading is'nt an activity that needs to be calculated for postgraduate students, because they usually conduct their work in private studies and not in common rooms. Reading in the library was very low, probably for the same reasons. It varied between 2-5% of the total number of postgraduate students, which is minimal and need'nt be calculated precisely. The maximum peak 2-5% can be used directly.

Eating arrangements proved to be another peculiarity of postgraduate students. No matter what the length of the lunch break, eating time in refectories always peaked at around 45%. After some investigation the reason was found to be the flexibility of their programme. They usually visited the refectories at the time which they thought to be the best of the day regardless of other factors which influence other students such as lectures. Consequently the figure of 45% can be considered constant to a certain degree.

CHAPTER NINE

EVALUATION OF SPATIAL ALLOCATION RESULTS

After going through the trouble of studying students' activities in detail to find if it is possible to use them for planning purposes, it would be interesting to find if they offer any significant difference for the actual planning process. From the study that was done during the run-up to the work proper in chapters one to three, the expectations are that the new method should offer a more realistic outlook to the spatial requirements from what appears to be a tendency for existing methods to offer an over-supply of space, and to have the ability to conform to changing needs of different establishments. These are the main problems. The term "over-supply of space" used with respect to spatial calculations using existing methods is strictly referred to in this chapter in terms of utilization levels and not comfort, the distinction is important as one does not imply the other.

Since the activity method exclusively involves student activities only, the areas that need to be studied here are only those related to student used areas. These include most of the university's spaces to the exclusion of staff offices, maintenance and store rooms, mechanical plant rooms, and administrative space. Furthermore, since the need for teaching areas is already calculated using activity requirements through employment of class timetables, it need not be changed in either method, existing or activity.

9.1 EXAMPLE OF SPATIAL CALCULATIONS

An example on one way of using activities to calculate spatial needs for universities is available in appendix (D). Two hypothetical establishments are involved with only a limited range of student entries, and no part-time or post-graduate students, to simplify calculations. The same hypothetical establishments will be used for the examples in this chapter. Briefly these are two universities with the following characteristics:

UNIVERSITY X

Number of students = 4000

Non resident = 3200

Resident = 800

Resident males = 600

Resident females = 200

Duration of lunch period = 1.8 hours

Lectures per week per student = 14 hours

Applied per week per student = 2 hours

UNIVERSITY Y

Number of students = 4000

Non resident = 800

Resident = 3200

Resident males = 2200

Resident females = 1000

Duration of lunch period = 2 hours

Lectures per week per student = 11 hours

Applied per week per student = 5 hours

9.1.1 EXAMPLE OF SPATIAL CALCULATIONS FOR HYPOTHETICAL UNIVERSITIES USING EXISTING METHODS

The source of the material that determined the steps used for, calculating the various areas in this example came from British acquired norms [refs 9, 30, and 45], or, where necessary, from their American counterpart [ref 21]. The scheduled areas were calculated for two separate economic targets, one of austerity, the other for generous spatial distribution. Applied on the two hypothetical universities outlined above, this would provide a total of four different samples; 1) Generous space, low ratio of resident students, high ratio of lecture hours, 2) Economic spatial allocations, low ratio of resident students, high ratio of lecture hours, 3) Generous space, high ratio of resident students, high ratio of applied hours, and 4) Economic spatial allocation, high ratio of resident students, and high ratio of applied hours. The economic targets were varied by applying the opposite ends of utilization levels for teaching areas as currently available in British universities.

1. NON SPECIALISED TEACHING AREAS: The calculations for teaching areas are the same for both the existing and new (activity) methods, and are as follows:

UNIVERSITY X

14 lect/week x 4000st = 56,000 st hrs

An average area per seat of 1.3 m^2, and a utilization level of between 0.50-0.20 will be used to show the difference between an economic allocation and a more generous one. These are the existing utilization levels in Britain today [ref 46]. The resultant spatial requirements would be:

Generous; 56,000/ 0.2 = 280,000 space hr

Economic; 56,000/ 0.5 = 112,000 space hr

The number of seats required for a 40 hour week would thus be;

Generous; 280,000/40 = 7,000 seats

Economic; 112,000/40 = 2,800 seats

The resultant area would be;

Generous; 1.3 m^2/seat x 7000 = 9,100m^2

Economic; 1.3 m^2/seat x 2800 = 3,640m^2

UNIVERSITY Y

11 x 4000 = 44.000 st.hrs.

Gen; 44000/0.5 = 220,000

Ecm; 44000/0.2 = 88,000

Gen; 220000/40 = 5,500 seats

Ecm; 88000/40 = 2,200 seats

Gen; 1.3 x 5500 = 7,150m^2

Ecm; 1.3 x 2200 = 2,860m^2

2. SPECIALISED TEACHING AREAS: Specialized teaching areas in this example are calculated under the assumption that only one subject is taught and only one spatial standard is required. This is to simplify the calculations and does in no way compromise the accuracy of the results. The calculation method is exactly the same as for non specialised teaching areas so the explanations will be summarised.

UNIVERSITY X

The utilization level for these spaces are generally calculated at 80% but variations occur in availability of spaces in terms of hours use per week. This ranges between 20-24 hours.

2 hrs/week x 4000st = 8000 hrs/week

8000/0.8 = 10,000 seat hours (or station hours)

Gen; 10000/20 = 500 stations

Ecm; 10000/24 = 417 stations

And assuming $8m^2$ per station is sufficient;

Gen; $8 \times 500 = 4{,}000m^2$

Ecm; $8 \times 417 = 3{,}336m^2$

The difference between university X and Y at the present stage is entirely due to varying requirements between a technical (case Y) and non-technical (case X) establishment. These differences are well known and arise due to the large area needed for specialised teaching space.

UNIVERSITY Y

The same procedure produced the following results;

Gen; $10{,}000m^2$

Ecm; $8{,}336m^2$

3. OTHER SPACES: These spaces will not be discussed in terms of generous or economic spacing terms. This is because the existing methods used to calculate them do not depend on activities so utilization levels are not available. Furthermore, these methods also discount any possible differences that may occur due to variations in

the subject being taught or the percentage of resident students, so the calculations will be the same for both university X and Y.

A) Library. For an assumed capacity of 500,000 books.

Bookshelf space = 4,134m^2 gross area

Reading area; calculated to accommodate 25% of the student population [ref 21] at 2.8m^2 per station = 2,800m^2 gross area.

Total library area = 6,934m^2

B) Catering area. It proved difficult to find an acknowledged estimate of the need for such space. However it was found that in the calculations for the University of Bath, it was assumed that enough space would be needed to accommodate 90% of the student population. This percentage was based on the fact that there were no surrounding facilities that the students could use. It was also assumed that the students would eat in two sittings (shifts). The same assumptions will be used for universities X and Y.

90% x 4000 = 3,600st

For two sittings; 3600/2 x 1.2m^2/seat = 2,160m^2

The kitchen area would require around 50% of this area, ie; $1,080m^2$.

Total area = $3,240m^2$

3) Communal space. The need for such space was judged to be $13.3ft^2$ per student, or around $1.23m^2$ [ref. 30].

$1.23 \times 4000 = 4,920m^2$.

4. TOTAL STUDENT USE AREA IN UNIVERSITY: To the individual areas calculated above will have to be added 40-60% additional space. This is to compensate for additional area required for circulation, plants, toilets, and buffer space, which is usually used for enlarging entrances or gathering areas. Since toilets and plant area are not included in the activity method, the addition of space will be restricted to 30% which would be for circulation and buffer space only to make proper comparisons possible. This is the percentage usually used for such purposes by planners. The results can be seen in tables (9.1 and 9.2).

9.1.2 EXAMPLE OF SPATIAL CALCULATIONS FOR HYPOTHETICAL UNIVERSITY USING ACTIVITY METHOD

It is very important to repeat what was mentioned

SPACE TYPE	**NET AREA**		**GROSS AREA**	
Library	6934		9014	
Catering	3240		4212	
Communal	4920		6396	
TEACHING SPACE	**ECNMC AREA**	**GNRS AREA**	**ECNMC AREA**	**GNRS AREA**
Non spec	3640	9100	4732	1183
Specilised	3336	4000	4338	5200
TOTAL			**29232**	**37192**

TABLE 9.1

SPATIAL ALLOCATIONS FOR UNIVERSITY X.

SPACE TYPE	**NET AREA**		**GROSS AREA**	
TEACHING SPACE	**ECNMC AREA**	**GNRS AREA**	**ECNMC AREA**	**GNRS AREA**
Non spec	2860	7150	3718	9295
Specilised	8336	10000	10837	13000
TOTAL			**34717**	**42421**

TABLE 9.2

SPATIAL ALLOCATION FOR UNIVERSITY Y. THE AREAS FOR LIBRARY, CATERING, AND COMMUNAL SPACE IS THE SAME AS FOR UNIVERSITY X (TABLE 9.2).

earlier in chapter eight about the necessity of establishing a criteria to use the activity times in translating them to actual areas. In this example the one used is the "reasonable maximum plus safety factor" one mentioned in that chapter, and once again it must be ascertained that this does not amount to a recommendation, merely that it seems to be a logical choice for this situations. What this method means is that instead of using the absolute maximum period, which may be a very sharp rise which only lasts for a few seconds, a reasonable maximum is selected, and to this maximum a safety factor is added to allow for seasonal variations and comfort in the use of the space. The exception to the rule is the eating time maximum period which was calculated for the absolute maximum. This is because of the limited time available to the students for lunch, and the necessity to provide a seat for each prospective diner. Furthermore the eating time calculations are based on a simple mathematical rule which discounts the need for a "reasonable" maximum.

The value of the safety factor changes according to the type of space. It depends on how much utilization is actually sought after. In the view of the research done by Doidge [ref 17] on this subject, it is obvious that areas that are designed to accommodate the maximum need are areas which are felt by their users to be crowded and under spaced. How much space above the maximum is necessary to provide enough of a psychological buffer is not known. However in this example only a small buffer will be added, not so much as to allow for this psychological phenomenon, but rather to allow for comfortable use of space such as to allow small groups to choose adjacent seats for example. As a result, a feeling of crowdedness may possibly be felt by the users of these spaces, and the resultant areas are certainly going to be below the usual provided by existing methods, but they do allow for a valuable comparative study. In other words, to find how much area beyond the necessary is being provided by existing methods in comparison with the activity method. 'Necessary' being the minimum space sufficient to accommodate the potential users in what is judged to be reasonable comfort.

The other point worth mentioning regards circulation space. Since the area for social gatherings is all included in the social activity times, the circulation area which is calculated need only be calculated for that purpose alone, any additional buffer space for gathering areas can be taken from the area allowed for social activities. The percentage that is usually suggested for pure circulation ranges between 12-25%. These figures were taken from studies on building types such as shopping centres, where keeping circulation space down to a minimum is often sought after. The figure that will be used in this example is 15%.

The areas for teaching space will be the same as those calculated using existing methods, as explained earlier, so only the non teaching areas will be calculated here.

The number of users for the reasonable maximum daytime period are all taken from the calculations done on the two exampleS in appendix (D).

UNIVERSITY X

A) Library. Area for stacks = 4,134m^2, same as for non activity method. Number of stations =57 (app D), and the safety factor is 100%. This is to compensate for the seasonal variations which account for higher demand during end of term periods. The resultant area, although still far less than the area allocated using existing methods which requires space for 25% of the students, was thought to be enough. The reason was that it was considered illogical to provide space which would only be used at 10-20% capacity, on average during the day, which would be the outcome if a large safety factor was employed. The 100% addition allows for around 35% utilization during the average period of daytime usage.

Reading area = $2.8m^2/st \times 57 = 159.5m^2$

Plus safety factor = $319m^2$

Total for library = $4,453m^2$

B) Catering. Number of seats = 1240 (app D), and only 15% safety factor because of the use of absolute maximum, and because the maximum period is very sharp and short.

Refectory area = $1.2 \times 1240 = 1,488m^2$

Plus 50% for kitchen and 15% safety area =$2,232m^2$

C) Social plus reading. Number of stations = 1150 (app D), and 20% safety factor.

Social + Reading = $1.65m^2/st \times 1150 = 1897m^2$

Plus safety = $1897 \times 1.2 = 2,277m^2$

UNIVERSITY B

A) Library. For 45 stations, area = $4,386m^2$.

B) Catering. For 640 stations, area = $883.2m^2$

C) Social plus Reading. For 664 stations, area = $1,315m^2$

SPACE TYPE	NET AREA		GROSS AREA	
Library	4453		5121	
Catering	2567		2952	
Communal	2277		2618	
TEACHING SPACE	**ECNMC AREA**	**GNRS AREA**	**ECNMC AREA**	**GNRS AREA**
Non spec	3640	9100	4186	10467
Specilised	3336	4000	3836	4600
TOTAL			**18713**	**25756**

TABLE 9.3

TOTAL AREAS FOR UNIVERSITY X USING THE ACTIVITIES METHOD. 15% IS ALLOWED FOR CIRCULATION.

SPACE TYPE	NET AREA	GROSS AREA
Library	4386	5043
Catering	883	1016
Communal	1315	1512
TOTAL	**20446**	**27294**

TABLE 9.4

TOTAL AREA FOR UNIVERITY Y USING THE ACTIVITY METHOD. THE TEACHING AREAS ARE THE SAME AS FOR UNIVERSITY X (TABLE 9.3).

9.2 COMPARISON BETWEEN EXISTING AND ACTIVITY METHODS IN EVALUATING SPATIAL NEEDS

As was expected, the results from applying the two methods produced different results, with the activity method giving lower figures. Table (9.5) shows a comparative study of two sets of results. The difference ranges from 44.4-69.8%, in terms of area, and from 5.259 to 7.564 million pounds in terms of expenditure.

This marked difference is owed to two factors. The first is the one already mentioned concerning the over-supply of space which is inherent in the existing methods, and the fact that the way the activity method was employed was designed to show off this difference by using high utilization ratios. The second concerns the ability of the activity method to show the different needs of campuses or universities which have different characteristics. The higher difference in table (9.5) was the case in university Y, which has a higher percentage of residential students. As explained earlier in the text, these need less space inside the campus for socialising, reading, and eating. Since existing methods cannot reflect this reduced need, the difference between the two methods grew even larger.

Another factor worth mentioning is that existing methods depend to a large extent on adding a percentage

ECONOMY	CALCTN METHOD		DIFFERENCE		
	ACT	EXIST	m^2	%	POUNDS
UNIVERSITY X					
ECONOMIC	18713	29232	10519	56.2%	5,259,000
GENEROUS	25756	37192	11436	44.4%	5,718,000
UNIVERSITY Y					
ECONOMIC	20446	34717	14271	69.8%	7,135,000
GENEROUS	27294	42421	15127	55.4%	7,546,000

TABLE 9.5

COMPARISON BETWEEN THE AREAS CALCULATED USING BOTH CALCULATING METHODS. THE DIFFERENCE IN POUNDS WAS ON THE BASIS OF A COST OF 500 POUNDS/METER.

ACTIVITY	UNIVERSITY X		UNIVERSITY Y	
	STATIONS	AREA	STATIONS	AREA
Soc+Read	1150	2277	664	1315
Library	57	319	45	252
Eating	1240	1711	640	883

TABLE 9.6

COMPARISON OF THE TWO HYPOTHETICAL UNIVERSITIES CALCULATED USNG THE ACTIVITY METHOD. THE AREAS INCLUDE SAFETY FACTORS.

of area to the scheduled teaching area to compensate for unlisted purposes. In the example used in this chapter it was 30%, to include circulation. Consequently the resultant area would increase with the decrease of utilization levels of teaching spaces, ie; more space for teaching spaces, for the same number of students would result in more space for social and communal needs. This would happen when in fact the need for such space would not change. For this reason the difference between the activity and existing methods in terms of area, or expenditure, was larger in the two examples where a generous amount of teaching space was given, 15,127m^2 or 7.596 million pounds, since the activity method calculated a fixed need for communal space with respect to the teaching space.

It is also interesting to compare, from tables (9.5) and (9.6), the two universities X and Y in terms of change in between them when using each calculation method. In existing methods the change was due to the different needs of teaching areas. For the activity method the difference was more complicated. In the non scheduled spaces, there is only a relatively small drop in the library reading space, but otherwise the change was between 57-71%. This resulted in a balancing of the total spatial requirements between the two universities where the increase in area in university Y, due to the higher demand of laboratory hours, was counteracted by the reduced need for non-teaching space from the larger number of resident students.

CHAPTER TEN

CONCLUSIONS

Variations between campus sites and universities or polytechnics do exist and do have an influence on the non-scheduled spatial need of each case. These affect the students in several ways and result in each campus having a different impact on the students. Such variations in impact may be of interest to the educational planners as well as to the architects. It is thus necessary that it be possible to explain the situation to all the parties concerned with the process in order to allow for the desired decisions to be made. To this end the relative activity graph has been introduced.

The factors which induced the change and the resultant changes themselves are numerous and take into account various aspects of each campus.

Changing the percentage of resident students in a campus has a profound effect . An increase implies relatively less need for common space to socialize and read in; less refectory space; larger site; more essential services; a higher attendance of scheduled hours, particularly the first class in the morning; and a lower passing rate for tests. Changing the place of residence on or off campus can remove some of these effects and decrease others. The rules regarding lunch time eating services may also have to be considered.

An increase in the number of scheduled hours that students have to attend results in less free time for students to spend in campus. The effect is more dramatic in the case of resident students. This implies less area for non-scheduled activities.

A change in the curriculum from one campus to the other also affects the students. If the change implies more applied hours, or less lectures, this means that less reading and more social activities will be performed by the non-resident students and vice versa. The influence on resident students is less profound. More applied usually also implies relatively more scheduled, which brings back the points mentioned on this subject earlier.

The increased size of a campus, in terms of number of students, encourages students to use it more. This applies equally to resident and non-resident students although the total effect appears to be small.

The location of the campus is only of consequence regarding its position relative to the urban centres. The closer it is to such places, the more willing the students will be to leave it during lunch time, although they rarely eat there. Consequently its effect on spatial allocation is only significant in terms of the provision of service facitilites.

An increase in the number of part time students in a campus adds little extra demand for space besides the scheduled, except for use of the library as it appears that they do almost all of their reading there. They socialise very little on campus, and they do not eat in the refectories often either.

Postgraduate students put extra demand on private study space and extra refectory space, but little in terms of reading area in the library. Extra common space is required only to house some of their social activities but not for reading, in contrast to undergraduates.

In organizational terms, the most obvious factor is the duration of the lunch break. For non-resident undergraduate students, longer lunch breaks mean lower peak times during lunch and a more evenly spread need for seats.

The planning method developed in this research has relied almost entirely on the data from two universities and one polytechnic. The results are applicable on other situations so long as they do not deviate strongly form the characteristics predominant in these establishments. This would include campuses strongly integrated into the urban environment with buildings from the surrounding vicinity closely related, and the campus not clearly defined as a single site, for instance. Its application on universities or polytechnics in other countries would require further research.

Employing activities for the planning process allows the planner to set the criteria he sees as most relevant to each individual case, and plan the subject accordingly. Direct comparisons with present methods re-emphasise the existing argument concerning the over-supply of space possible with these methods. Relatively large economic benefits are possible by using activities to calculate spatial needs for a reasonable rate of utilization. This is especially the case if the university or polytechnic being planned tends towards the characteristics that result in less need for space, such as a higher resident content. In such cases the difference between existing methods and using student activities could be as high as 70% of the student use area.

APPENDIX A

THE CONTENTS OF EACH ACTIVITY GROUP

GROUP ONE: APPLIED ACTIVITIES.

1. Attending practical laboratory class.
2. Work related external visits.
3. Studio work.
4. Research work in laboratory.
5. Working with laboratory equipment, performing experiments.
6. Preparing for laboratory work.
7. Listening to taped lecture.
8. Using language laboratory.
9. Playing musical equipment, work related.
10. Singing, work related.
11. painting, work related.
12. Listening to music, work related.
13 . Looking around a museum, work related.

GROUP TWO: LECTURES.

1. Attending lecture.
2. Attending seminar.
3. Taking test.

GROUP THREE: EATING.

This group is sometimes included with the social activities to calculate the social to reading ratio in a campus (see chapter six).

1. Breakfast.
2. Lunch.
3. Tea.
4. Snack.
5. Supper/Dinner.
6. Formal dinner.
7. Celebration meal.
8. Eating take away.
9. Queuing for meal.
10. Drinking tea/coffee alone.

GROUP FOUR: COMPLEMENTARY

GROUP FIVE: READING.

This group includes all the activities that have not been mentioned in other categories. They mainly consist of circulation, and administrative and service work.

Reading is divided into two sub-categories; reading in the library; and reading outside the library. The term "reading" on its own refers two all categories, ie; reading inside and outside library.

Reading Inside Library:

1. Using reference books.
2. Looking for books.
3. Taking and returning books.
4. Reserving books.
5. General use of library.

Reading outside library.

1. Reading (work).
2. Preparing for lecture or seminar.
3. Private study.
4. Writing and making notes.
5. Numerical exercises.
6. Drawing maps.

GROUP SIX: OTHER ACADEMIC WORK.

1. Discussion of work with fellow student.
2. Discussion of work with member of staff.
3. Collecting computer results.
4. Using xerox machine.
5. Colecting samples for experiments.
6. Arranging, waiting for, looking for, tutorial.
7. Looking at notice board.
8. Handing in work.

9. Punching computer cards.

10. Using computer terminal.

11. Collecting computer results.

GROUP SEVEN: SOCIAL ACTIVITIES.

1. Drinking alcoholic drink.

2. Casual small group social such as calling on friends, playing cards, or looking at slides.

3. Parties.

4. Bar games.

5. Attending public entertainment facilities, such as cinemas and theatres.

6. Individual leasure activities such as listening to music.

7. Watching television.

8. Outdoor leisure activities.

9. Hobbies.

10. Dancing and playing musical instruments for pleasure.

11. Playing sports for personal pleasure.

12. Convenience shopping like buying cigarettes.

GROUP EIGHT: TUTORIALS.

APPENDIX B

BASIC RESULTS FROM SURVEY ON PART-TIME AND POSTGRADUATE STUDENTS.

NAME OF ESTABLISHMENT = LEICESTER POLYTECHNIC

SITE = MAIN

NUMBER OF STUDENTS IN SURVEY = 29

ACTIVITY	TIME	TIME PER ST	
SOCIAL	22.4	0.77	±0.053
EATING	7.517	0.26	±4.36
LECTURE	161.2	5.55	±0.25
APPLIED	20.35	0.70	±0.079
TOTAL SCHEDULED	**181.45**	**6.257**	**±0.261**
TUTORIAL	9.0	0.31	±0.52
READING	17.967	0.619	±0.055
READING IN LIBRARY	4.05	0.135	±0.027
MISCELLANEOUS	44.533	1.535	±4.30
FREE TIME ON CAMPUS	101.66	3.505	±0.13
TOTAL TIME ON CAMPUS	**283.116**	**10.11**	**±0.347**

TABLE 1

TIME SPENT ON ACTIVITIES PER WEEK FOR PART TIME STUDENTS

NAME OF ESTABLISHMENT = UNIVERSITY OF READING

SITE = WHITEKNIGHTS

NUMBER OF STUDENTS = 9

ACTIVITY	TIME	TIME PER ST	
SOCIAL	27.017	3.002	±0.462
EATING	26.167	3.907	±0.485
LECTURE	19.500	2.167	±0.716
APPLIED	69.416	7.713	±2.061
TOTAL SCHEDULED	**88.916**	**9.880**	**±2.027**
TUTORIAL	8.667	0.96	±30.365
READING	35.483	3.943	±1.158
READING IN LIBRARY	1.900	0.211	±0.135
READING NOT IN LIBRARY	33.583	3.731	±1.63
MISCELLANEOUS	54.248	6.028	±3.533
FREE TIME ON CAMPUS	207.282	23.031	±3.115
TOTAL TIME ON CAMPUS	**296.198**	**32.911**	**±2.848**

TABLE 2

TIME SPENT ON ACTIVITIES PER WEEK FOR NON RESIDENT POSTGRADUATE STUDENTS

NAME OF ESTABLISHMENT	= UNIVERSITY OF LEICESTER
SITE	= MAIN
NUMBER OF STUDENTS	= 14

ACTIVITY	TIME	TIME PER STUDENT	
SOCIAL	64.317	4.954	±0.499
EATING	64.316	3.141	±0.296
LECTURE	44.917	3.208	±0.562
APPLIED	35.383	2.527	±0.389
TOTAL SCHEDULED	**80.290**	**5.735**	**±0.783**
TUTORIAL	7.450	0.532	±0.095
READING	182.366	13.026	±1.53
READING IN LIBRARY	8.283	0.592	±0.133
READING NOT IN LIBRARY	174.083	12.434	±1.506
MISCELLANEOUS	86.380	6.170	±1.743
FREE TIME ON CAMPUS	390.346	27.882	±1.939
TOTAL TIME ON CAMPUS	**470.647**	**33.618**	**±1.811**

TABLE 3

TIME SPENT ON ACTIVITIES PER WEEK FOR NON RESIDENT POSTGRADUATES

NAME OF ESTABLISHMENT = UNIVERSITY OF READING

SITE = WHITEKNIGHTS

NUMBER OF STUDENTS IN SURVEY = 13

ACTIVITY	800 TO 1800 TIME	PER ST	TO 2400 PER ST
SOCIAL	35.21	2.709 ±0.201	
EATING	15.35	1.182 ±0.183	
LECTURE	70.43	5.418 ±0.129	
APPLIED	59.58	4.583 ±0.304	
TOTAL SCHEDULED	**130.02**	**10.00 ±0.118**	
TUTORIAL	5.90	0.454 ±0.230	
READING	42.32	3.225 ±0.225	
READING IN LIBRARY	5.25	0.409 ±0.313	
READING NOT IN LIBRARY	37.07	2.851 ±0.236	
TOTAL IN NON RES. AREA	**404.60**	**31.12 ±0.134**	**52.211**
SOCIAL IN RESIDENCE	59.58	4.583 ±0.321	10.097
READING IN RESIDENCE	78.57	6.044 ±0.267	9.886
TOTAL IN RESIDENCE	**138.15**	**10.63 ±0.258**	**19.983**
FREE TIME; ALL CAMPUS	**412.73**	**31.75 ±0.170**	**41.362**
TOTAL TIME; ALL CAMPUS	**542.75**	**41.75 ±0.137**	**72.199**

TABLE 4

TIME SPENT ON ACTIVITIES PER WEEK FOR RESIDENT POSTGRADUATE STUDENTS

APPENDIX C

DAILY ACTIVITY GRAPHS FOR ALL STUDENTS

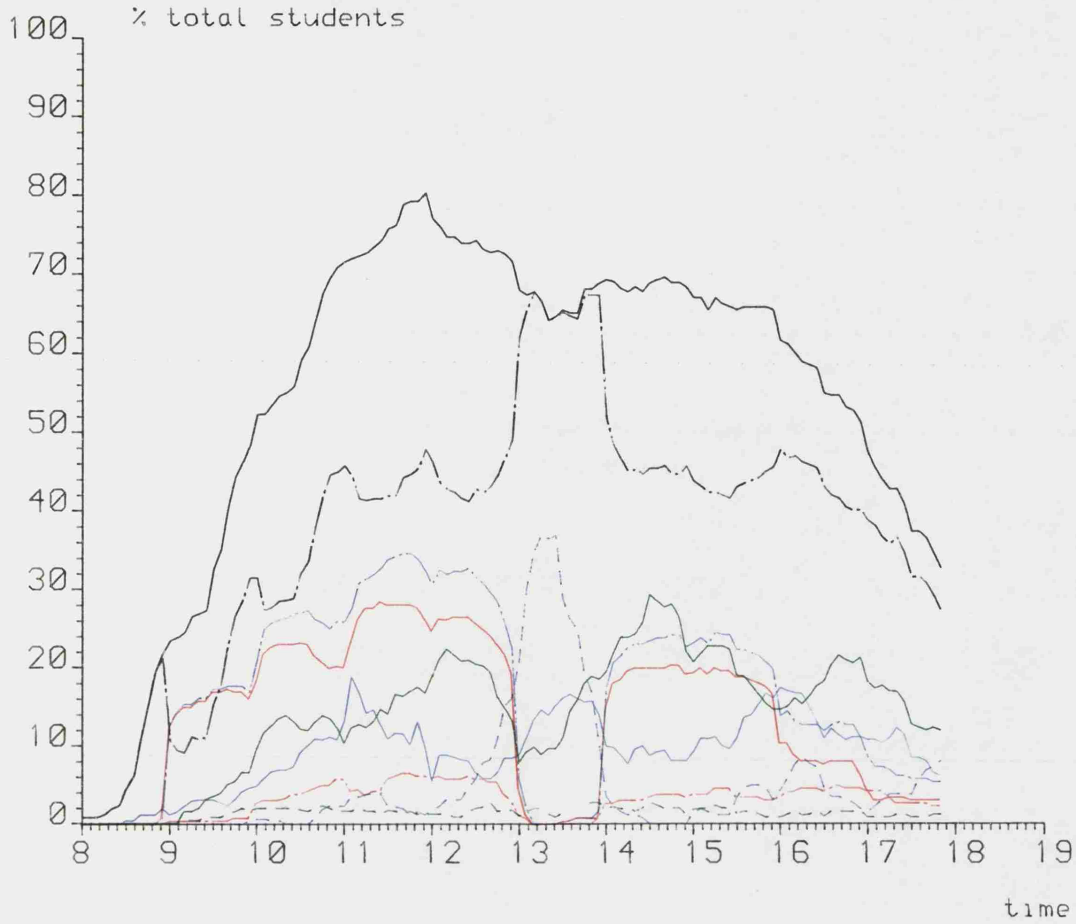


Figure 1

READING UNIVERSITY WHITEKNIGHTS
NON RESIDENT UNDERGRADUATE STUDENTS

Total
Reading
Social
Lectures
Applied
Scheduled
Total minus scheduled
Reading in library
Eating

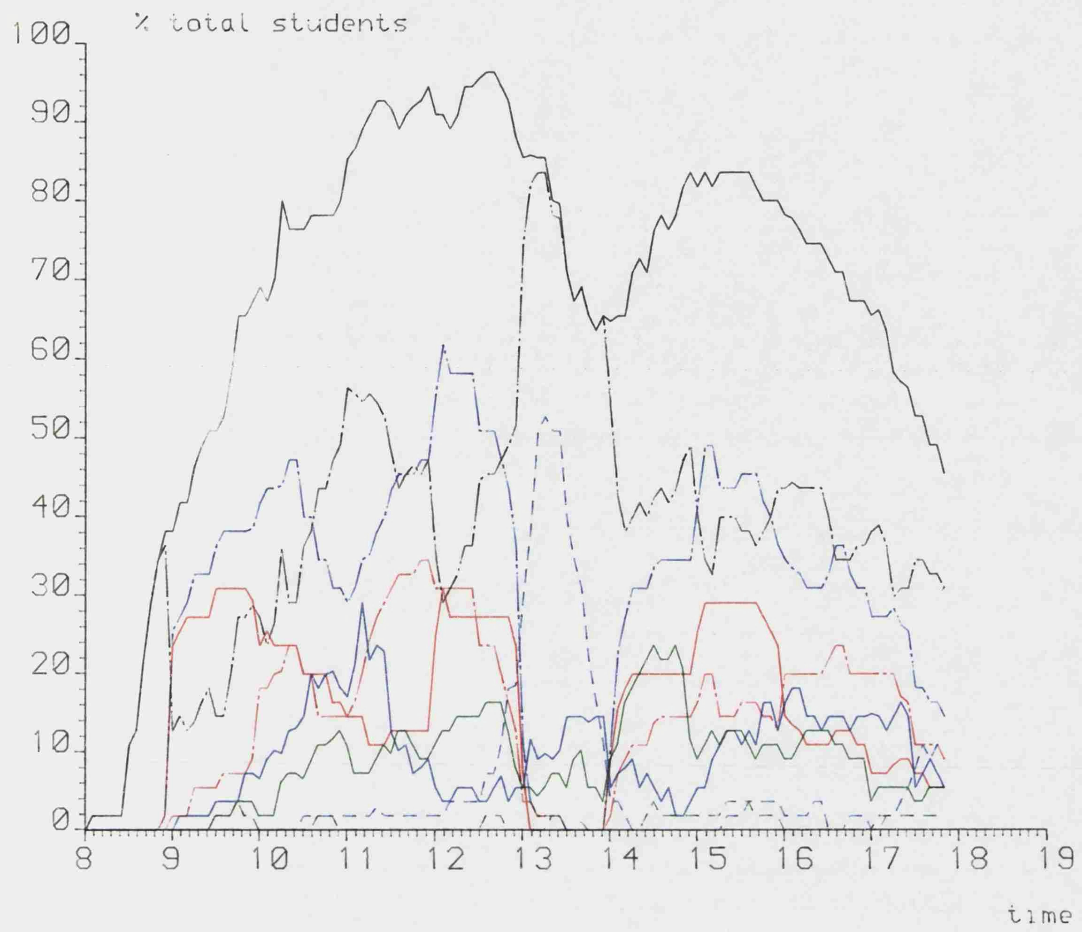


Figure 2

READING UNIVERSITY DUAL SITE
NON RESIDENT UNDERGRADUATE STUDENTS

Total
Reading
Social
Lectures
Applied
Scheduled
Total minus scheduled
Reading in library
Eating

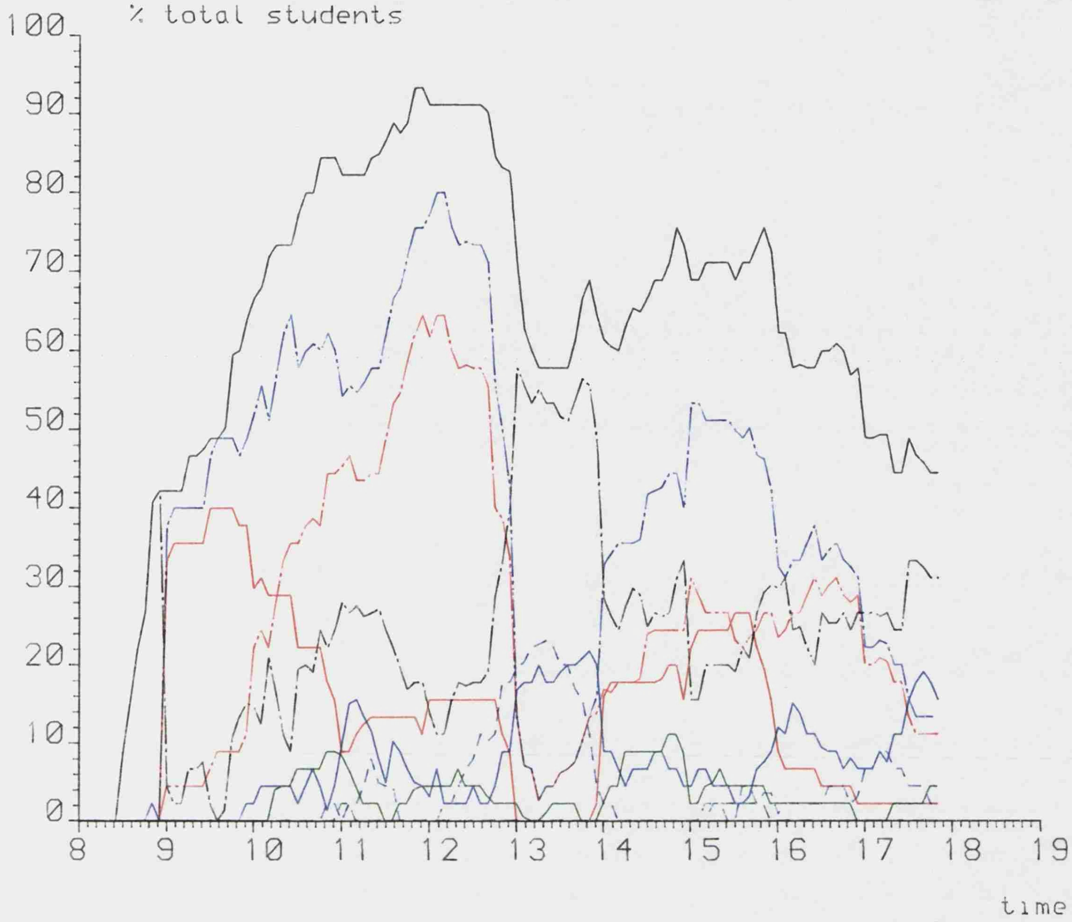


Figure 3

READING UNIVERSITY LONDON ROAD
NON RESIDENT UNDERGRADUATE STUDENTS

Total
Reading
Social
Lectures
Applied
Scheduled
Total minus scheduled
Reading in library
Eating

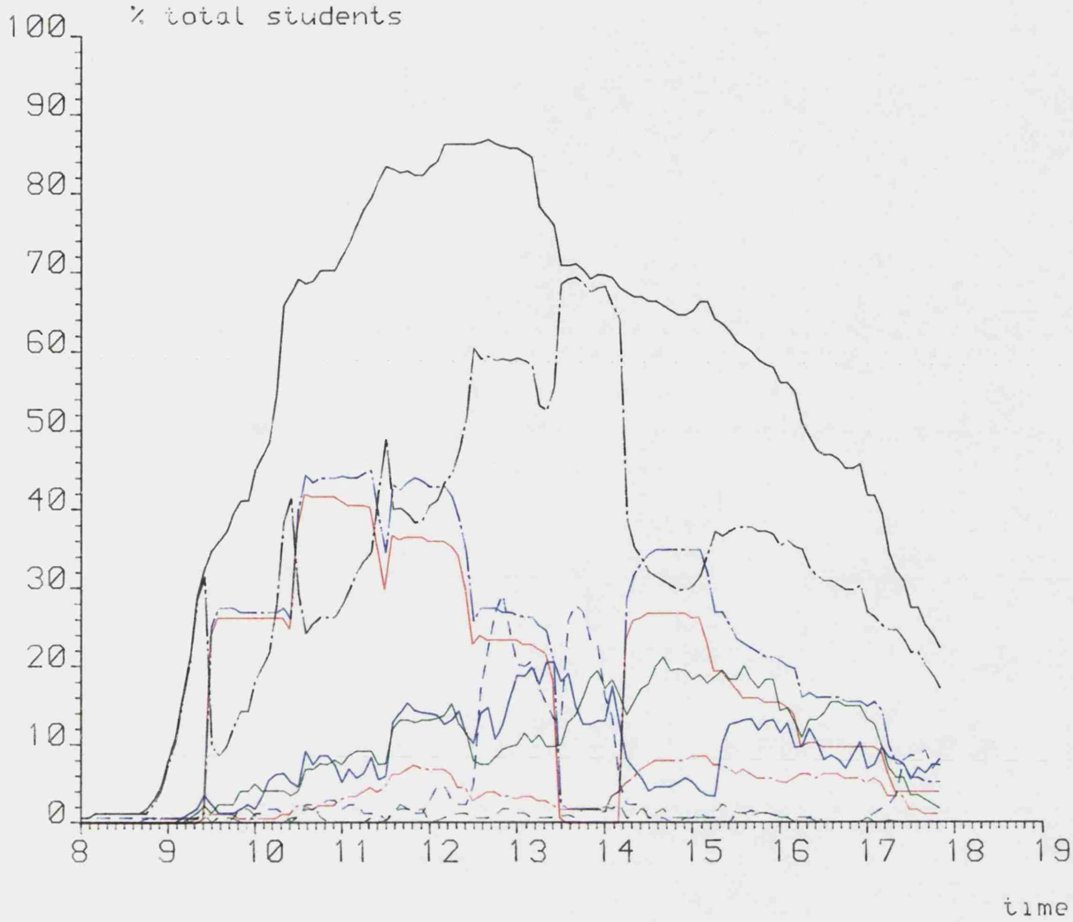


Figure 4

LEICESTER UNIVERSITY
NON RESIDENT UNDERGRADUATE STUDENTS

Total
Reading
Social
Lectures
Applied
Scheduled
Total minus scheduled
Reading in library
Eating

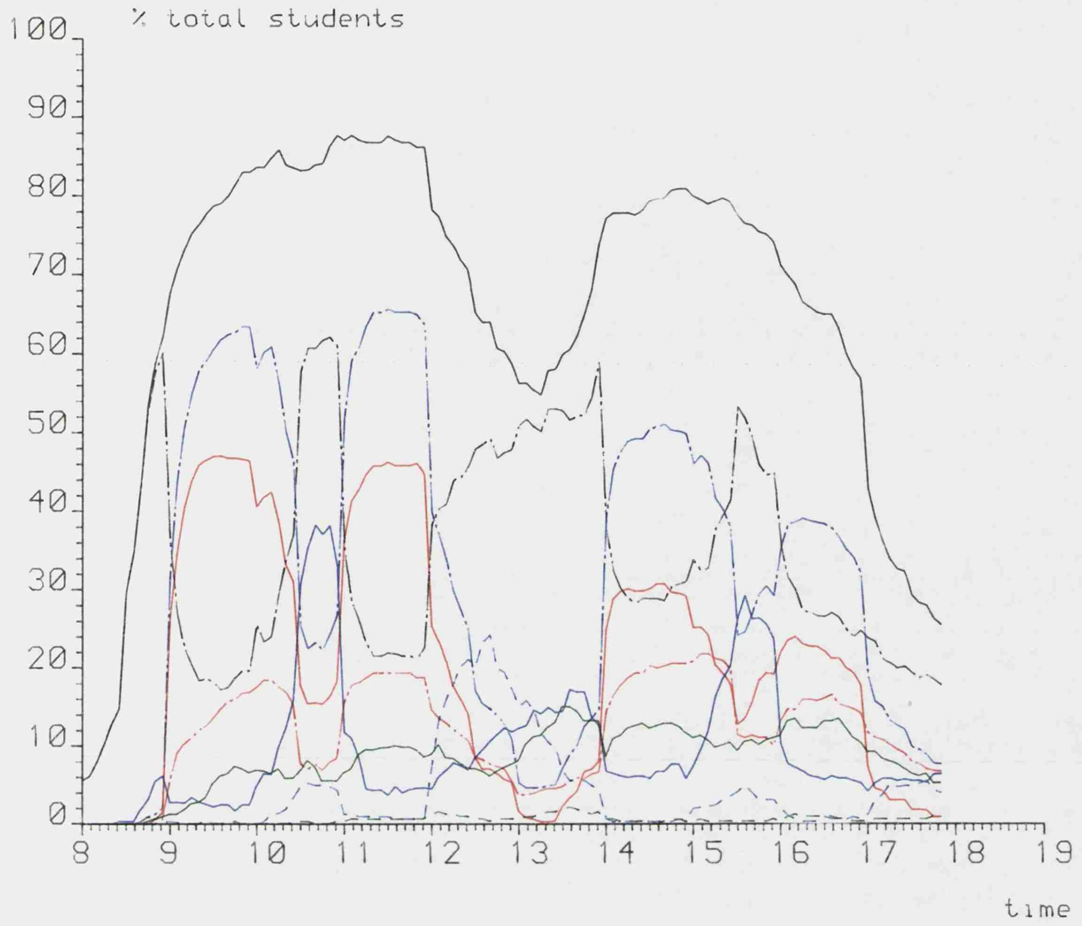


Figure 5

LEICESTER POLYTECHNIC
NON RESIDENT UNDERGRADUATE STUDENTS

Total
Reading
Social
Lectures
Applied
Scheduled
Total minus scheduled
Reading in library
Eating

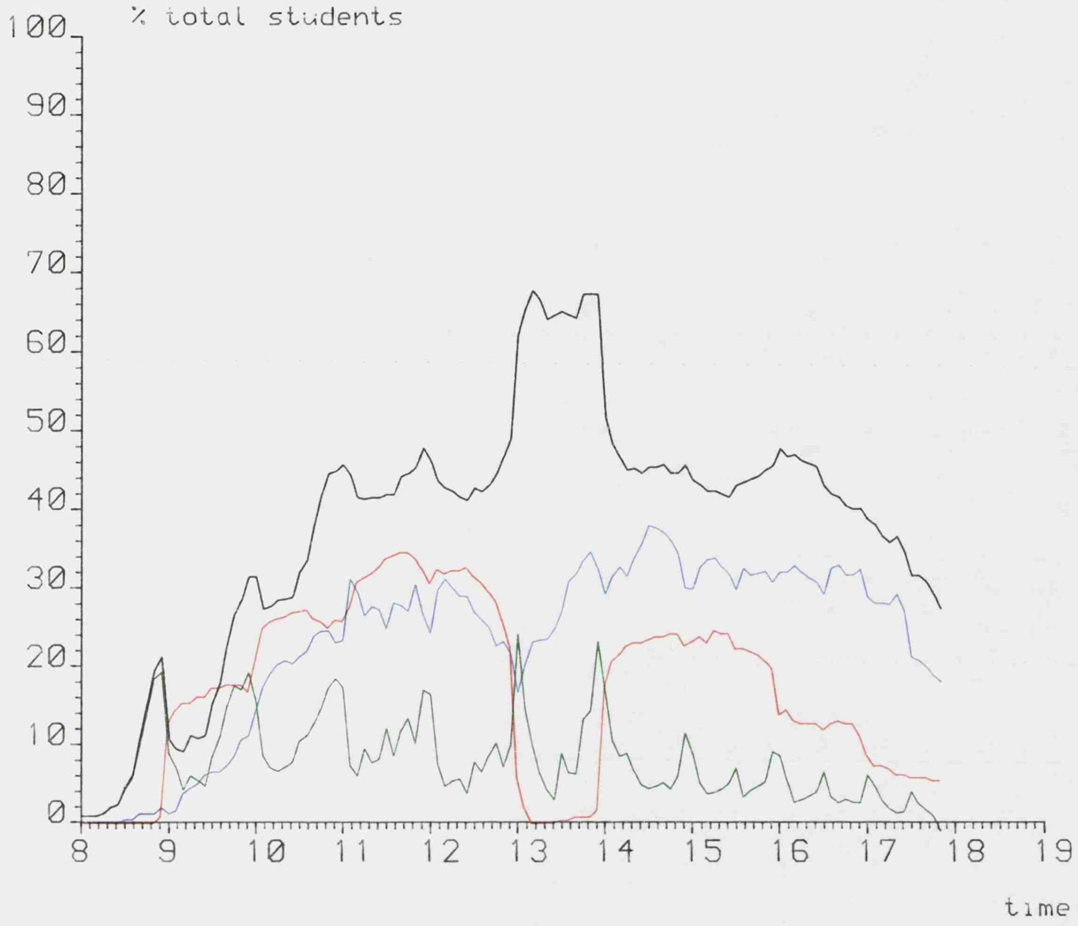


Figure 6

READING UNIVERSITY WHITEKNIGHTS
SELECTED ACTIVITIES FOR NON RES UNDERGRADS

Total minus scheduled

Scheduled

Social plus Reading

Miscellaneous

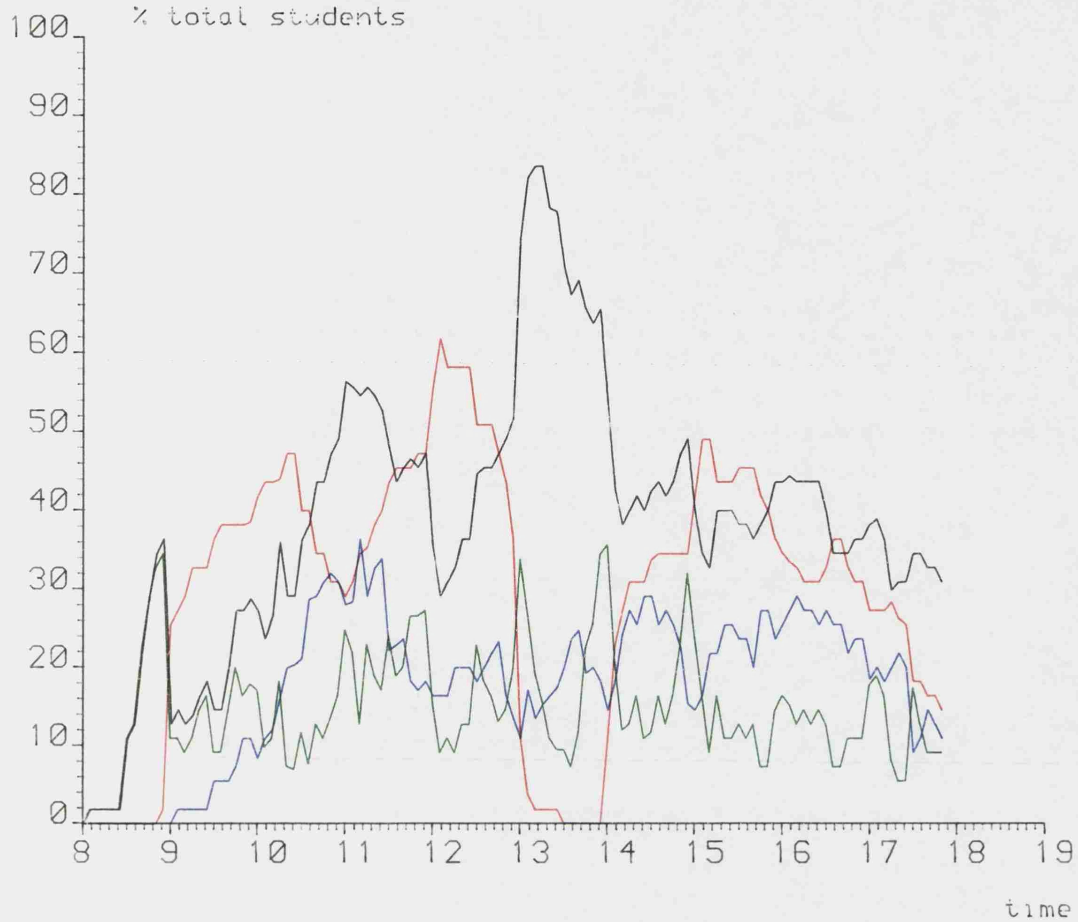


Figure 7

READING UNIVERSITY DUAL SITE
SELECTED ACTIVITIES FOR NON RES UNDERGRADS

Total minus scheduled

Scheduled

Social plus Reading

Miscellaneous

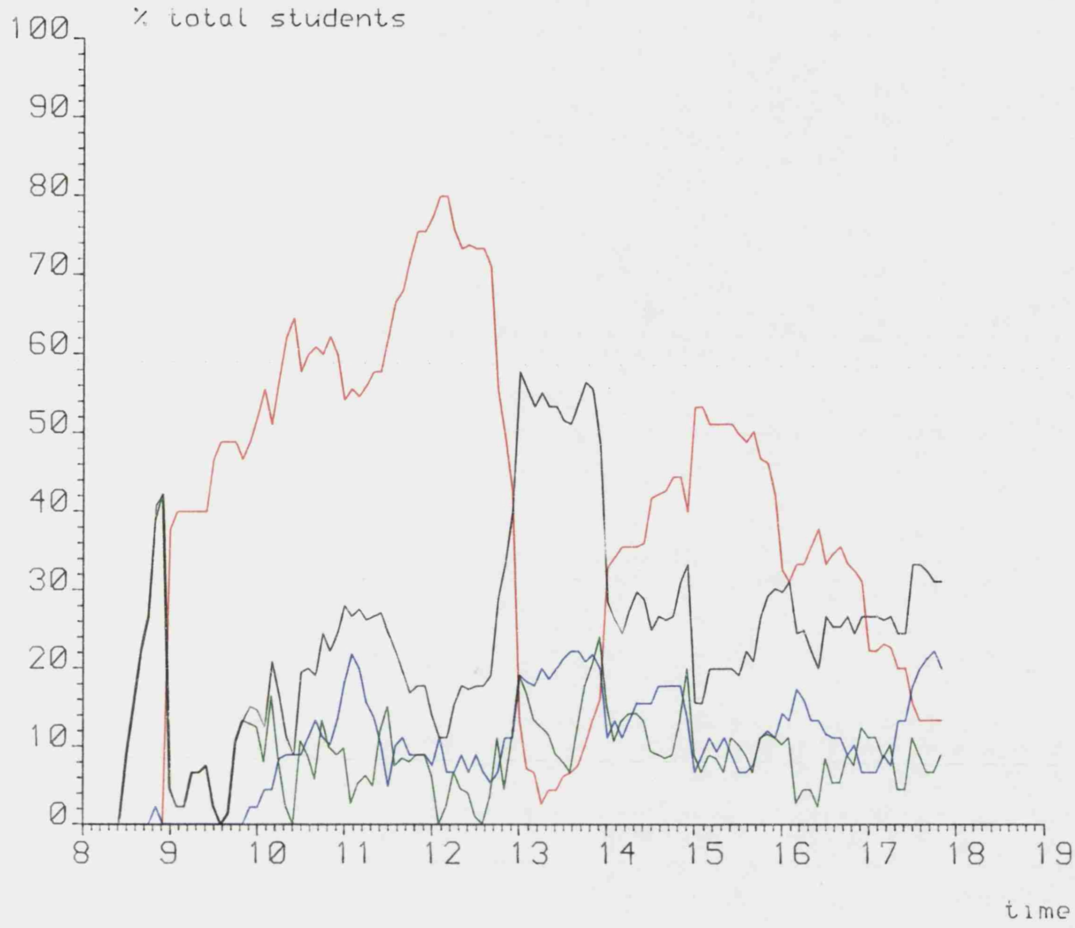


Figure 8

READING UNIVERSITY LONDON ROAD
SELECTED ACTIVITIES FOR NON RES UNDERGRADS

Total minus scheduled
Scheduled
Social plus Reading
Miscellaneous

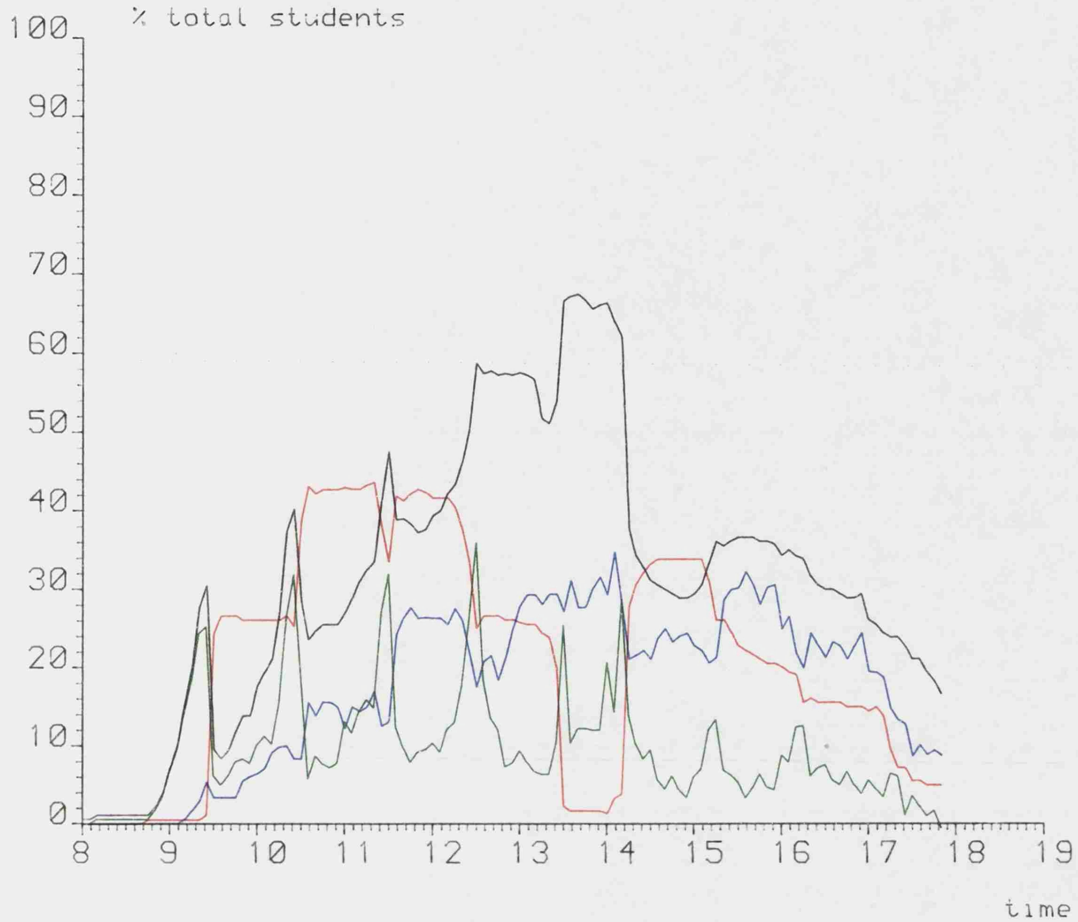


Figure 9

LEICESTER UNIVERSITY
SELECTED ACTIVITIES FOR NON RES UNDERGRADS

Total minus scheduled

Scheduled

Social plus Reading

Miscellaneous

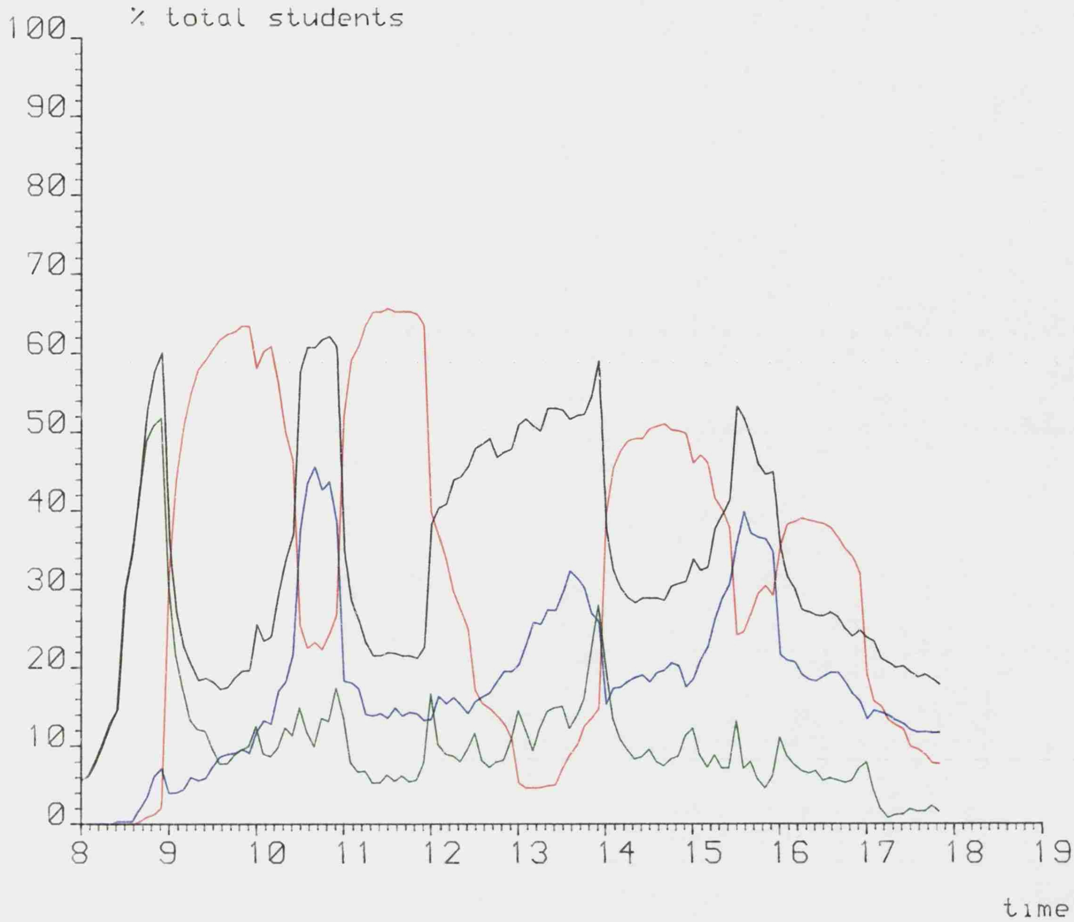


Figure 10

LEICESTER POLYTECHNIC
SELECTED ACTIVITIES FOR NON RES UNDERGRADS

Total minus scheduled

Scheduled

Social plus Reading

Miscellaneous

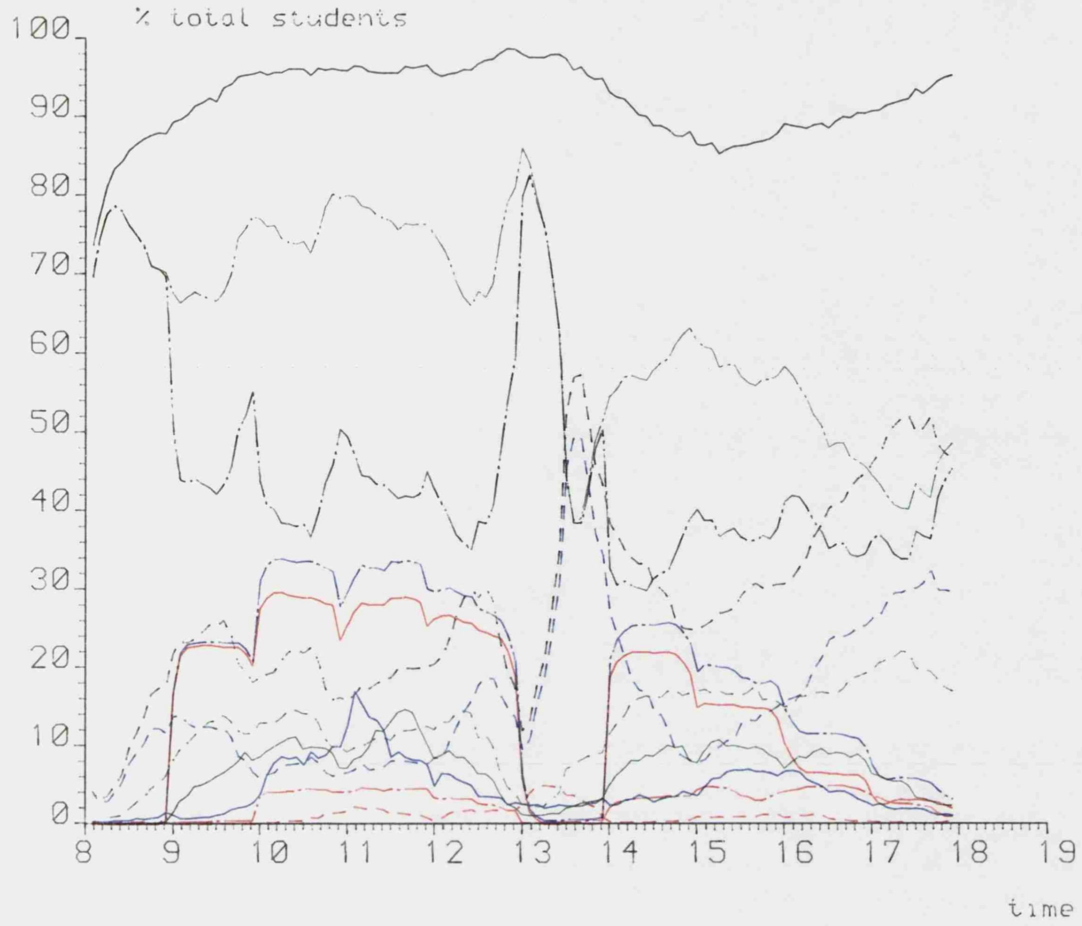


Figure 11

READING UNIVERSITY WHITEKNIGHTS SITE
UNDERGRADUATE RESIDENT STUDENTS

Total
Reading in academic area
Social in academic area
Lectures
Applied
Scheduled
Total minus scheduled in academic area
Total in academic area
Total in residence
Reading in residence
Social and Eating in residence
Eating in academic area

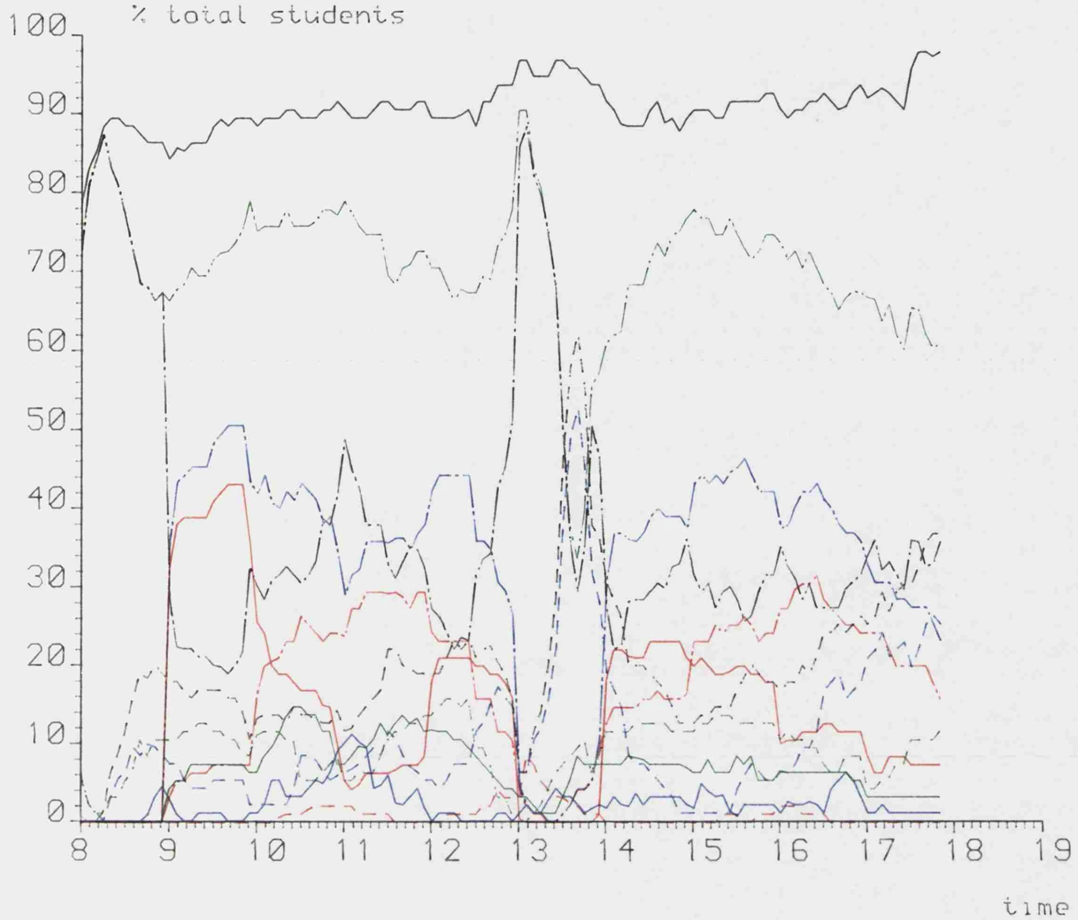


Figure 12

READING UNIVERSITY DUAL SITE
RESIDENT UNDERGRADUATE STUDENTS

Total
Reading in academic area
Social in academic area
Lectures
Applied
Scheduled
Total minus scheduled in academic area
Total in academic area
Total in residence
Reading in residence
Social and Eating in residence
Eating in academic area

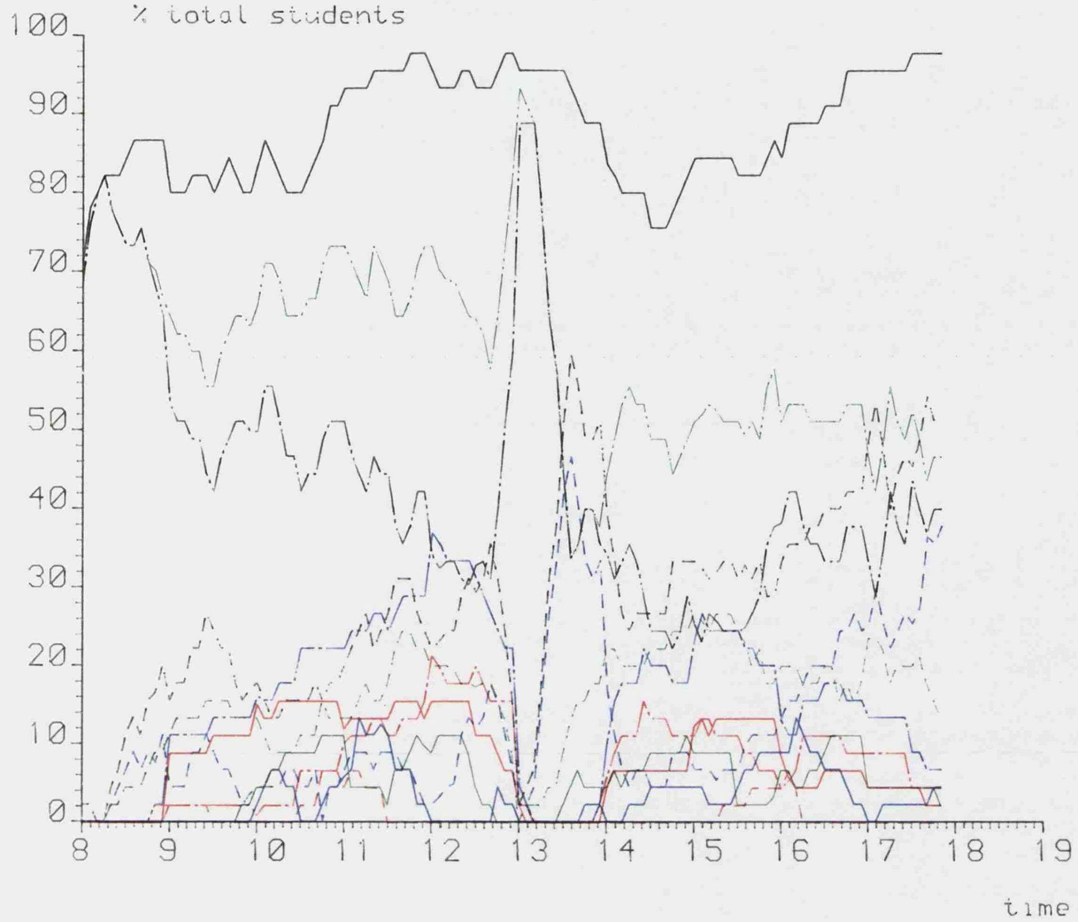


Figure 13

READING UNIVERSITY LONDON ROAD
RESIDENT UNDERGRADUATE STUDENTS

- Total
- Reading in academic area
- Social in academic area
- Lectures
- Applied
- Scheduled
- Total minus scheduled in academic area
- Total in academic area
- Total in residence
- Reading in residence
- Social and Eating in residence
- Eating in academic area

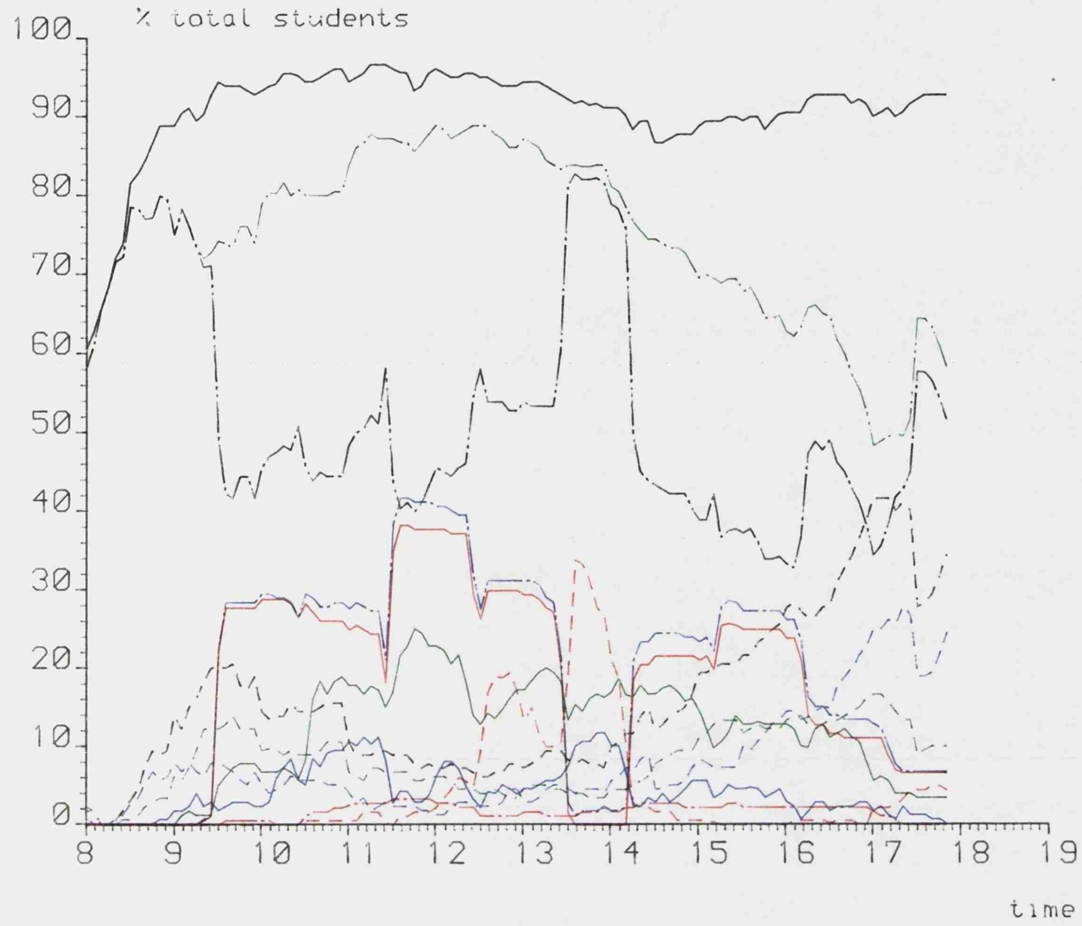


Figure 14

LEICESTER UNIVERSITY
RESIDENT UNDERGRADUATE STUDENTS

Total
Reading in academic area
Social in academic area
Lectures
Applied
Scheduled
Total minus scheduled in academic area
Total in academic area
Total in residence
Reading in residence
Social and Eating in residence
Eating in academic area

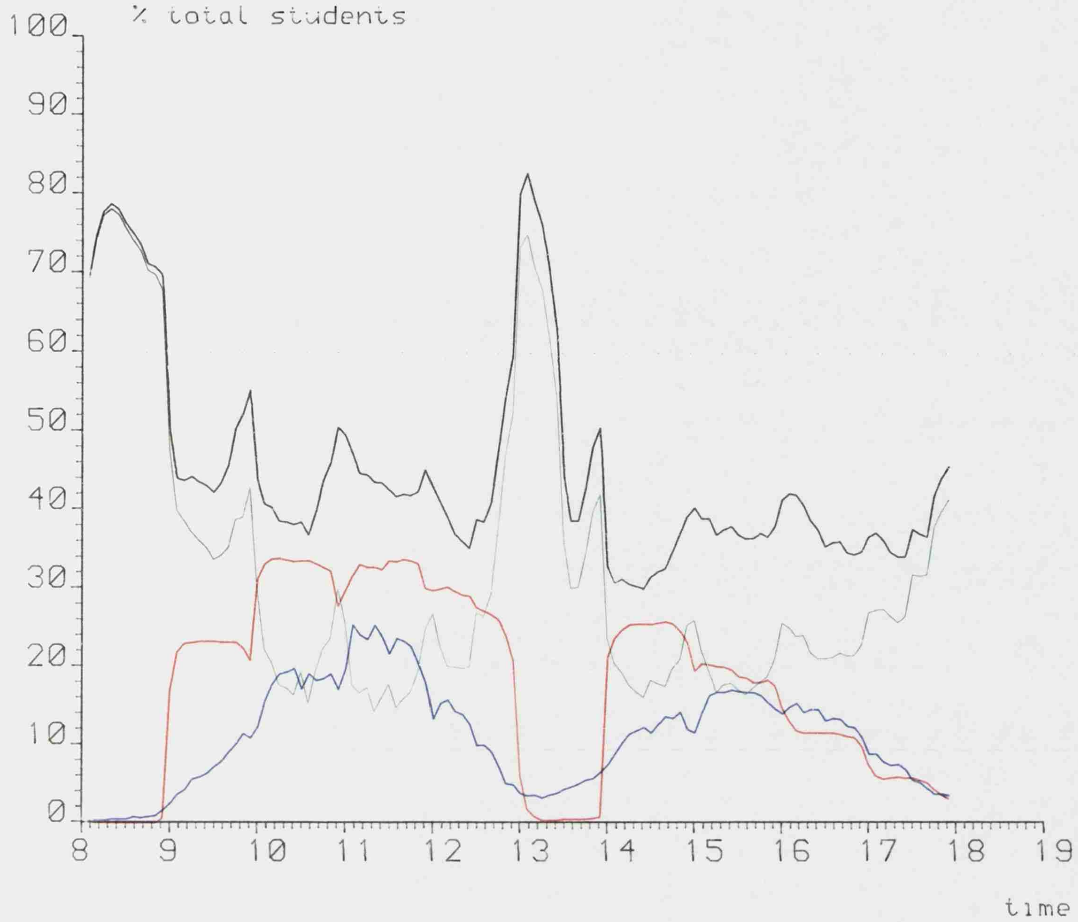


Figure 15

READING UNIVERSITY WHITEKNIGHTS SITE
SELECTED ACTIVITIES FOR RESIDENT UNDERGRADS

Free time in academic area

Scheduled

Social plus Reading in academic area

Miscellaneous in academic area

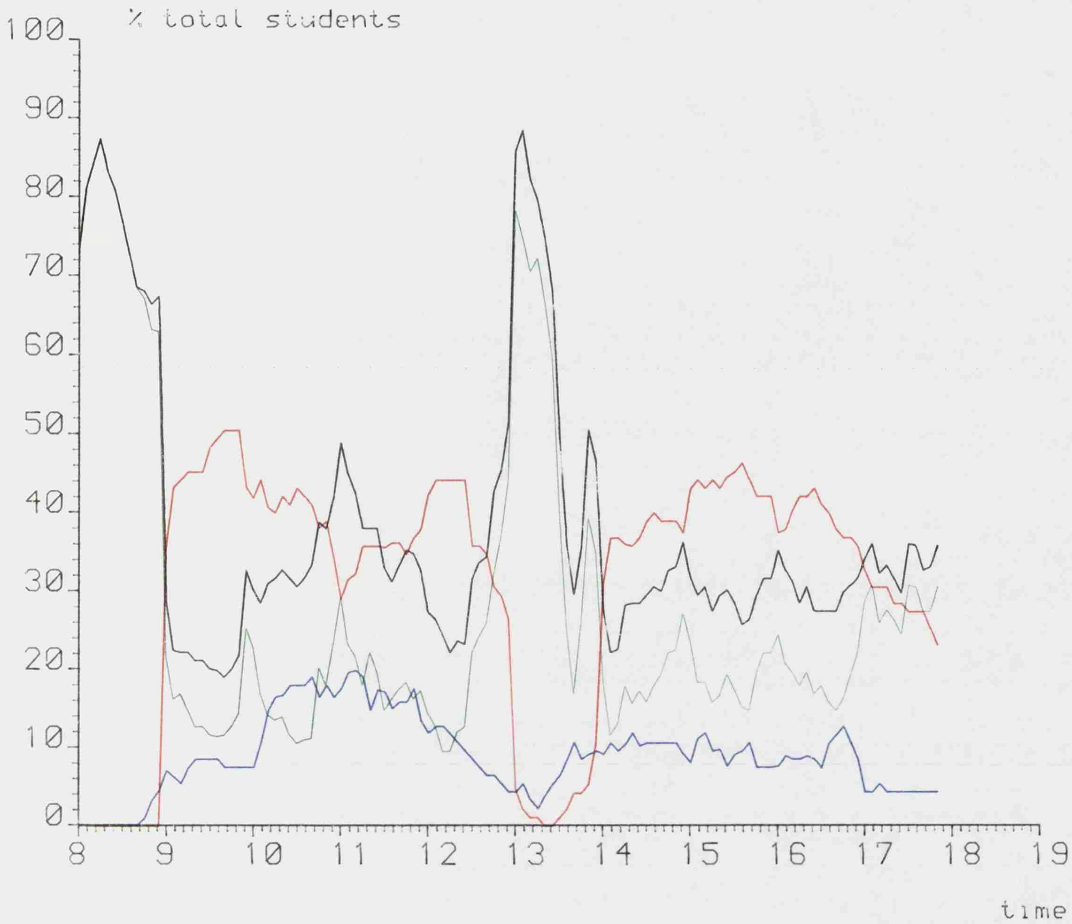


Figure 16

READING UNIVERSITY DUAL SITE
SELECTED ACTIVITIES FOR RESIDENT UNDERGRADS

Free time in academic area

Scheduled

Social plus Reading in academic area

Miscellaneous in academic area

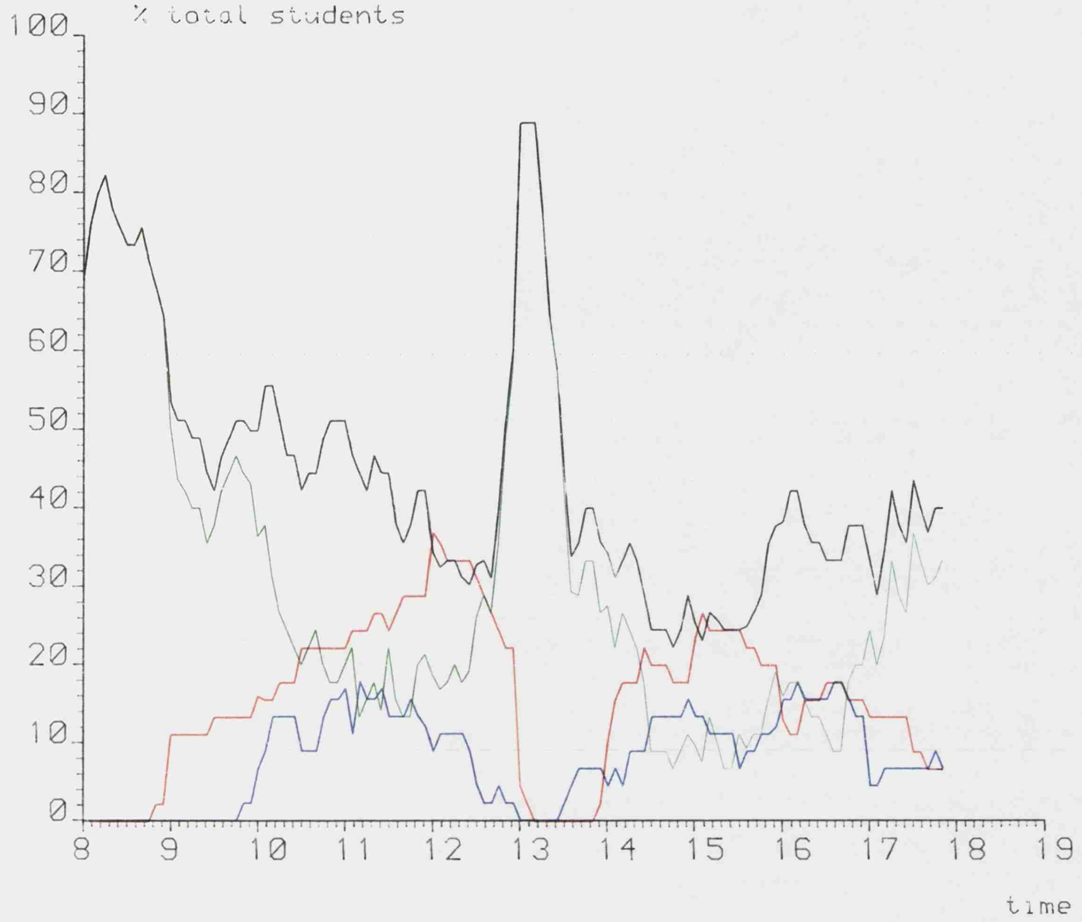


Figure 17

READING UNIVERSITY LONDON ROAD
SELECTED ACTIVITIES FOR RESIDENT UNDERGRADS

Free time in academic area

Scheduled

Social plus Reading in academic area

Miscellaneous in academic area

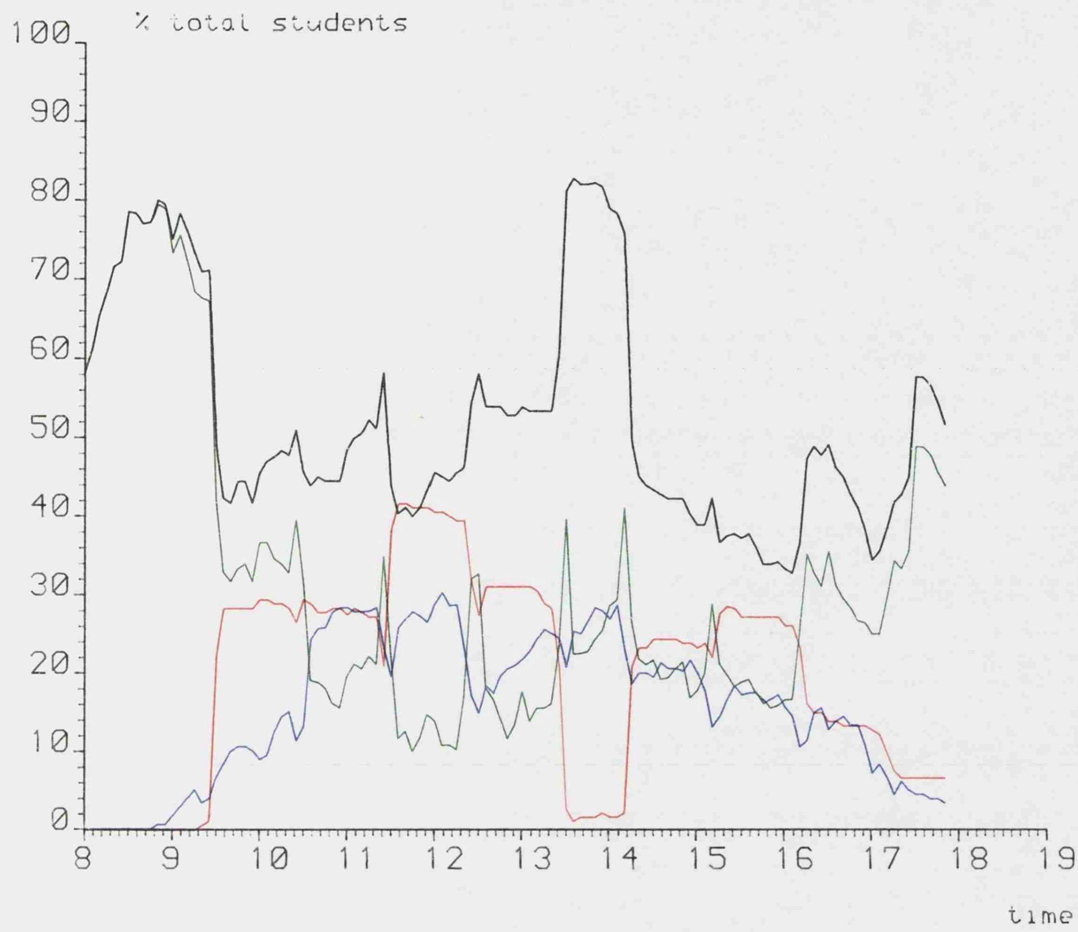


Figure 18

LEICESTER UNIVERSITY
SELECTED ACTIVITIES FOR RESIDENT UNDERGRADS

Free time in academic area
Scheduled
Social plus Reading in academic area
Miscellaneous in academic area

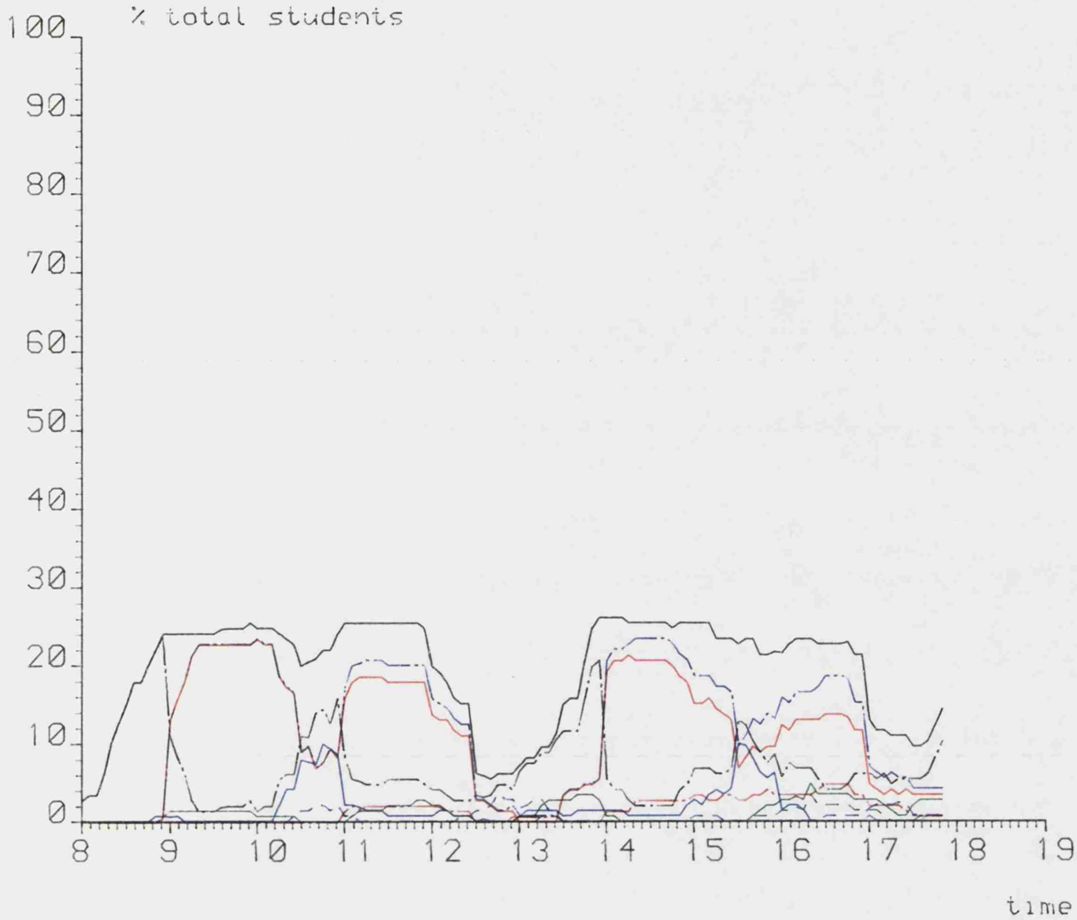


Figure 19

LEICESTER POLYTECHNIC
PART-TIME STUDENTS

Total
Reading
Social
Lectures
Applied
Scheduled
Total minus scheduled
Reading in library
Eating

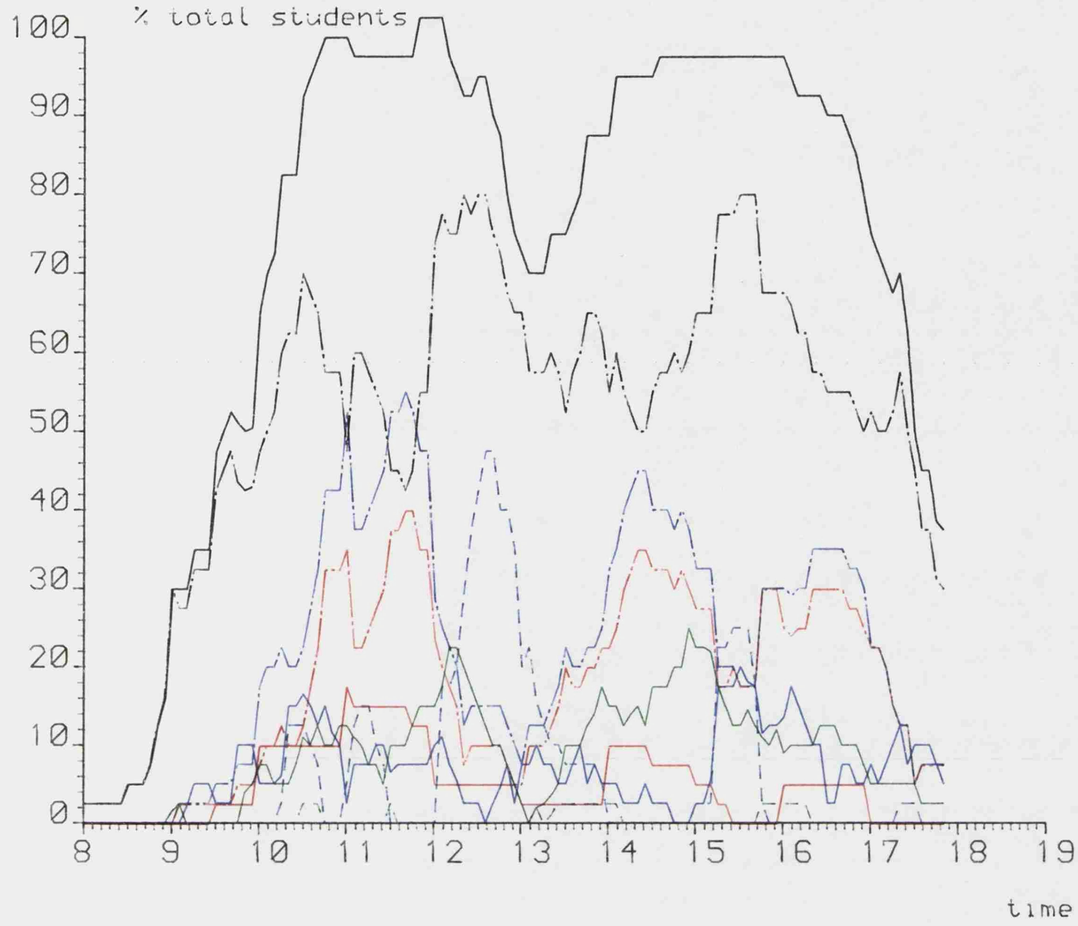


Figure 20

READING UNIVERSITY WHITEKNIGHTS
NON RESIDENT POSTGRADUATE STUDENTS

- Total
- Reading
- Social
- Lectures
- Applied
- Scheduled
- Total minus scheduled
- Reading in library
- Eating

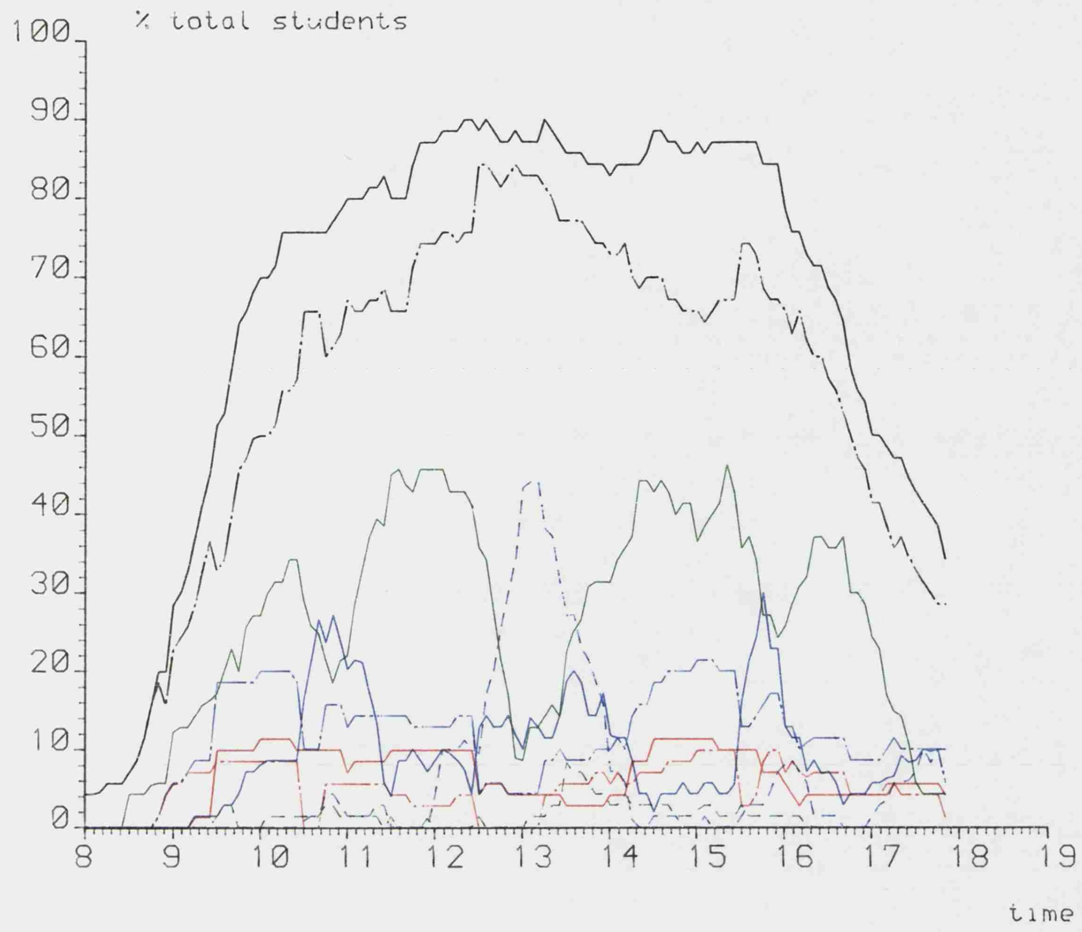


Figure 21

LEICESTER UNIVERSITY
NON RESIDENT POSTGRADUATE STUDENTS

Total
Reading
Social
Lectures
Applied
Scheduled
Total minus scheduled
Reading in library
Eating

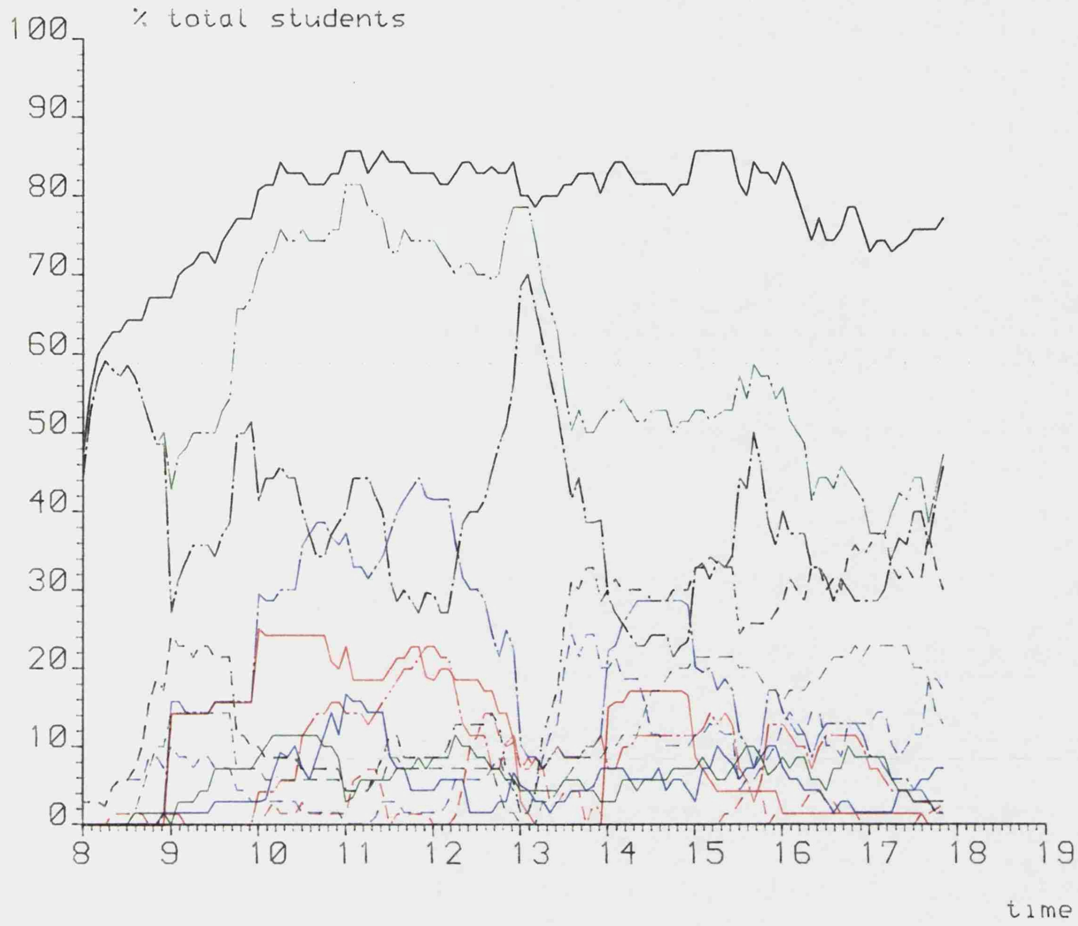


Figure 22

READING UNIVERSITY WHITEKNIGHTS
RESIDENT POSTGRADUATE STUDENTS

- Total
- Reading in academic area
- Social in academic area
- Lectures
- Applied
- Scheduled
- Total minus scheduled in academic area
- Total in academic area
- Total in residence
- Reading in residence
- Social and Eating in residence
- Eating in academic area

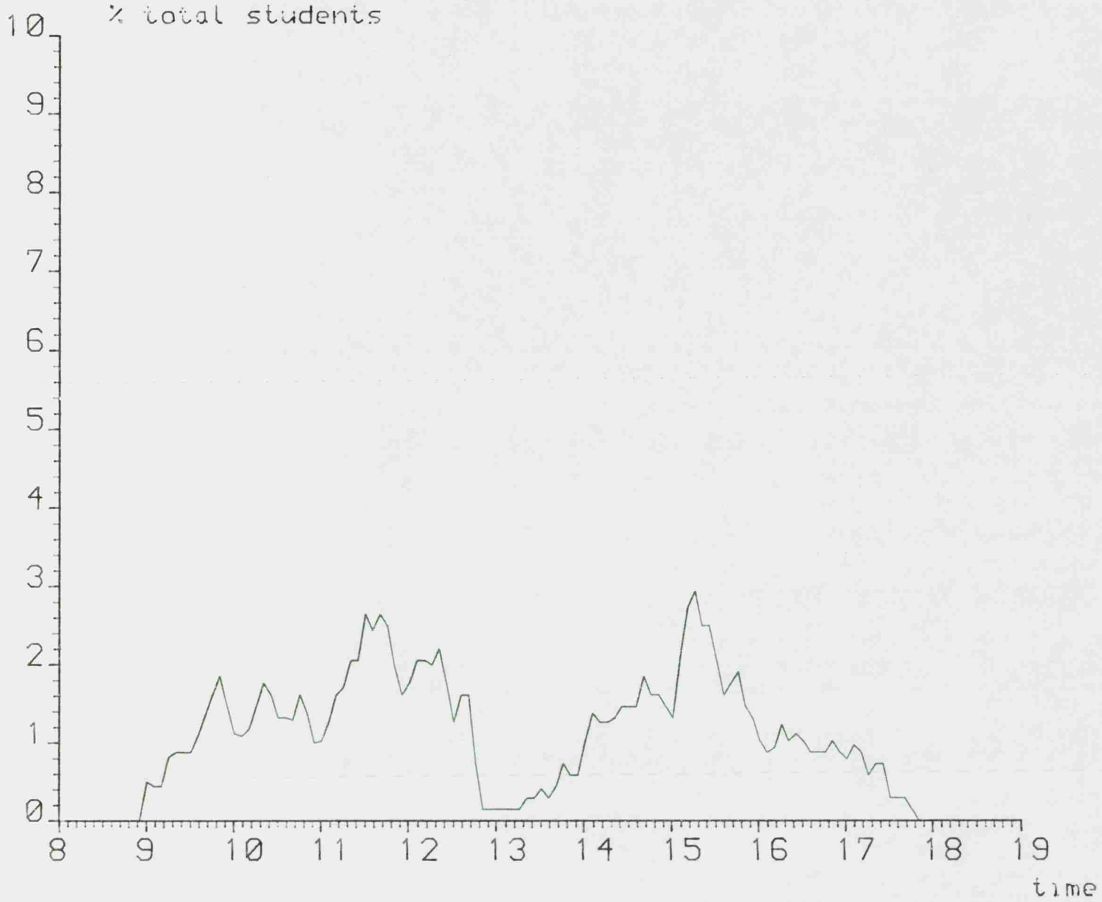


Figure 23

READING UNIVERSITY WHITEKNIGHTS
RESIDENT UNDERGRADUATE STUDENTS

______ Reading in Library

APPENDIX D

AN EXAMPLE SHOWING ONE WAY IN WHICH ACTIVITES CAN BE USED TO CALCULATE THE SPATIAL NEEDS OF AN ASSUMED UNIVERSITY IN TERMS OF USERS DURING PEAK TIMES. THE PEAK PERCENTAGE VALUES USED ARE THE RATIONALIZED ONES SHOWN IN CHAPTER EIGHT.

EXAMPLE A

UNIVERSITY X

Number of students = 4000

Non resident = 3200

Resident = 800

Resident males = 600

Resident females = 200

Duration of lunch period = 1.8 hours

Lectures per week per student = 14 hours

Applied per week per student = 2 hours

CALCULATIONS FOR RESIDENT STUDENTS

Attendance for lectures = 78% (assumed as example)

Attendance for applied = 90% (assumed as example) lectures attended per week = 10.92 hours

Applied attended per week = 1.80 hours

Total scheduled attended = 12.72 hours

Percentage of males eating in refectory =15% (ill 8.5)

Percentage of females using refectory = 4% (ill 8.5)

Total using refectory for lunch 15 + 4 =19%

Free time in all campus = 17.8 hours (ill 7.2)

Free time in residence = 12.0 hours (ill 7.3)

For an attractive campus (7.1.3),

Free time in residence = 0.92 x 12 = 11.04 hr

Free time in academic area = 17.8-11.04 = 6.76 hrs

Soc/Read = 1.3 (ill 7.4)

Social = 1.3 x Reading = 6.76 - Reading

Reading = 2.94 hours

Social = 3.82 hours

Rationalized peak percentages (chptr 8):

Social	= 3.82 x 6	=	22.92%
1st Rd	= 2.94 x 3.6	=	10.88%
2nd Rd	= 10.88x 0.7	=	7.60%
Soc+Rd	= 6.76 x 4	=	27.04%
Library	= 2.94 x 0.168 x 3.7	=	1.83%
Eating		=	19.00%

Users during peak period:

Social	800 x 0.2292	= 183 st
1st Read	800 x 0.1088	= 87 st
2nd Read	800 x 0.0760	= 61 st
Soc + Rd	800 x 0.2704	= 216 st
Library	800 x 0.1900	= 15 st
Eating		= 152 st

CALCULATIONS FOR NON RESIDENT STUDENTS

Attendance for lectures = 70% (assumed as example)

Attendance for applied = 85% (assumed as example)

Lectures attended per week = 9.8 hrs

Applied attended per week = 1.7 hrs

Total scheduled = 9.8 + 1.7 = 12.72hrs

Eating time per week per student = 2.35 hrs (ill 8.2)

Free time = (3200 x 127.24) / 11.5 +

(800 x 34.52) / 12.564 = 37607 hrs

Total free for res = 800 x 6.76 = 5408 hrs

Free time for non res = 37607 - 5408 = 32199 hrs

Free time per student per week = 32199/3200 = 10.062 hrs

App/Theo = 1.7/9.8 = 0.1734

(Soc + Eat)/Read = 1.6 (ill 6.5 assuming the new

university rankes between Leicester

University and Leicester Poly)

Soc + Eat + Read = 10.062 + 2.35 = 12.412 hrs

Soc + Eat = 12.41 -Rd = 1.6 x Rd

Reading = 4.77 hrs

Social = 7.636 - 2.35 = 5.29 hrs

Rationalized peak percentages:

Social	= 5.29 x 4.5	= 23.80%
1st Read	= 4.77 x 3.8	= 18.12%
2nd Read	= 15.4 x 0.85	= 13.10%
Soc + Rd	=10.06 x 2.9	= 29.20%
Library	= 4.77 x 0.0722 x 3.8	= 1.31%
Eating		= 34.00%

Users during peak period:

Social	= 3200 x 0.2380	= 762 st
1st Read	= 3200 x 0.1812	= 580 st
2nd Read	= 3200 x 0.1310	= 419 st
Soc + Rd	= 3200 x 0.2929	= 934 st
Library	= 3200 x 0.0131	= 42 st
Eating	= 3200 x 0.3400	=1088 st

TOTAL FOR CAMPUS:

Social	=	762 + 183	= 945 st
Reading	=	87 + 419	= 506 st
or	=	61 + 580	= 641 st

The larger (641) figure should be used.

Soc + Rd	=	216 +	934	=	1150	st
Library	=	15 +	42	=	57	st
Eating	=	152 +	1088	=	1240	st

EXAMPLE B

UNIVERSITY Y

Number of students = 4000

Non resident = 800

Resident = 3200

Resident males = 2200

Resident females = 1000

Duration of lunch period = 2 hours

Lectures per week per student = 11 hours

Applied per week per student = 5 hours

CALCULATIONS FOR RESIDENT STUDENTS

Attendance for lectures = 78% (assumed as example)

Attendance for applied = 90% (assumed as example)

lectures attended per week = 8.58 hours

Applied attended per week = 4.50 hours

Total scheduled attended = 13.08 hours

Percentage of males eating in refectory =11% (ill 8.5)

Percentage of females using refectory = 3% (ill 8.5)

Total using refectory for lunch 15 + 4 =14%

Free time in all campus = 17.6 hours (ill 7.2)

Free time in residence = 12.7 hours (ill 7.3)

For an attractive campus (7.1.3),

Free time in residence = 0.92 x 12.7 = 12.7 hr

Free time in academic area = 17.6-12.7 = 4.9 hrs

Soc/Read = 1.3 (ill 7.4)

Social = 1.3 x Reading = 4.9 - Reading

Reading = 2.13 hours

Social = 2.77 hours

Rationalized peak percentages (chptr 8):

Social	= 2.77 x 6	= 16.60%
1st rd	= 2.13 x 3.7	= 7.88%
2nd Rd	= 7.88 x 0.7	= 5.52%
Soc+Rd	= 4.90 x 4	= 19.60%
Library	= 2.13 x 0.168 x 3.7	= 1.32%
Eating		= 14.00%

Users during peak period:

Social 3200 x 0.1660 = 531 st

1st Read 3200 x 0.0788 = 252 st

2nd Read	3200 x 0.0552 = 177 st	
Soc + Rd	3200 x 0.1960 = 627 st	
Library	3200 x 0.0132 = 42 st	
Eating	3200 x 0.1400 = 448 st	

CALCULATIONS FOR NON RESIDENT STUDENTS

Attendance for lectures = 70% (assumed as example)

Attendance for applied = 85% (assumed as example)

Lectures attended per week = 7.7 hrs

Applied attended per week = 4.25 hrs

Total scheduled = 9.8 + 1.7 = 11.95hrs

Eating time per week per student = 2.00 hrs (ill 8.2)

Free time = 800 x 127.24) / 11.95 +

(3200 x 34.52) / 13.08 = 16963 hrs

Total free for res = 3200 x 4.9 = 15680 hrs

Free time for non res = 16963 -15680 = 1283 hrs

Free time per student per week = 1283/800 = 1.6 hr/st

App/Theo = 4.25/7.7 = 0.552

(Soc + Eat)/Read = 2.1 (ill 6.5 assuming the new
university rankes between Leicester
University and Leicester Poly)

Soc + Eat + Read = 1.6 + 2.00 = 3.6 hrs

Soc + Eat = 3.6 - Rd = 2.1 x Rd

Reading = 1.16 hrs

Social = 3.6 - 2.0 = 0.44 hrs

Rationalized peak percentages:

Social	= 0.44 x 4.5	= 1.98%
1st Read	= 1.16 x 3.8	= 4.41%
2nd Read	= 4.4 x 0.85	= 3.75%
Soc + Rd	= 1.6 x 2.9	= 4.64%
Library	= 1.16 x 0.07225 x 3.8	= 0.32%
Eating		= 24.00%

Users during peak period:

Social	= 800 x 0.0198	= 15.8 st
1st Rd	= 800 x 0.0441	= 35.2 st
2nd Rd	= 800 x 0.0299	= 29.9 st
Soc+Rd	= 800 x 0.0464	= 37.2 st
Library	= 800 x 0.0032	= 2.6 st
Eating	= 800 x 0.24	= 192 st

TOTAL FOR CAMPUS:

Social = 531 + 15.8 = 547 st

Reading = 176.6 + 35.2 = 211 st

or = 252 + 29.9 = 282 st

The larger (282) figure should be used.

Soc + Rd = 627 + 37.2 = 664 st

Library	=	42 + 2.6	=	45 st
Eating	=	448 + 192	=	640 st

APPENDIX E

I. USE OF REFECTORY SURVEY ON RESIDENT STUDENTS IN THE UNIVERSITY OF BATH.

Stutents were questioned as to how many times per week they ate their lunch in the refectory during weekdays, the results were as follows:

A) Male students.

Number of students surveyed	36
Total use of refectory per week	63.5
Lunch in residence per week	113.5

B) Female students.

Number of students surveyed	42
Total use of refetory per week	19.5
Lunch in residence per week	176.5

II. SURVEY OF READING TRENDS AMONG RESIDENT STUDENTS WITH EXPERIENCE OF LIVING OFF CAMPUS IN THE UNIVERSITY OF BATH.

The students were asked how different they found reading and studying while they were living off campus to living in it. All the students questioned had experience of both residence types.

Number of students questioned	37
Number that found reading while living in campus easier	28

Reasons mentioned were easier access to library, everything provided, and the lack of the need for travel.

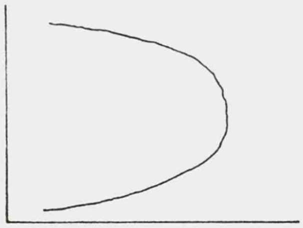
Number that found reading off campus easier, 17

Reasons mentioned were less distractions, and less noise.

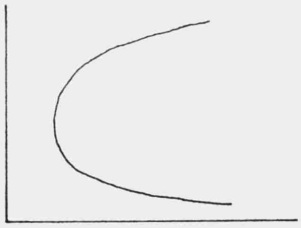
* As can be seen from summing both groups, some students were undecided and chose both.

APPENDIX F

RELATIVE GRAPHS OF STUDENT GROUPS

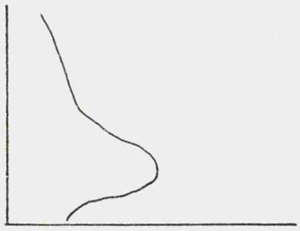


With theoretical studies

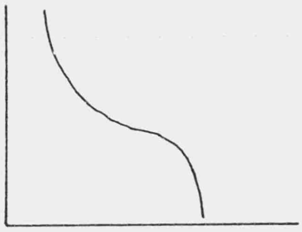


With applied studies

NON-RESIDENT UNDERGRADUATE STUDENTS

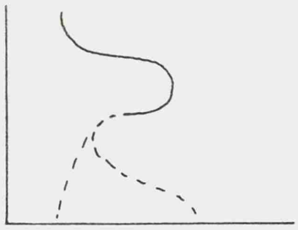


With theoretical studies

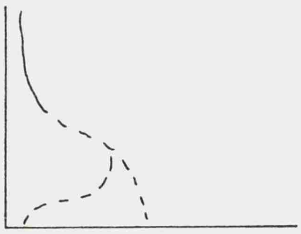


With applied studies

RESIDENT UNDERGRADUATE STUDENTS



POST-GRADUATE STUDENTS



PART-TIME STUDENTS

GUIDELINES TO RELATIVE PROFILES OF STUDENT GROUPS

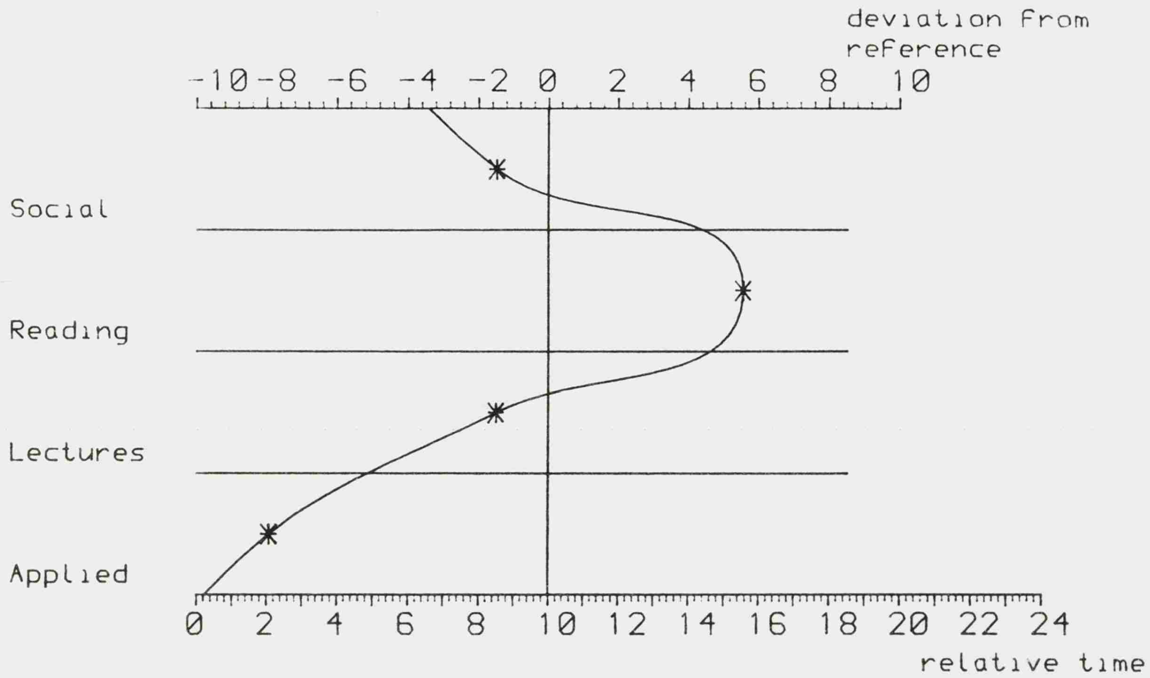


Figure 1
Reading University, Whiteknights, non-res students

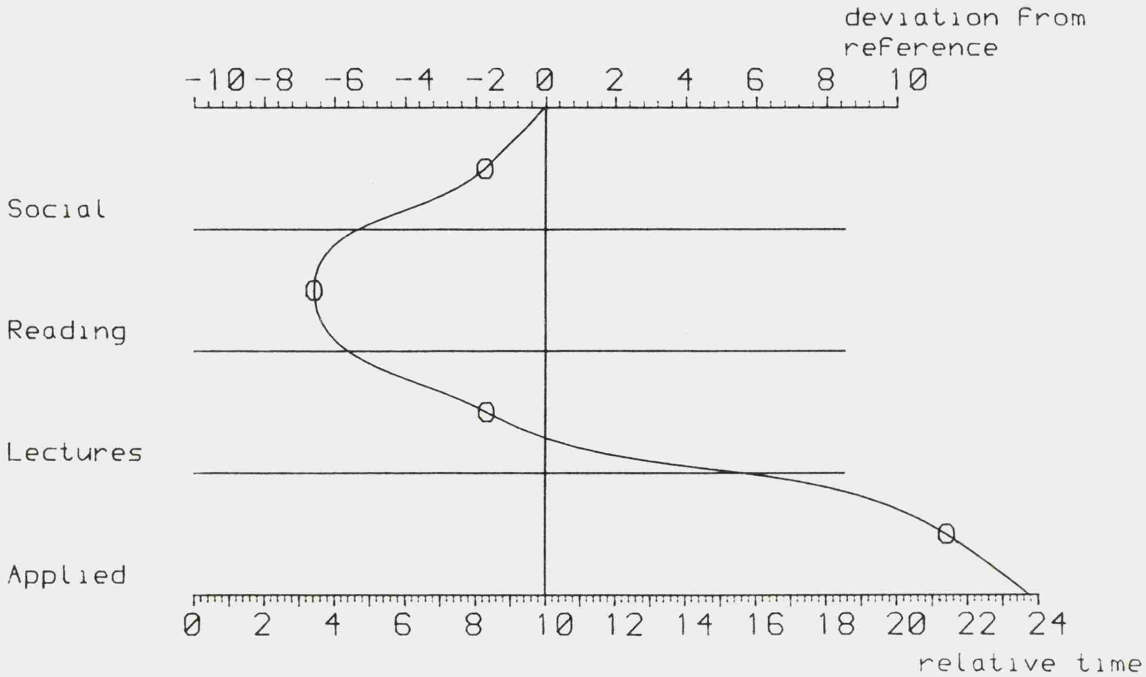


Figure 2
Reading University, Lndn rd., non-res students

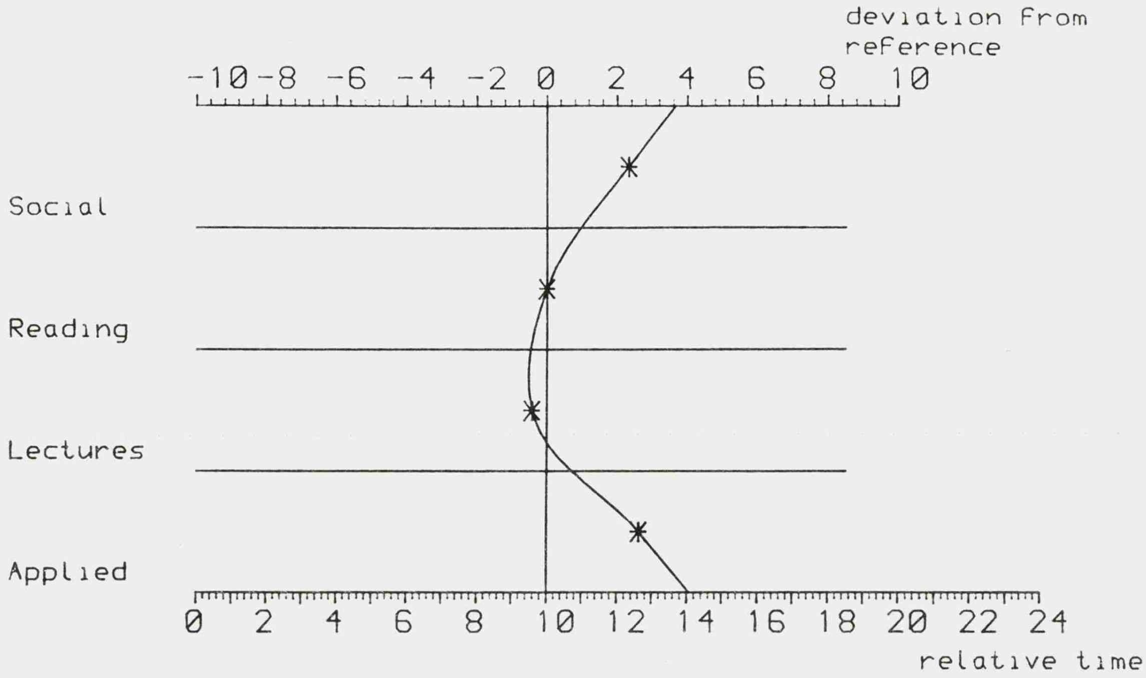


Figure 3
Reading University, Dual site non-res students

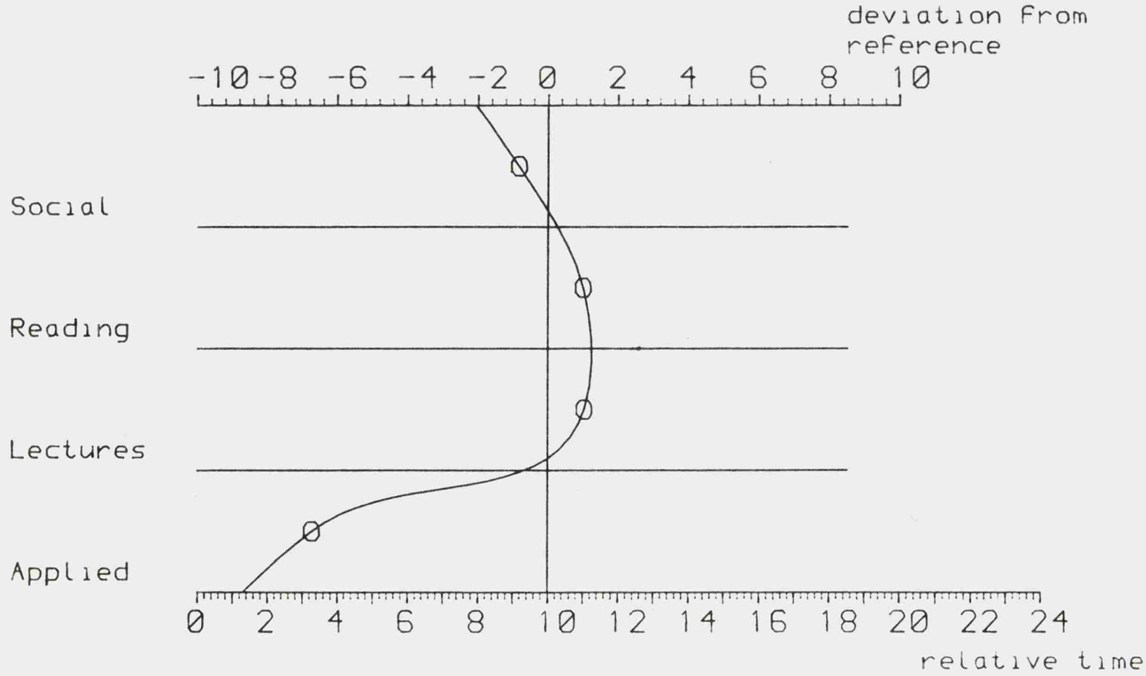


Figure 4
Leicester University, non-res students

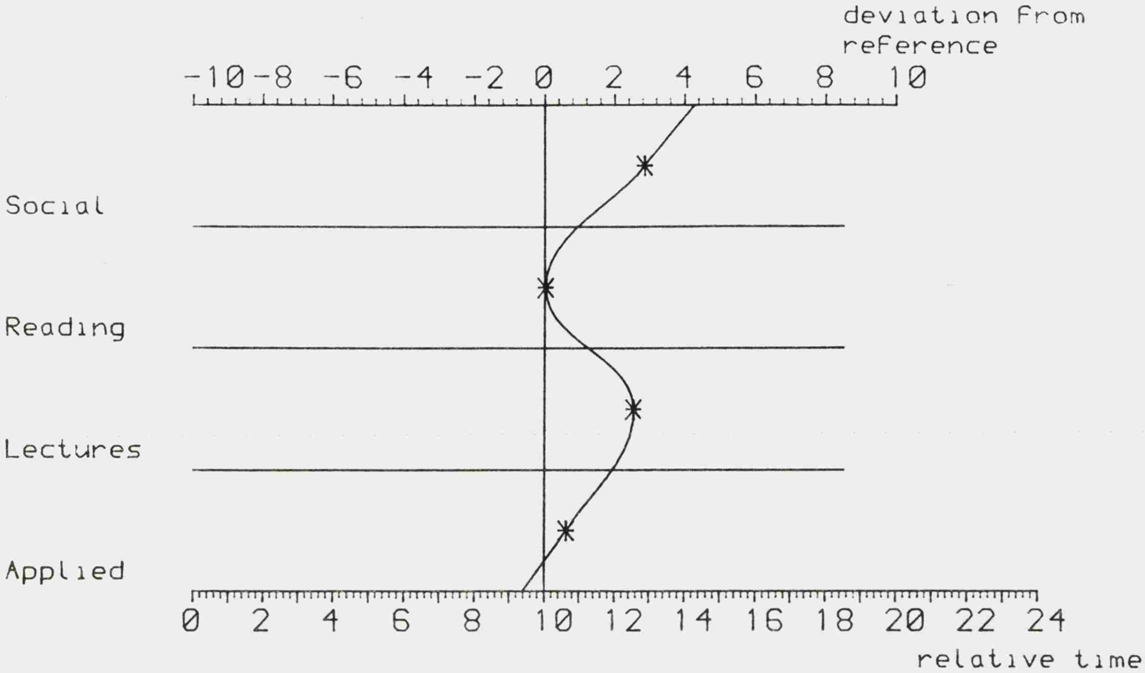


Figure 5
Leicester Polytechnic, non-res students

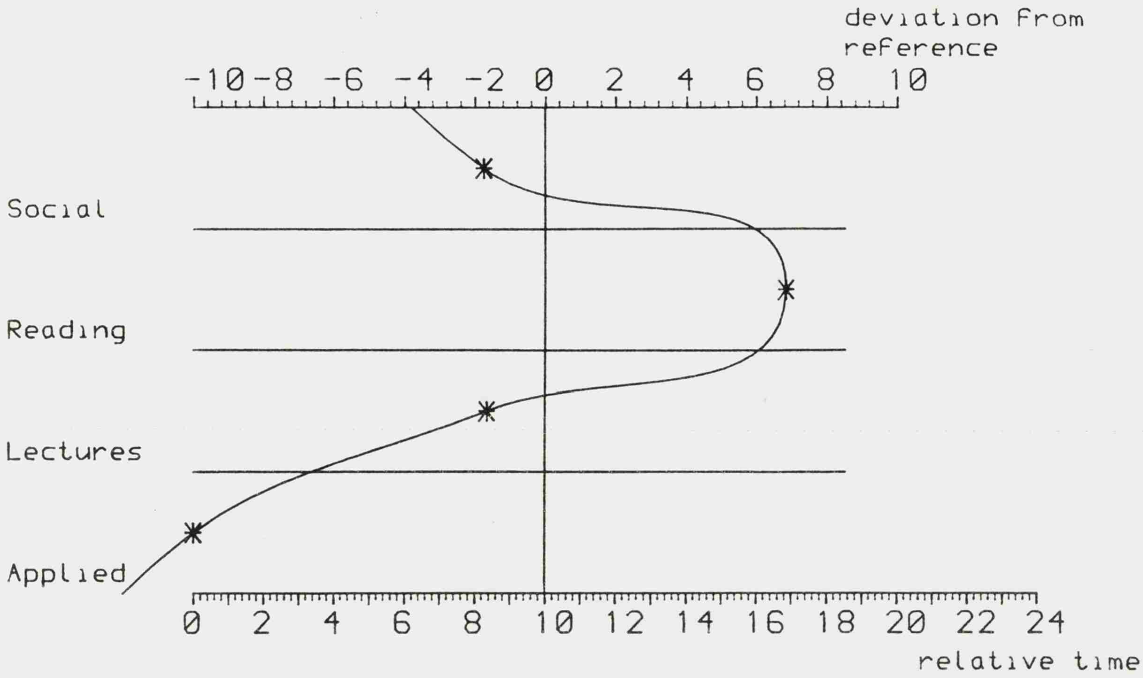


Figure 6
Whiteknights non-res students with no applied sched.

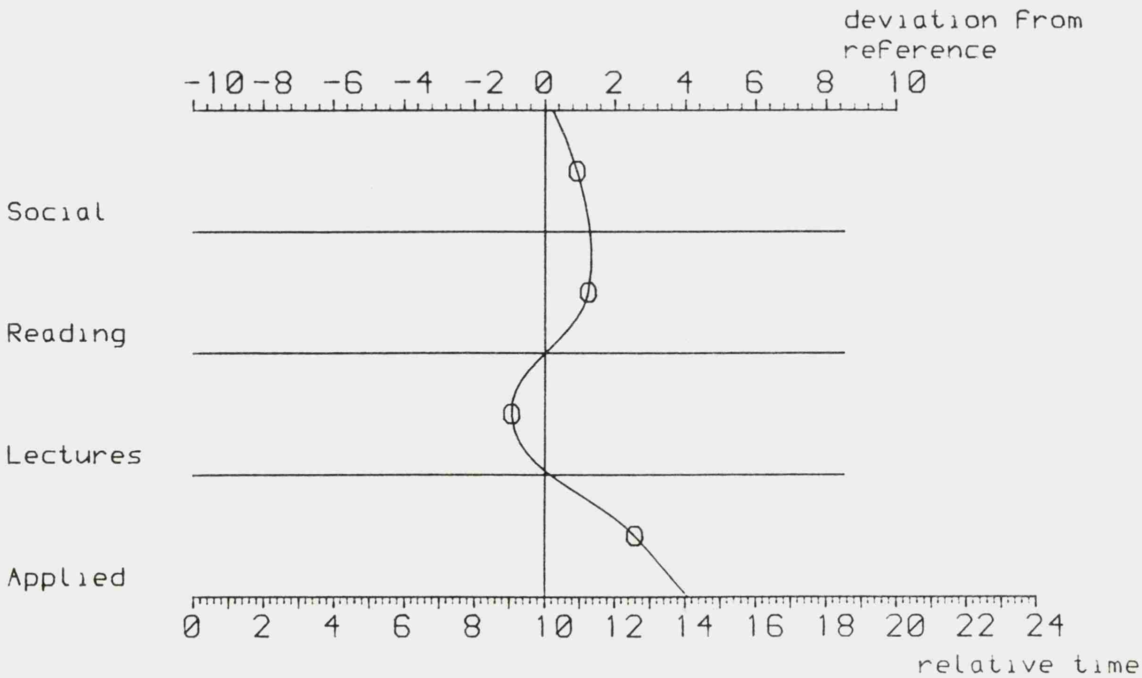


Figure 7
Whiteknights non-res students with applied sched.

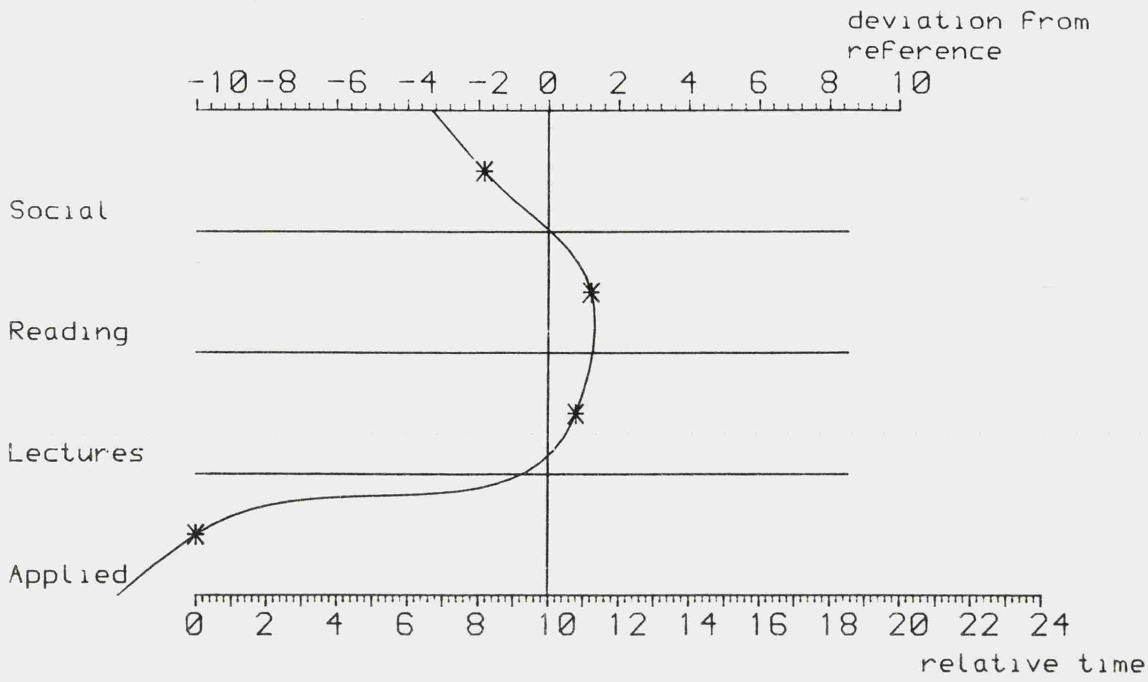


Figure 8
Lec Un. non-res students with no applied sched.

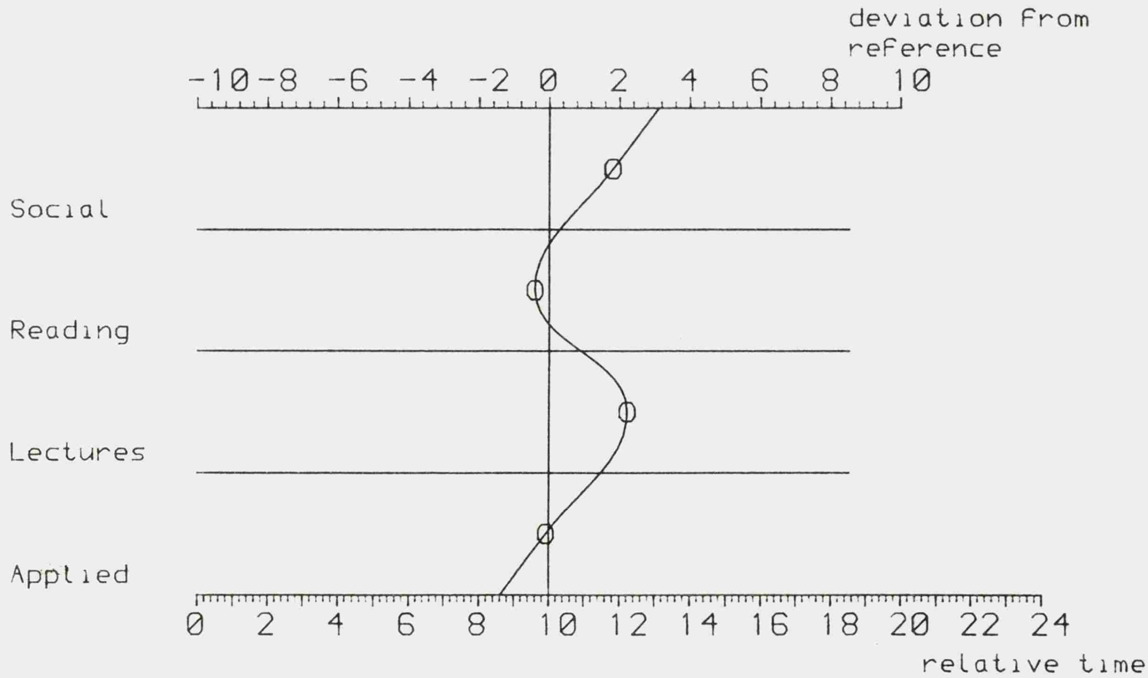


Figure 9
Lec Un. non-res students with applied sched.

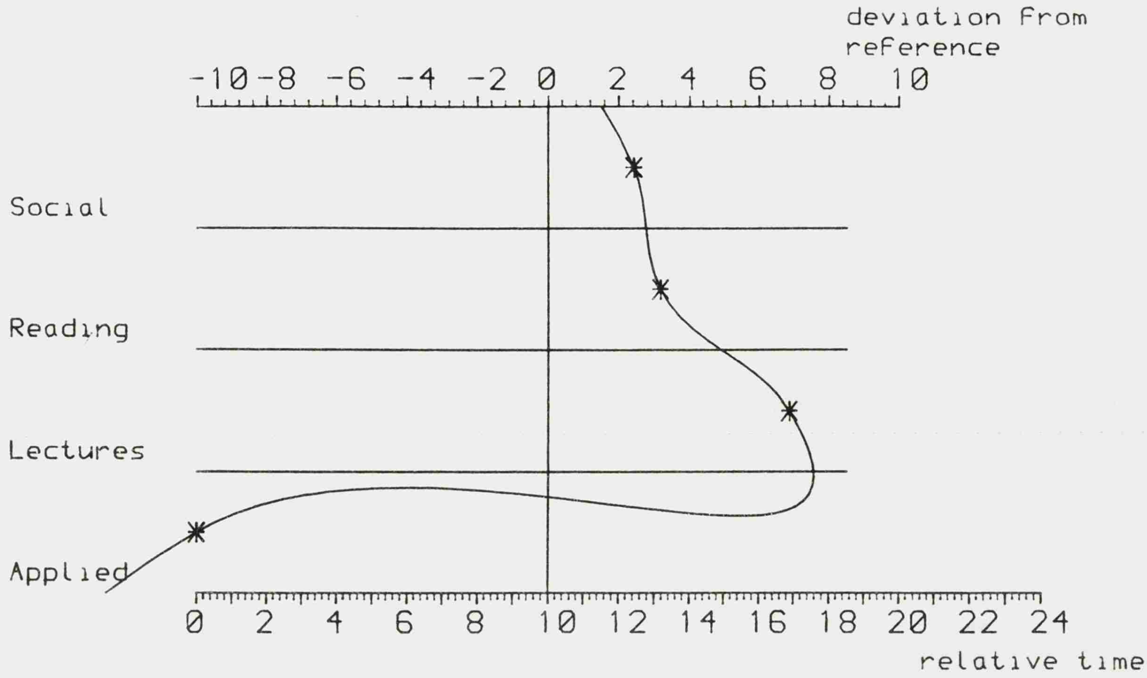


Figure 10
Lec Poly non-res students with no applied sched.

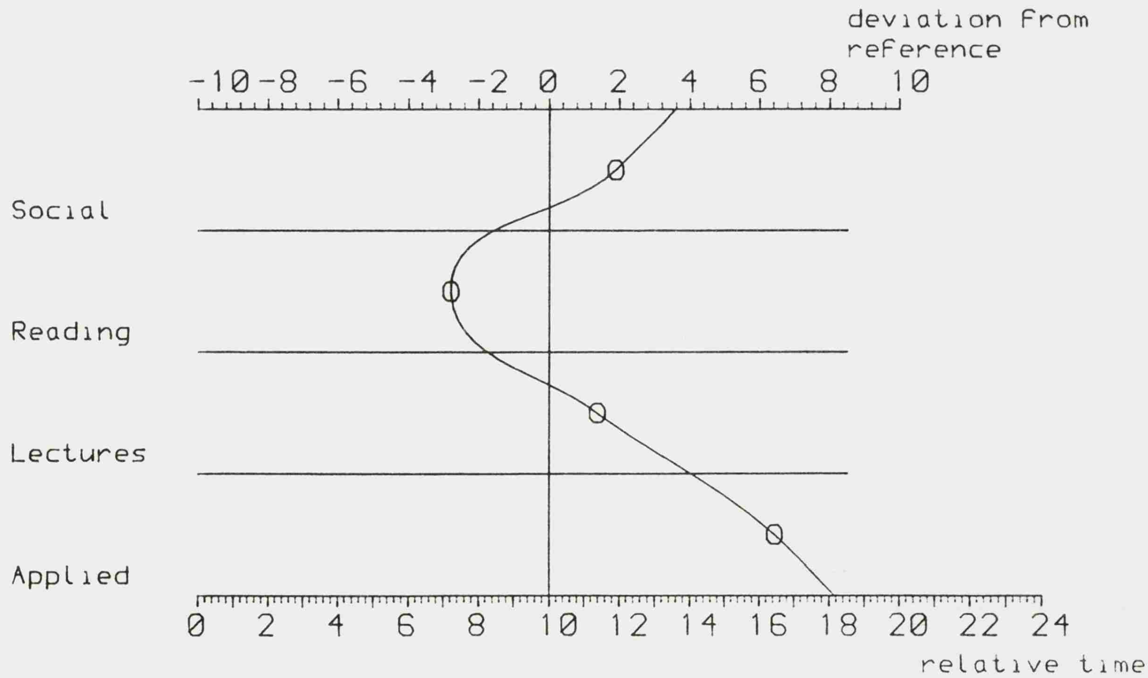


Figure 11
Lec Poly non-res students with applied sched.

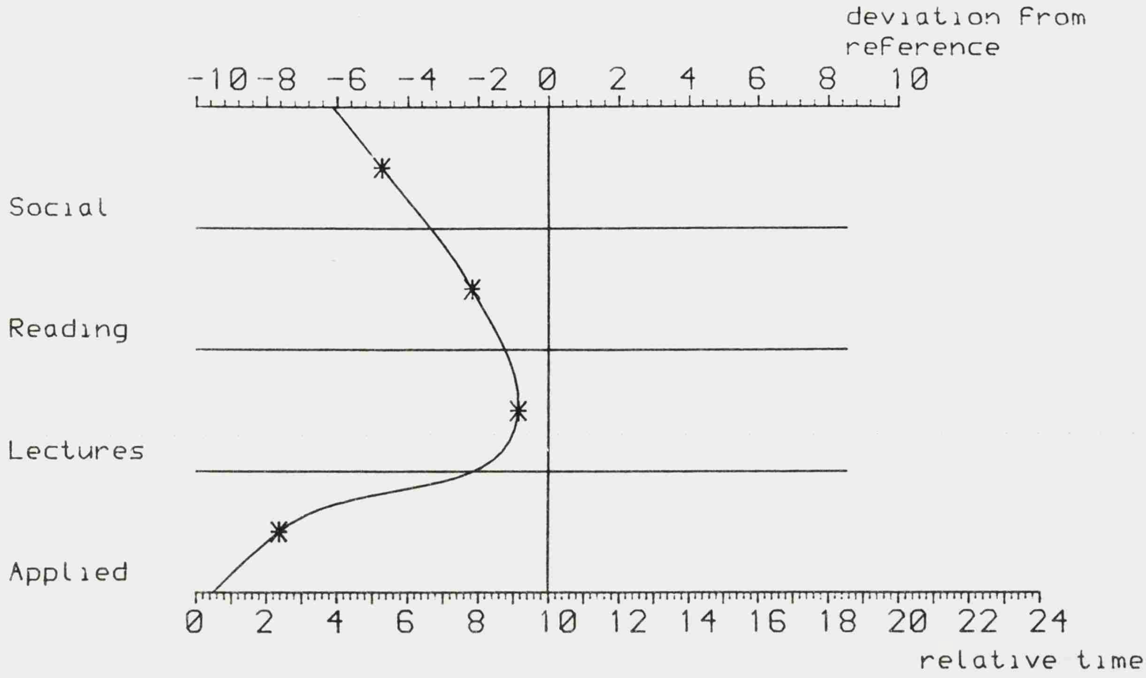


Figure 12
Reading Un, Whiteknights resident students

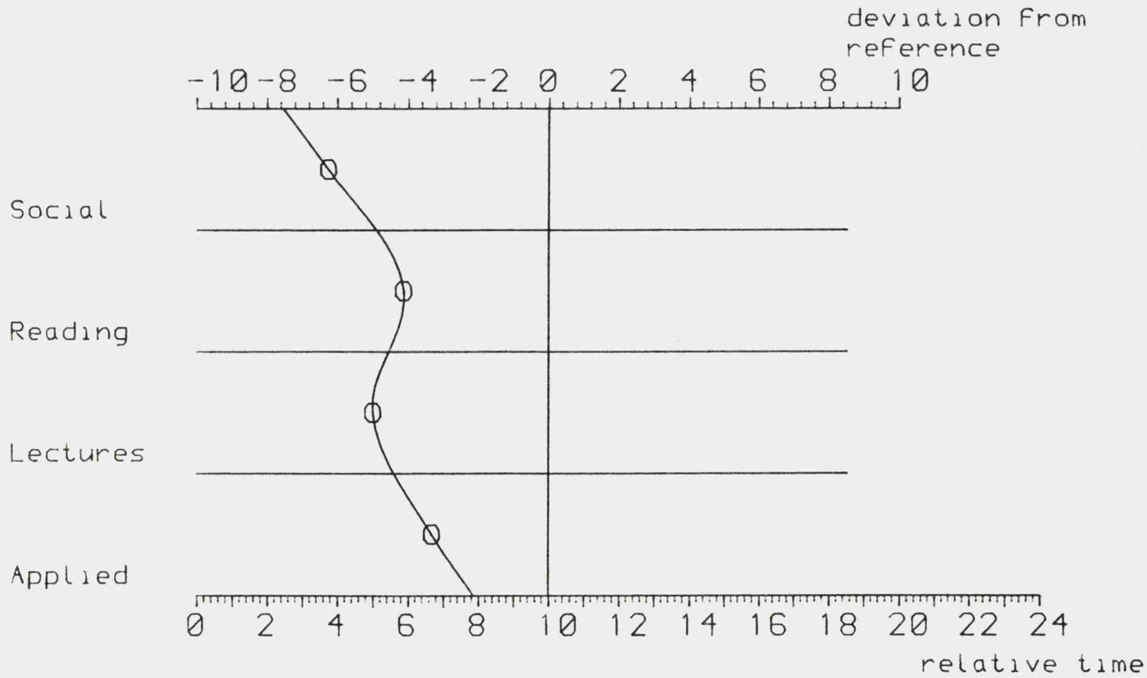


Figure 13
Reading Un, Lndn Rd resident students

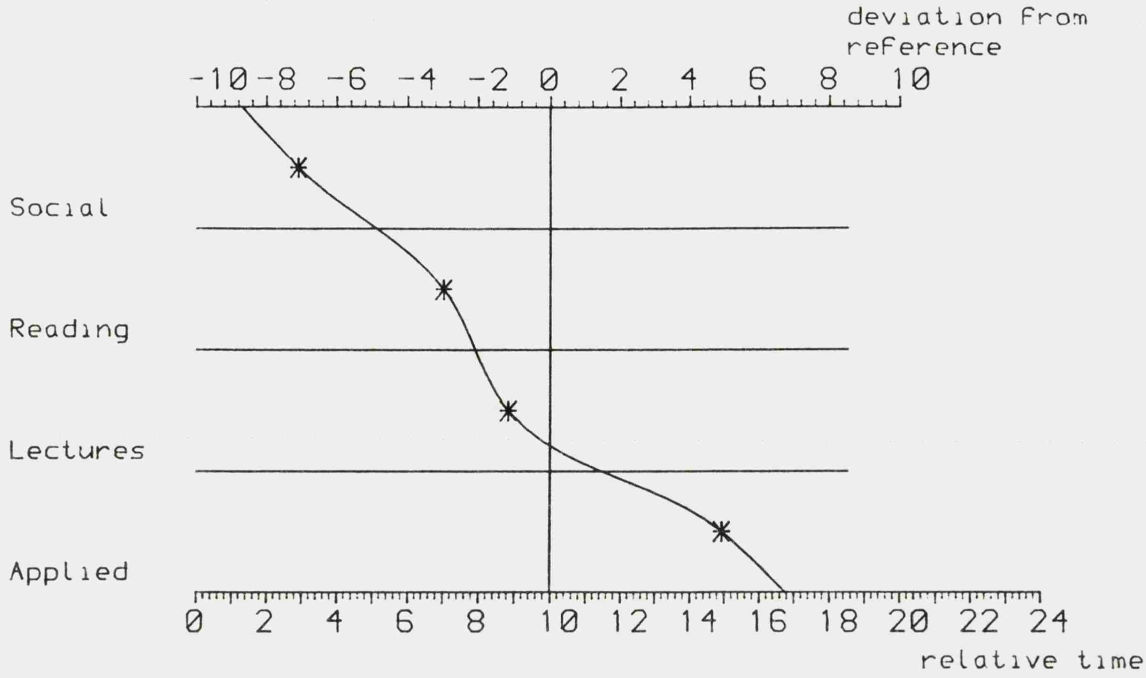


Figure 14
Reading Un, Dual site resident students

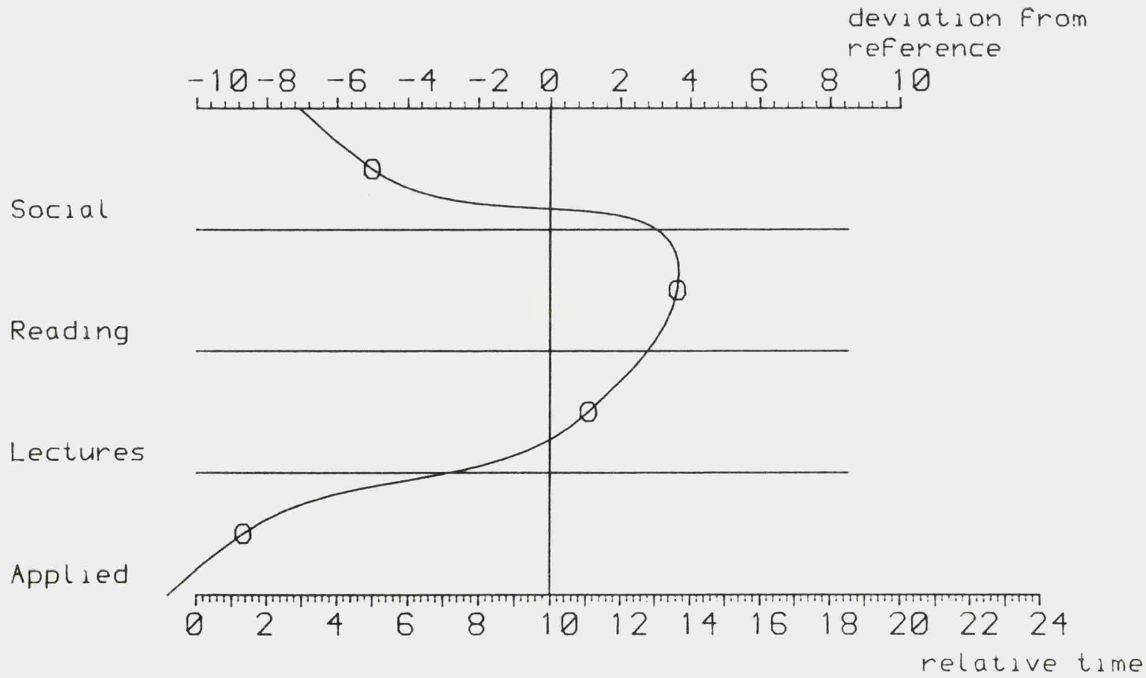


Figure 15
Leicester Un, resident students

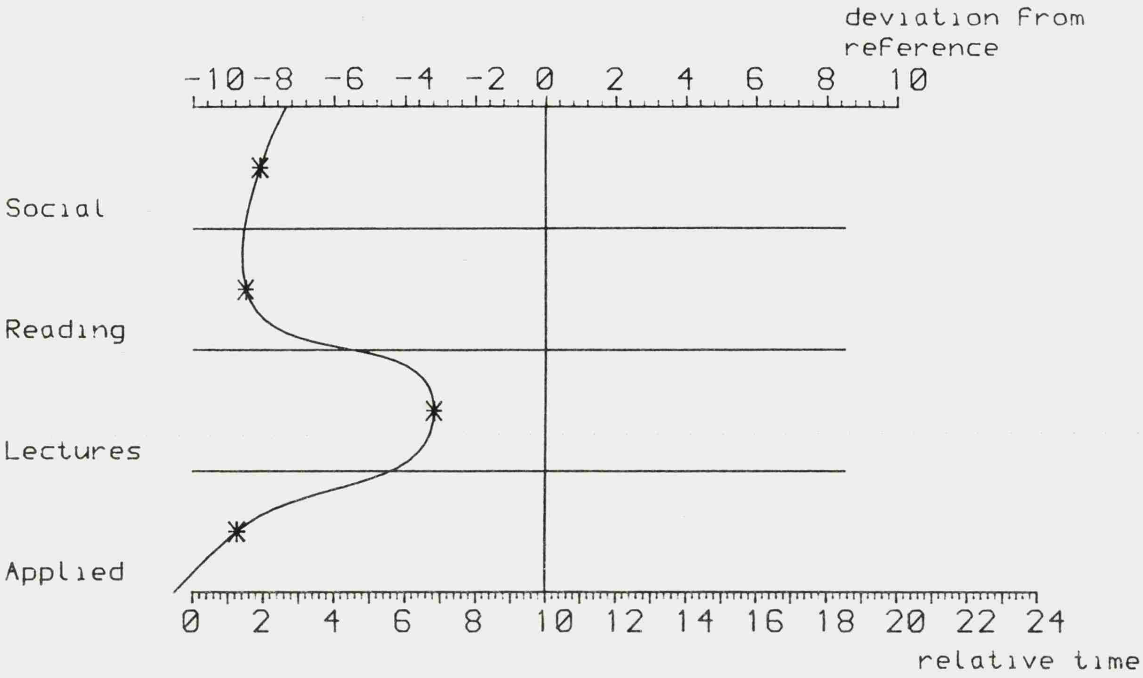


Figure 16
Leicester Poly, Part-time students

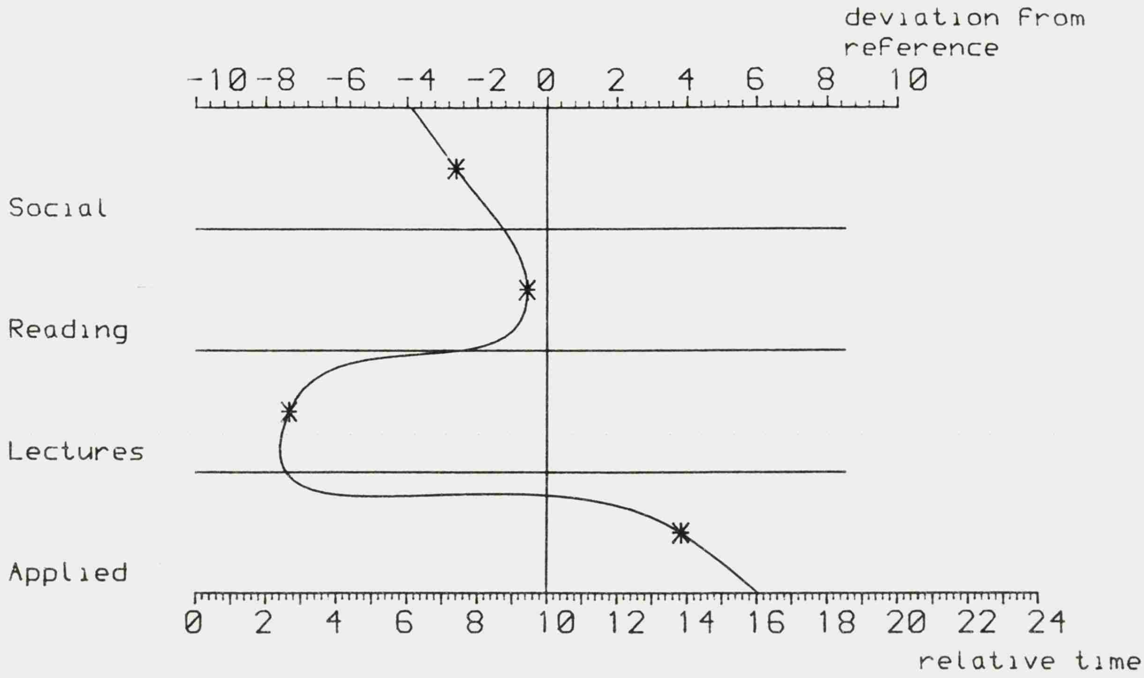


Figure 17
Rd Un Whiteknights, non-res postgraduate students

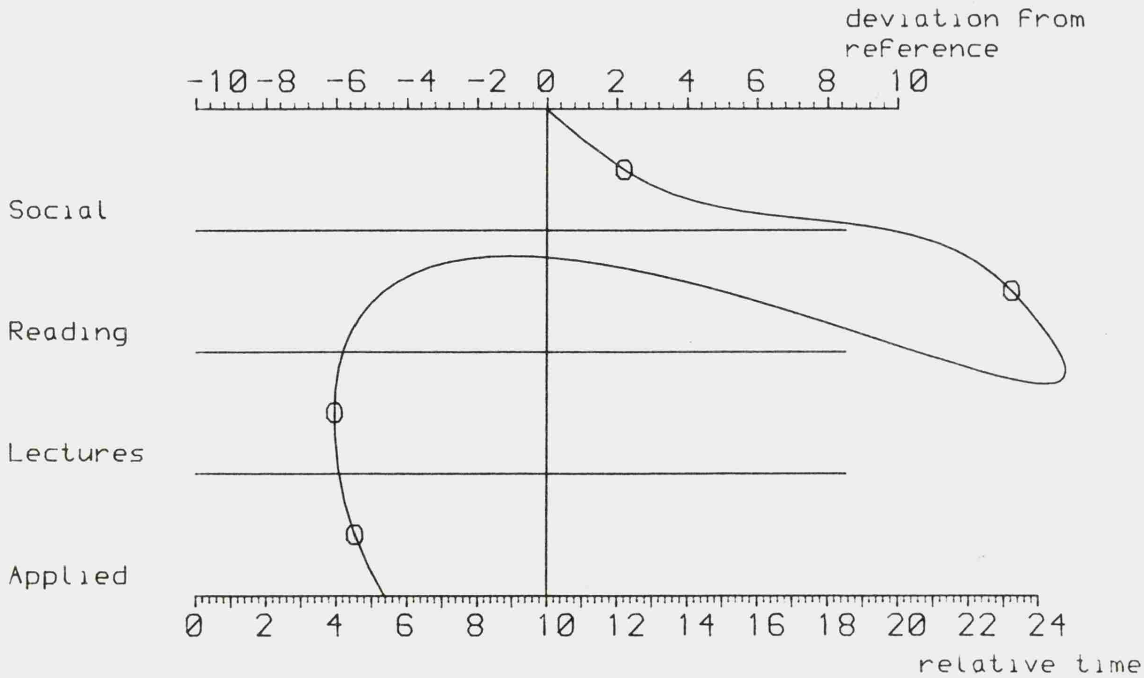


Figure 18
Leicester Un, non-res postgraduate students

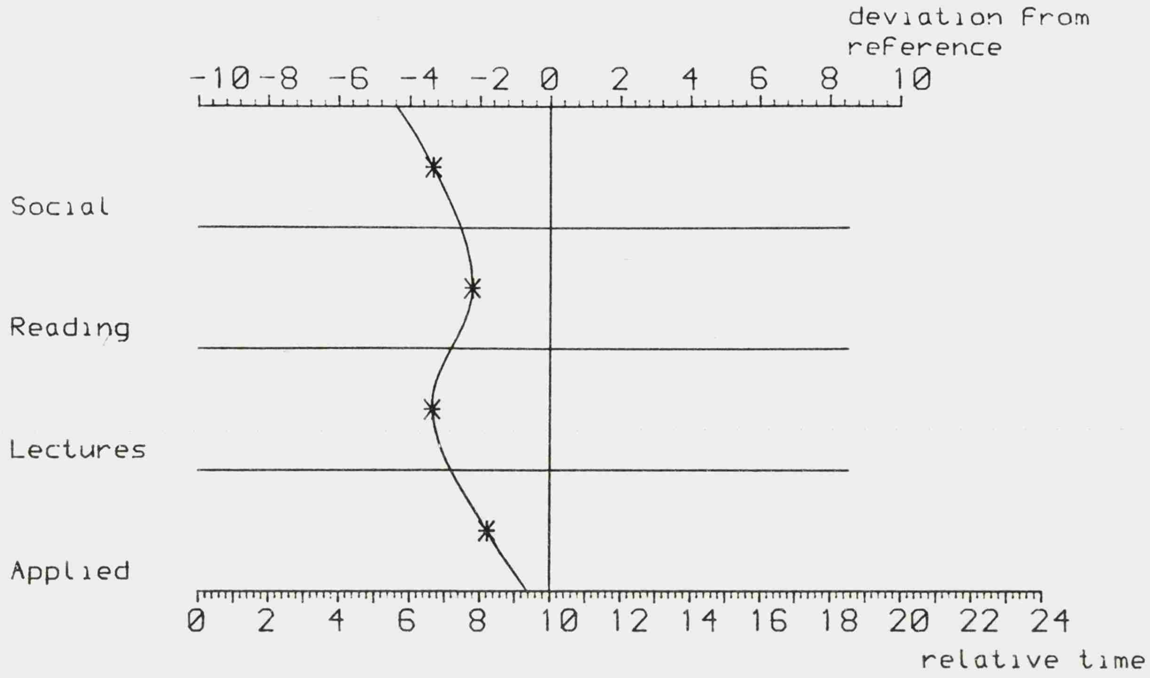


Figure 19
Reading Un, resident postgraduate students

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