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APPLIED BENCHMARKING AND PERFORMANCE INDICATORS FOR FACILITIES MANAGERS OF EDUCATIONAL BUILDINGS

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Introduction

The purpose of this exploratory research is to investigate issues surrounding the impact of lecture facilities on the student learning experience.

The significance of facilities form on function has long been recognised. Florence Nightingale[1] is reported to have said:
" The very first condition to be sought in planning a building is that it be fit for its purpose. And the first architectural law is that fitness is the foundation of beauty. The hospital architect may feel assured that, only when he has planned a building which will afford the best chance of speedy recovery to sick and maimed people, will his architecture and the economy he seeks be realised."

The growing significance of lecturer/ student ratios, and room occupancy levels (Smith, 1979) the importance of the lecture facility within Universities' operation is central. It is clearly vital that they provide the best possible conditions to enhance student learning experiences. The function of a facility should affect design decisions in regard to both new build facilities and refurbishment projects. The better informed those decisions are the greater the quality of the learning experiences taking place in them.
A review of the literature generally can be split broadly into two disparate sectors. First, work on educational issues and second, work in relation to design or the 'technical' specifications of facilities. Previous studies attempting to link these two areas are largely limited to work on secondary school buildings and predominantly based in the United States.
One of the few studies which does combine issues of learning and lecture theatre environment is that of Smith (1979) undertaken at the Institute for Advanced Architectural Studies, University of York. Smith reviewed a number of upgrading schemes and looked for what were described as "successful" features. However, the work does not define "successful" and tends to concentrate on matters of 'technical' specification and less on user experience. It does, however, provide a starting point for discussion on links between the learning experience of students and the facilities within which they take place.

This paper reviews the cognate literature within the two areas and then synthesises matters raised by a survey of student experiential views.

LECTURE THEATRE DESIGN

Design will always affect the value of a building. This may be in terms of investment or functional value although arguably the two are not unrelated. However, as the literature below indicates performance reviews tend to ignore the latter.

R. Bunn (1997) writing in the Building Services Journal is typical of much of the literature to be found on the 'technical' aspects of lecture theatre design. He reports on a new low energy office building which includes two seminar rooms and a one hundred-seat lecture theatre. The work focusses on whether the design has managed to achieve its low-energy consumption objective. It is typical of much research in this area which concentrates on assessing technical specifications and not on the effectiveness of the building for the occupants.
Similarly the work of Singmaster and Edwards (1995) although analysing various components, fails to examine users' perceptions[2] .Focussing on new university provision in Oxford and Sheffield. The work primarliy considers interior aesthetics and the technical achievements of converting a neo-gothic church to provide lecture facilities and other student accommodation.

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[1] Quote taken from NHS Estates (1994) Better by Design Pursuit of Excellence in Healthcare Buildings NHSL
[2] Lianacre College Oxford University student accommodation and education block and St Georges Church Student Accommodation Sheffield University
[3] The Chartered Institute of Building Surveyors (1991) The Visual Environment in Lecture, Teaching and Conference Rooms CIBSE Unwin London

Similar papers by Carolin (1996) in the RIBA Journal and Greenberg (1994) look at a variety of technological and design issues in relation to academic accommodation

All these papers are limited to considering issues in relation to structure, aesthetics or technical function. Similarly, a number of other recent publications prescribe specification standards for lecture facilities. Typical of such is the Lighting Guide[3], which concentrates on minimum specification requirements. This work includes consideration of both natural and artificial light including minimum requirement in terms of technical specifications. Although all of these matters are important there is a demonstrable primary need to consider them in relation to a building's function.

EDUCATIONAL ISSUES

Lang (1996) considers the essential criteria for an ideal learning environment. Although he examines the functions of schools in the U.S.A. and not universities he does explore how space can enhance or detract from the learning experience. Despite his statement that *"Learning is essentially a mental process. So why do we bother how the classroom looks or feels?"* (1996), his work looks at the variables influencing the learning process. He suggests that as we adapt our understanding of learning and develop new ideas and techniques to enhance the learning process we should develop ways to enhance the learning environment. Of particular importance is that Lang identifies six categories of component to be considered in the design of academic accommodation to provide an optimum learning environment. He identifies these as:

- **Size shape and scale -** in relation to flexibility and adaptability. Occupancy and perceived occupancy are also considered.
- **Acoustical quality and noise control** - acoustic characteristics are made up of room configuration, surface finishes and sound transfer qualities. For lecture theatres the aims are to amplify and clarify noise from front to back and absorb noise from back to front.
- **Illumination and views -** both natural and artificial light sources are considered and the clarity and nature of the view afforded to the student. It suggests that a balance of natural and artificial light is most likely to achieve the optimum learning environment. Although it considers such factors as control and positioning of lighting it suggests that natural light is often preferred by students but that in practice it is hard to control and may cause problems such as secondary glare and other distractions[4] .
- **Temperature, humidity and ventilation -** determined by configuration and materials of the building, amount of solar gain and loss, size and volume of space, numbers of occupants and their state of activity, as well as the heating, cooling and ventilation system. In addition, consideration must be given to control systems.
- **Materials finishes, textures and colour** are argued to be crucial to the creation of an appropriate and successful learning environment.

The key conclusions of Lang's work is that designers and architects must understand the effects of design decisions on the ability of the learning space to successfully create an appropriate learning environment.

Bligh (1972) considered the common factors likely to be the ingredients of a successful lecture. These include the overall effect of room shape on aural and visual perception and environmental conditions. Bligh comments on the need for variation in stimulation of the physical environment. He suggested conditions must be comfortable. *"i.e. not soporific, or too bracing, to distract attention. Acoustic, visual and thermal conditions are a matter of standard specification*[5] *.* For example, it is suggested that seating should be comfortable for a sufficient period of time compatible with the average usage time.

However, as argued earlier, the literature fails to synthesise both technical issues and matters of learning experience. There is a substantial literature on each but little to link the two. This research attempts to explore the views of students to establish the significant components of lecture theatre form and function.

Research Methods

[4] The Chartered Institute Surveyors (1991) The Visual Environment in Lecture, Teaching and conference Rooms CIBSE Unwin London

[5] Bligh D (1972) What's the use of Lectures pp69-71 Penguine London

The methodology adopted was required to evaluate the effects of design features on the student learning experience. A positivist approach would have taken as its starting point known 'technical' design issues. It was more central to the research, however, to determine the 'environmental' factors affecting the learning experience of the occupiers. A non- positivist approach was therefore developed which allowed links to be maintained with the design literature. Although initially derived from the literature the selection of variables was made from information derived from discussions with small sample groups of students. To avoid the discussions being influenced by immediate surroundings they were not held in lecture theatres.

Having derived the components to be included in this way a questionnaire approach was adopted for primary data collection. This allowed for the maximum response within available resources. A questionnaire approach is also entirely suitable for the type of data sought i.e. at an exploratory level. In the pilot study respondents had an opportunity to incorporate further variables. The first part of the selection exercise involved two large groups of students (sixty plus per group) being asked to list as many features of a lecture theatre as possible. The pilot survey was tested on a number of small groups and some amendments to wording and instructions were subsequently made. Three lecture theatre locations for the survey were selected to include a range of facilities. These were representative of types of facilities across the university; For reasons of confidentiality they have coded names

The L1 Lecture Theatre. A newly completed facility with a capacity for 364 students. This lecture theatre the flagship of the university's teaching accommodation and is equipped with modern audio-visual equipment. Having been completed in January 1998 the facility should represent all the best practice and up to date specifications of a modern facility.

The B2 Lecture Theatre. This is a lecture theatre with a capacity of 120 seats converted from existing accommodation within a 19th. century building. It has a steep rake and most significantly a high level of natural light on two elevations. The conversion took place some 30 years ago and there have been only small upgrades since that time.

The C3 Lecture Theatre. This 84 seater room has no natural light, a steep rake and narrow seating and desk space.

The selection of this sample of facilities was intended to provide a range of actual facilities with features representing all the design variables included in the questionnaire.

Survey implementation

The full weekly timetable for all three facilities was analysed. Sample sessions were selected from the timetable to try to represent all variables in the general information section of the questionnaire namely:

Year of programme
Gender
Science or Art based programmes
Mode of study
The theatre itself

By adopting this selection process a balance of views was collected, however, it is accepted that the study is only able to address factors available within the programmed sessions available to the researchers. Therefore, for example, some user types (such as engineering students) have no programmed lectures in the selected facilities.

The questionnaires were distributed at the beginning of a lecture session and were completed always within 10 minutes although no time limit was imposed. There were no verbal instructions and all students were told only that this was a university research project into lecture theatre design. The questionnaire data was then entered into an SPSS data set which was used for all analysis. There were 338 questionnaires completed representing a 98% response rate.

Survey findings

For purposes of clarity only the frequencies of section one variables are set out below. However, it should be noted at the outset that throughout the findings there are no significant variations in responses across these groups.

Gender of respondent

	Frequency	Percent
male	188	**55.6**
female	150	**44.4**
Total	338	100.0

Location of survey

	Frequency	Percent
L1	102	**30.2**
B2	110	**32.5**
C3	126	**37.3**
Total	338	100.0

Mode of study

	Frequency	Percent
full time	311	**92.0**
Part time	27	**8.0**
Total	338	100.0

Year of course

	Frequency	Percent
1	70	**20.7**
2	184	**54.4**
3	84	**24.9**
Total	338	100.0

The data demonstrate there is reasonably equal representation from the categories. This was designed to analyse any variance related to sample differences. However as reported above no significant differences were found throughout the analysis.

General significance of lecture theatres on the learning experience

The question “Does the quality of a lecture theatre affect the learning experience? “ was to validate, or otherwise, the underlying hypothesis for this project derived from Bligh and to a lesser extent Lang (op cit).

The results were as follows:

Quality affect your learning experience

	Frequency	Percent
yes	263	**77.8**
No	75	22.2
Total	338	100.0

The results from this table is quite clear, 77.8% of respondents indicated that the quality of the lecture theatre affected their learning experience. Significantly there is no gender or other factor differentiation in relation to the answer to this question.

It is central to the arguments offered that this study looks to test only students' perceptions and a concomitant is that if there is such a perception by students (that facilities influence learning) then this alone will have some effect.

The results do lead to the conclusion that there is a relationship between the lecture theatre facility and the students' perception of their learning experiences. It could be argued however, that despite their general perceptions the true effect of individual facilities is minimal. This was

examined from sample opinions of the particular facilities occupied at the time of the survey each of which exhibited substantial differences of quality.

How important are the lecture theatre facilities to this teaching session? (Q7)

This question attempts to incorporate the students' perspective of their immediate surroundings asking them to consider the effect of the lecture facilities occupied at the time of the survey. As they are positive these results are significant in two ways. First they confirm that students perceive that lecture theatre design does have an effect on their learning experience (as examined above). Second for those particular contact sessions during which the question was asked the students felt that the facility they were in with all its attributes was influencing the learning experience.

Importance of facilities to this teaching session (Q7)

	Frequency	Percent	Cumulative Percent
very important	77	**22.8**	22.8
Important	124	**36.7**	59.5
Quite Important	88	**26.0**	**85.5**
neutral	33	9.8	95.3
less important	8	2.4	97.6
unimportant	7	2.1	99.7
Not relevant	1	.3	100.0
Total	338	100.0	

This result shows that 85.5% rate the facilities as important taking into account their immediate surroundings with only 0.3% considering them to be not relevant.

If this data is cross-tabulated with gender or year of study there is no significant variance to the result. There is therefore a clear association with all types, modes, location and gender of respondents and their ranking of the importance of the facilities.

These results confirm with similar levels of occurrence that the students surveyed rated the importance of the facility they were in very highly in terms of effect on the learning experience. The implication is important and reinforces the results of the generic question already asked.

As the student perception is that the facilities are important the next stage in the research is to attempt to establish the relative significance of specific features within a facility.

Statistics

	N		Mean	Std. Deviation	Skewness	
	Valid	Missing				
	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error
Quality affect your learning experience	338	0	1.2219	.4161	1.345	.133

The significance of individual design variables

The data provided by the survey gives an opportunity to consider the importance of design variables individually by analysing the aggregate returns of the responses.

The research questionnaire asked students to rate the importance of individual components of lecture theatres in terms of their effect on their learning experience. A seven point Likert scale was used ranging from “Very Important” (1) to “Not important” (7). Although many forms of analysis are available for data of this type it was decided for initial analysis to adopt a simple descriptive statistical approach. An arithmetic mean was calculated for the scores for each of the design variables. Thus lowest score represented the feature considered most important on ‘average’ Standard rankings of the percieved effect on learning experience of the generic design criteria were as follows:

Ranked generic design criteria

Rank	Design Variable	N	Mean	Std. Deviation
1	Quality of audio visual equipment	338	2.239645	1.09
2	Desk Space	338	2.328402	1.23
3	Visibility of visual displays	338	2.476331	1.28
4	Accoustic quality (internal)	338	2.485207	1.14
5	Seating Comfort	338	2.565089	1.21
6	Illumination (Natural)	338	2.612426	1.31
7	Ventilation	338	2.639053	1.35
8	Occupancy level	338	3.171598	1.45
9	Illumination (Artificial)	338	3.245562	1.52
10	External noise	338	3.41716	1.47
11	Distractions	338	3.470414	1.54
12	Appropriate size	338	3.576923	1.66
13	Position of lecturn	338	3.692308	1.52
14	Rank	338	4.118343	1.76
15	Internal finishes	338	4.281065	1.42
16	Shape of the room	338	4.544379	1.44

The results provide an initial view of students' perceptions to aid design decisions. Some components may not be ranked in a way which might have been anticipated. Further work will expand on this to identify causal factors and cost implications.

A further analysis was made to compare the overall generic design criteria means against the mean results for each lecture theatre. From the analysis it is possible to identify where individual lecture theatres under-perform against the generic mean.

Individual facility performance/generic design performance - Interpretation

	L1	B2	C3	
				Generic mean
Quality of the audio visual equipment	2.19	4.03	4.84	2.24
Desk space	3.56	4.22	5.38	2.33
Visibility of visual displays	2.39	3.64	3.68	2.48
Accoustic quality (Internal)	2.26	3.43	3.33	2.49
Seating comfort	3.05	4.33	5.03	2.57
Illumination (natural)	na	2.44	na	2.61
Ventilation	3.61	3.86	5.32	2.64
Occupancy Level	2.95	3.18	3.65	3.17
Illumination (artificial)	2.80	3.51	4.85	3.25
External Noise	2.33	3.60	3.04	3.42
Distractions	2.42	3.62	3.33	3.47
Size	2.15	2.91	3.96	3.58
Position of lectern	3.35	3.20	4.51	3.69
Rank	2.98	2.85	4.64	4.12
Internal finishes	2.82	4.95	4.64	4.28
Size	3.01	2.51	4.03	4.54

The results provide an initial view of students' perceptions to aid design decisions. Some components may not be ranked in a way which might have been anticipated. Further work will expand on this to identify causal factors and cost implications.

The results of this analysis provide a guide as to where the student perception of actual facilities falls short of their generic ranking and value of design features in general. The new facility as might be expected is performing well in most sectors but nevertheless falls short of the generic mean in three areas those of seating comfort, ventilation and desk space. Both the other facilities under

perform in most categories suggesting that the facilities fail to meet the 'average' standards. Performance below these standards infers that they may have a detrimental affect on the student learning experience.

Further Research Undertaken

Some time later whilst presenting some findings from the research to a group of 24 University Facilities Senior Managers the opportunity was taken to seek their views on what components of facilities were thought to be significant to the learning experience of the students occupying them. A similar analysis of their Likert scaled replies produced the following results.

FACILITIES MANAGER'S VIEWS

	Mean	Std. Deviation	% Response
VISABILITY OF DISPLAYS	1.13	0.50	100.0%
SEATING	1.44	0.73	100.0%
VENTILATION	1.44	0.73	100.0%
ARTIFICIAL ILLUMINATION	1.50	1.03	100.0%
ACOUSTIC QUALITY	1.56	0.96	100.0%
WRITING SPACE	1.63	0.74	50.0%
TEMPERATURE	1.67	0.65	75.0%
DESK SPACE	1.69	0.79	100.0%
DISTRACTIONS	1.75	1.34	100.0%
EXTERNAL NOISE	1.81	1.33	100.0%
VISION	1.83	0.72	75.0%
AUDIO VISUAL QUALITY	1.94	1.18	100.0%
AUDIO VISUAL EQUIPMENT	2.09	1.58	68.8%
TECHNICAL SUPPORT	2.40	0.55	31.3%
APPROPRIATE SIZE	2.50	1.15	100.0%
INTERNAL NOISE	2.50	1.38	37.5%
NATURAL ILLUMINATION	2.69	1.85	100.0%
DECOR	2.92	1.26	81.3%
ACESS	3.00	2.10	37.5%
VISIBLE CLOCK	3.00		6.3%
LECTERN POSITION	3.00	1.37	100.0%
TOILETS CLOSE	3.00		6.3%
ROOM SHAPE	3.06	1.81	100.0%
OCCUPANCY LEVEL	3.19	1.83	100.0%
RAKE	3.25	1.65	100.0%
DISABLED PROVISION	4.00	2.00	18.8%
FLEXIBILITY	4.00		6.3%
ROOM HEIGHT	5.00		6.3%
INTERNAL FINISHES	7.13	15.76	100.0%

The table shows that of the 29 variables recorded only 16 (55%) were identified by all respondents. Again, 4 (13%) of the variables were not cited by most respondents.

A total of 11 variables identified by the facilities managers were not specified by the student occupiers. These are in some cases contextual variables such as disabled provision and access

There is a significant juxtaposition of rank between the student occupier and facilities managers views. For more on this analysis see Flemming and Storr 1999

Conclusion

This exploratory research has revealed important factors in lecture theatre design and their significance in influencing students' perceptions of their learning environment.

The data set is relatively small and is limited locationally. It also represents perceptions of only one type of facility employed in the learning environment. Work is underway to correct both of these restrictions.

Further work is also required to identify the cost relationships involved in providing satisfactory facilities. Perhaps most important is work to identify the causal relationships in facility performance and the student learning experience.

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