DESIGN CRITERIA FOR LEARNING SPACES IN TECHNICAL INSTITUTIONS

A DISSERTATION

Submitted in partial fulfillment of the requirements for the award of the degree of

MASTER OF ARCHITECTURE

By

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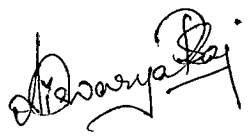
CANDIDATE'S DECLARATION

I hereby declare that the work which has been presented in this dissertation entitled as **'DESIGN CRITERIA FOR LEARNING SPACES IN TECHNICAL INSTITUTIONS'** in partial fulfilment of the requirement for the award of the postgraduate degree of **MASTER OF ARCHITECTURE**, submitted in the Department of Architecture and planning, Indian Institute of Technology, Roorkee, is an authentic record of my own work carried out by me during the period from August 2010 to June 2011 under the supervision and guidance of **Dr. MAHUA MUKHERJEE.**

The matter embodied in this dissertation has not been submitted by me anywhere else for the award of any other degree elsewhere.

Date:

Place: Roorkee



(Aiswarya Shylaja Baburaj)

CERTIFICATE

This is to certify that the above statement made by the candidate **Aiswarya Shylaja Baburaj** is correct to the best of my knowledge and belief.

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EXECUTIVE SUMMARY

Awareness of the relationship between the educational and architectural design features and principles when planning new learning environments has escalated in the last few years. Not only should institutional buildings be durable and aesthetically pleasing, but they also need to be functional and fit for purpose. These trends are underpinned by a body of unique research. The research focuses on the way in which campuses have used resources for time, space and information communication technologies (ICT) to change the existing pedagogical model and teacher practices to a more student-centered approach. The increasingly diverse offering of global higher education effectively means that there is no single prescription or model which represents the learning environment (pedagogy and infrastructure) in the 21st century. Although not prescient at the start of the project, the need for a critical review of a campus offering is ever more important in the light of a reduced publicly funded higher education budget for the foreseeable future. Efficient and effective use of space can contribute not only to an enhancement of the academic offering, but it can also contribute significantly to savings other than in the staffing budget.

The dissertation sets out to explore current issues and trends in new approaches to the design and use of flexible technology-rich learning spaces in Higher Education, and to consider the implications of these for new generation institutions. The aim of the entire work is to conceptualize the future design of formal learning spaces, in order to facilitate the changing pedagogical practices needed to support a mass higher education system in technical institutions.

Design criteria learning spaces in technical institutions looks at the relationship between campus planning and specific exemplary teaching and learning spaces in a set of new generation campuses. A key feature of the research is the way in which these exemplary spaces are integrated into an overall campus plan. Based on principles derived from the latest research in design and planning, the work looks at the way in which campus teaching and learning spaces and their master plans express the values and aspirations of the campuses within which they are sited.

An extensive review was carried out in order to establish the background to the study and to begin to explore new approaches to the design of learning spaces. The dissertation has produced a series of case studies that reveal the manner in which these innovative teaching and learning spaces have been developed, with a particular focus on the various kinds of formal learning spaces, their role in the learning process and teaching styles adopted in each of them. The information acquired about these aspects provides knowledge about the design process that has been identified as a gap in the literature on pedagogy and the built environment.

Visits were then made to selected institutes in India in order to observe new developments in learning space design and need assessment surveys on various aspects

regarding learning spaces were also carried out. Interviews were also conducted with some of the key individuals involved in the design and use of the spaces. Learning spaces need assessment survey was intended to understand how pervasive the trend toward learning-centered space design is on campuses today and to understand their spatial quality which is crucial to a rich learning experience, and was designed to get the opinion from both the student and faculty community. Qualitative techniques are used to analyse the data collected.

An analytical model developed for the entire process where at each stages the results make way to identify strategies on which the design criteria would be formulated. To develop specific criteria for design for formal learning spaces, strategies help to narrow our perspective to certain key ingredients that are most important to guideline formulation. Based on the pedagogy-space-technology-capacity nexus, the design criteria was developed for the learning precinct.

The result of this work has established a set of principles that support and enhance the design and development of teaching and learning spaces. These principles include the importance of evidence based decision making, the need for student engagement, the significance of leadership, the necessity of role clarification, the establishing of appropriate management structures and the need to ground the design processes in an academic culture of debate and discussion. Principles of design are evaluated in a design application for a campus for the Indian Institute of Technology at Gandhinagar.

The findings of this study can help to provide new institutes with a general indication of the sorts of things that it has got right in the design of its learning and teaching spaces. The study also offers suggestions for future evaluative research.

ACKNOWLEDGEMENT

A dissertation of this scope would not have been possible without the active and passive support of my guide, many teachers, friends, colleagues, and scholars who have contributed greatly to my thinking and insights during the entire work, and who were instrumental in the crystallization and formulation of my thoughts on many of the subjects and issues discussed within. To them I am heavily indebted, as I am to the innumerable people and few organizations that have contributed ideas, comments, photographs, illustrations, and other items that have helped make this work a reality instead of a pipe-dream.

I am immensely grateful to the Director of IIT Gandhinagar campus and Prof. Najmur Rahman of TERI University for giving access to the campuses for the case study research and for their active participation as members of the learning spaces survey.

I express my sincere appreciation to my guide, my supervisor, Dr. Mahua Mukherjee who extended all facilities and for her guidance, help and motivation. Apart from the subject of my research, I learnt a lot from her, which I am sure, will be useful in different stages of my life. I deem it as my privilege to work under her able guidance. I would like to express my gratitude to the other faculty members of our dissertation jury committee: and Prof. P. S Pushpalata, Dr. S.K. Misra, Prof. R. Sankar, Prof. S.Y Kulkarni for their much help with the research design and methodology, review and many helpful comments.

I am especially grateful to my bachelor degree classmates Krishna Kant Tiwari and Liji Mohan for their assistance, criticisms and useful insights. I am thankful to all the Master students of IIT Roorkee with whom I share tons of fond memories. I would also like to acknowledge the support and encouragement of my friends Vijaya Lakshmi and Sreenita Mukherjee. I would like to thank the architecture department office and staff for their help. I also want to express my sincere appreciation to Mr. Sunil sir and Mr. Ajay sir of the Department of Architecture, IIT Roorkee for all their assistance on the departmental lab. My sincere gratitude also goes to all those who instructed and taught me through the years.

This dissertation would not have been possible without the confidence, endurance and support of my family. My family has always been a source of inspiration and encouragement. I wish to thank my parents, Dr. Vijayan Baburaj and Late Mrs. Shylaja Baburaj, whose love, teachings and support have brought me this far. I wish to thank my sister, Ms. Aswini Baburaj for her affection, understanding and patience.

And finally but most importantly from the depth of my heart I express profound gratitude to the Almighty for the Blessings He had bestowed upon me to do this work to the best of my abilities.

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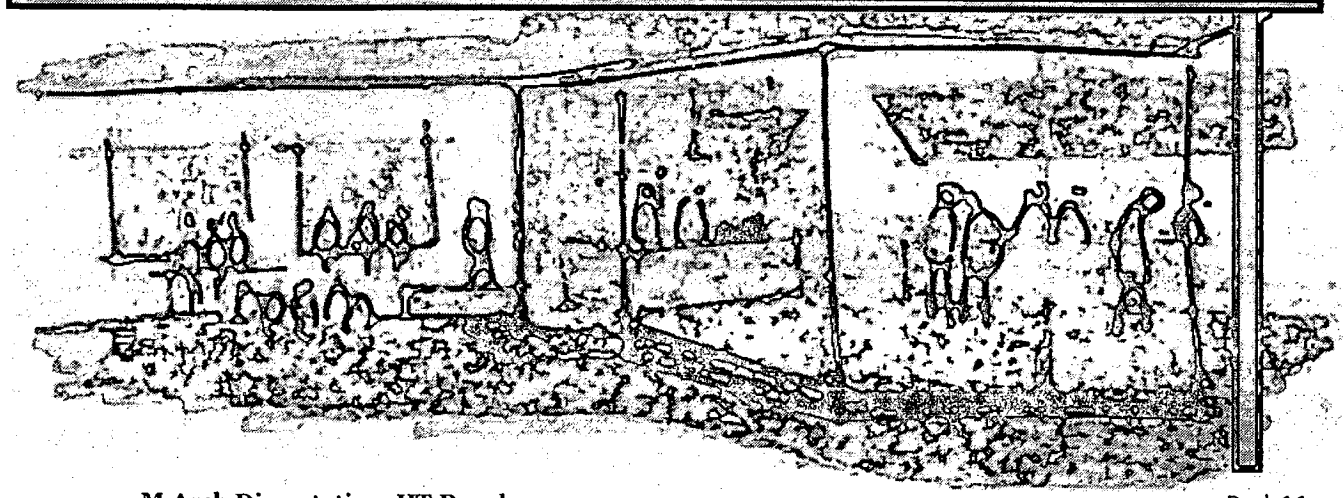
1.0 CHAPTER INTRODUCTION



1.1 PREAMBLE

Traditional teaching space in Higher Education can be characterised by its fixed rows of seats, which all face forward in the direction of a lectern or presentation facilities intended solely for use by an instructor. However, it is recognised that this type of classroom arrangement is no longer appropriate as it does not meet the requirements of 21st century learning (i.e. active and collaborative forms of learning). Academic institutions are currently rethinking and redesigning their learning and teaching spaces to accommodate changing pedagogy and technological advances.

Brown and Long (2006) identify some of the key trends that are influencing new approaches to the design of learning spaces:

• Design based on learning principles, For example, purpose-designed spaces that support active learning, interaction, and collaboration.

• Diverse devices that enrich learning, For example, spaces that incorporate a range of technologies such as laptops and wireless networking, and also various presentation facilities for use by students and instructors.

• A holistic view of learning, i.e. learning is not confined to the classroom, but happens anywhere and at any time, For example, spaces and facilities that are designed to support more social forms of learning.

The field of higher education also faces many challenges, primarily driven by sweeping changes in how technology is used in the learning process, and by an expansion in the variety of learning styles favoured by students. These trends are influenced by the large influx of Generation Y students, [Oblinger, 2005] with their penchant for collaboration and constant communication, and by the widespread use of personal computing and communication devices. Further, competition to attract top students has never been greater, presenting the challenge of how to design learning spaces and deploy technology to positively influence the institutional brand and image to current and prospective students. Together, these forces are changing how learning spaces should be designed to best support the learning experience.

An educational building is an expensive long-term resource. The design of its individual spaces needs to be: Flexible – to accommodate both current and evolving pedagogies, Future-proofed – to enable space to be re-allocated and reconfigured, Bold – to look beyond tried and tested technologies and pedagogies, Creative – to energise and inspire learners and tutors, Supportive – to develop the potential of all learners & Enterprising – to make each space capable of supporting different purposes.

A learning space should be able to motivate learners [Kolb, 1984] and promote learning as an activity, support collaborative as well as formal practice, provide a personalised and inclusive environment, and be flexible in the face of changing needs.

1.2 IDENTIFICATION OF THE PROBLEM

1.2.1 Introduction

India's higher education system is the third largest in the world, after China and the United States. The higher education system in India comprises of more than 17000 colleges, 20 central universities, and 217 State Universities, 106 Deemed to Universities and 13 institutes of National importance. Some institutions of India, such as the Indian Institutes of Technology (IITs), Indian Institute of Management (IIMs) and Indian Institute of Science (IIScs) have been globally acclaimed for their standard of education. They were conceived as Institutes of National Importance to act as leaders in Technology innovation.

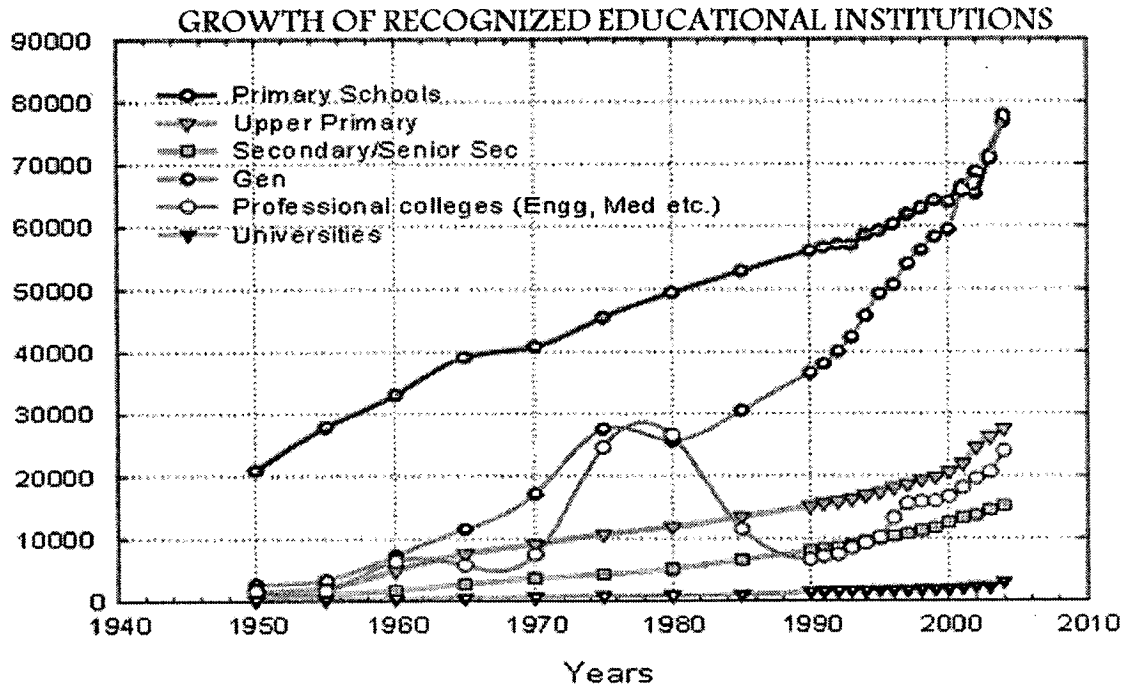


Figure 1.4 Growth trend of educational institutions in India

IIT campus can be compared to a neighbourhood because it meets most of the needs for the campus community. However, the campus is non-commercial and primarily a place of serious study and hence the design of formal learning spaces is crucial to any campus. The 11th Five Year Plan, endorsed by the National Development Council in December, 2007, envisages, inter-alia, establishment of the following new higher education institutions [Figure 1.1] in the Central sector: 8 new IIT's [Figure 1.2] and 7 IIM's, of which one of the IIT is in Gandhinagar, in the state of Gujarat.

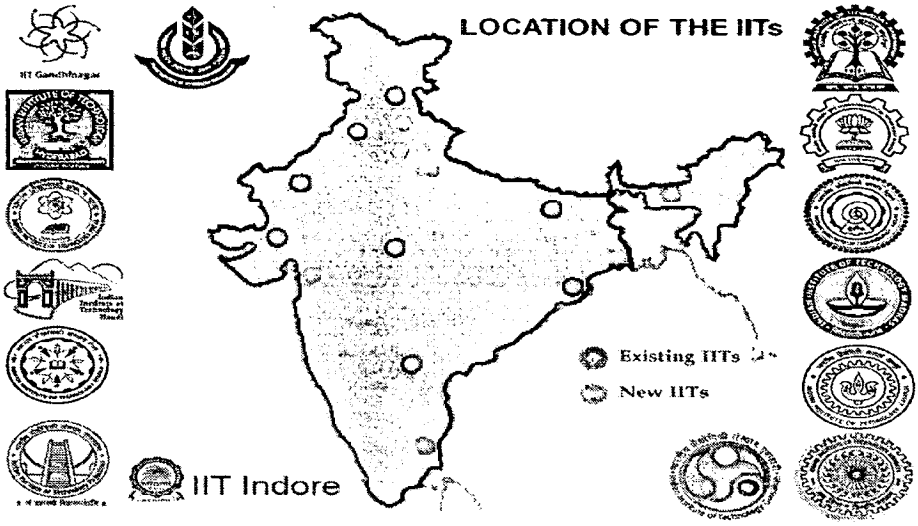


Figure 1.5 Map showing the existing and new IITs in India

1.2.2 Need for the research

Learning and discovery happens in the academic spine of the campus. This is the foundation of learning space design, which has to be given a significant role in campus planning. Planning for a diverse landscape of spaces — from specialized to multipurpose and formal to informal — maximizes encounters among people, places, and ideas. Cultivating a thriving 21st century Learning Space is a critical component to achieving academic excellence and IIT being symbolic to this aspect, there is a felt need for exploring strategies and concepts for these spaces that invigorate, supplement, and allow growth and with new institutions of national importance coming up in various parts of India, the study holds importance.

1.3 AIM AND OBJECTIVES

1.3.1 Aim

The aim is to conceptualize the future design of formal learning spaces, in order to facilitate the changing pedagogical practices needed to support a mass higher education system in technical institutions.

1.3.2 Objectives

- To study on critical components of formal learning experience and thus cultivate improvements in the campus where this experience should be constructive and exciting.
- To identify relevant learning space design concepts and the main spatial issues in through literature reviews and case studies and identify general design criteria
- To study the implications of users' perception about the formal learning spaces in existing technical institutions.

- To analyse various theories and guiding factors to develop a model on the basis on which design criteria can be derived.
- To provide design criteria for formal learning spaces in the modern context and its application for IIT Gandhinagar.

1.4 SCOPE AND LIMITATION

1.4.1 Scope

The study of learning spaces in higher education has to attract a great deal of attention from scholars or researchers. The role that space plays in the dynamics of creating productive higher education communities needs further study. Today in most of the technical institutions, the palette of formal learning spaces include centrally- or departmentally-scheduled classrooms situated along a spectrum from specialized to multi-purpose spaces. Hence the scope of the work is to cultivate a thriving 21st century learning core design criteria which is a critical component to achieve academic excellence and to upgrade existing learning spaces configurations to meet new teaching and learning and augmenting them with a range of additional spaces that support a diversity of pedagogies and sizes. There is also scope for support facilities design so that the functionality of these spaces is enhanced and in context to the modern trends and needs.

1.4.2 Limitation

The study will examine strategies and the design criteria will be formulated for formal learning spaces in specific.

1.5 METHODOLOGY

The dissertation has been carried out in different stages [Figure 1.3]. Initially a background study on various aspects of learning spaces is done with the identification of need for the study and dissertation problem. The study helped in the formulation of the aims and objectives of the research work.

An extensive literature review is done to focus on the understanding the evolution of education in India, how the learning spaces has evolved over time and also a background study on the formation of IITs. Studies were carried on learning spaces their concepts and standards for their design with focus on formal learning spaces. Primary case studies include new campuses like Vidyalankar Institute of Engineering and the TERI University and other secondary studies which helped in drawing various conclusions regarding learning space design. With the inferences from case studies and literature review an analytical model was framed. The model analyses design aspects for learning spaces in three stages to finally identify strategies for formulating design criteria for learning spaces in campuses.

The design criteria are applied in the study area- IIT Gandhinagar through a design approach of the academic core with the building level comprising various learning spaces.

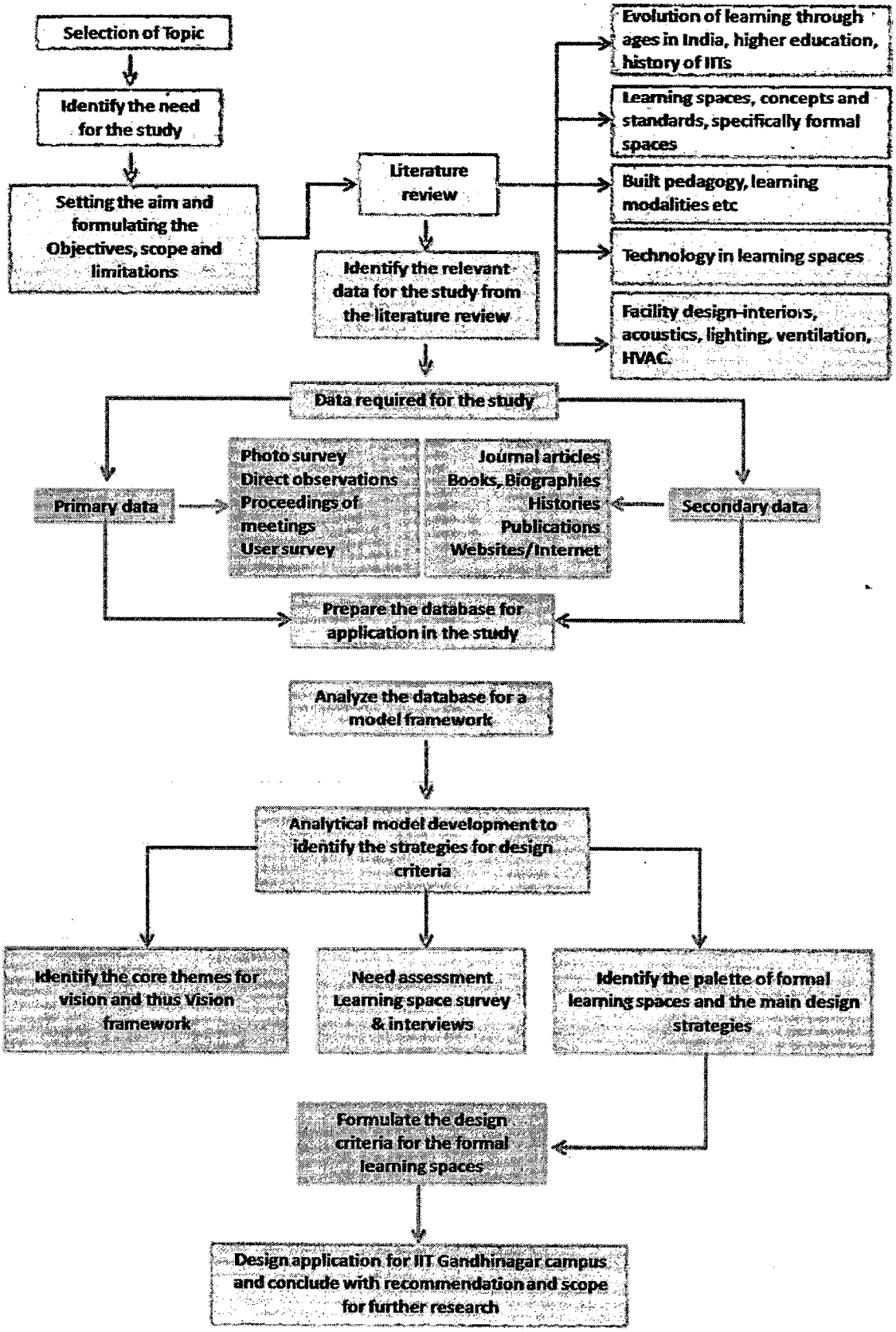


Figure 1.6 Methodology flowchart

1.6 ORGANIZATION OF THE DISSERTATION

The dissertation is chalked out into eight main sections where the introductory chapter introduces the background to the research, outlined the research topic, and also states the aims and objectives of the study. The second chapter is a review of literature and research relevant to the current study. It is divided into six main sections, which deal with key themes emerging from the literature.

The third chapter comprises the case studies which determine usage patterns in learning spaces, accompanied with photographic studies to capture observational data across time and in multiple settings with natural intrusiveness. The fourth chapter details out the area of study and the site details.

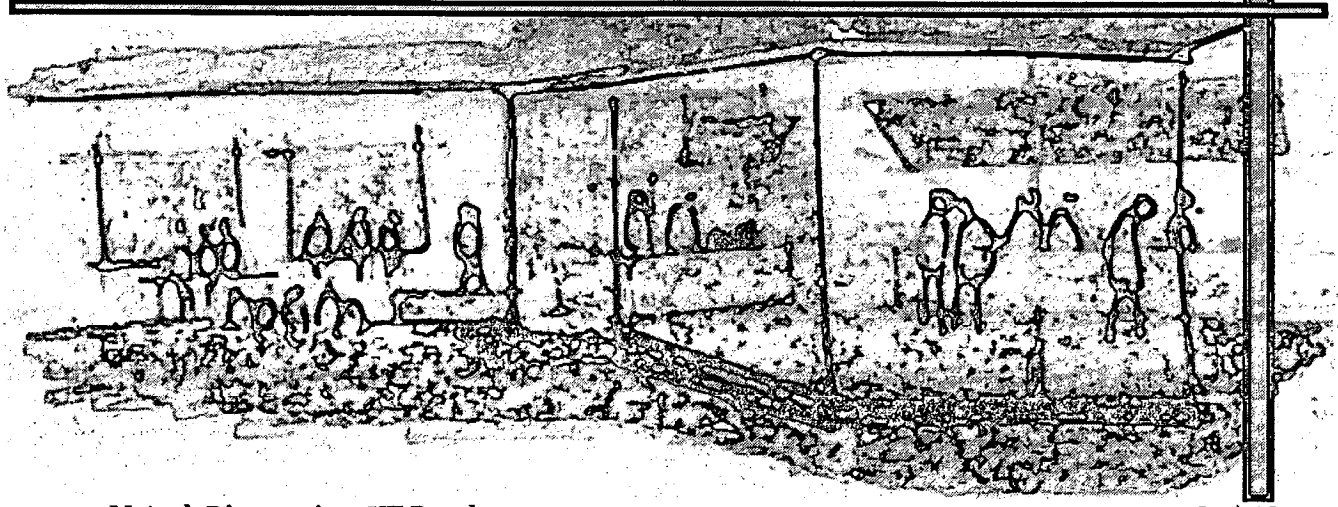
The analysis model is developed on the basis of the second and third chapter, embodying chapter five. The chapter details out the three phases which finally helps to formulate the design guidelines. The first phase being the ***Vision formulation*** where based on the core themes visions are set. The second phase is the ***Need assessment*** which is necessary so that we know the existing campus learning spaces so that we can identify the strategies for design effectively. The final stage is the ***Strategy development*** where the strategies on which the design guidelines evolve are identified and guidelines formulated on its basis which forms the crux of the next chapter.

The sixth chapter outlines the guidelines under the strategies identified. These guidelines form the basis of design which is discussed under chapter seven. The final eighth chapter enfolds the conclusions and future areas of research.

1.7 SUMMARY

This chapter gave the overview of the work intended to be done and the following chapter will discuss on the relevant literature data which will support further study and research.

2.0 CHAPTER
LITERATURE REVIEW



2.1 INTRODUCTION

This chapter is a review of literature and research relevant to the current study. It is divided into six main sections, which deal with key themes emerging from the literature. The chapter also includes examples of new approaches to the design and use of learning spaces in order to illustrate some key issues and trends.

This review began by searching databases using relevant search terms. This produced a large number of articles and books, which were briefly considered for relevance and reduced to a smaller number that could be read in full. As well as papers providing references back to earlier work, the citations of a number of notable articles were also traced forwards to more recent research.

2.2 CHANGING EDUCATIONAL PATTERN IN INDIA

The history of education in India is very rich and interesting. One can trace the ancient India education to the 3rd century BC. Research shows that in the ancient days, sages and scholars imparted education orally, but after the development of letters, it took the form of writing. Palm leaves and barks of trees were used for education, and this in turn helped spread the written literature. Temples and community centers often took the role of schools. [Blackwell, 2004]

When Buddhism spread in India, education became available to everyone and this led to the establishment of some world famous educational institutions Nalanda, Vikramshila and Takshashila. These educational institutes in fact arose from the monasteries. History has taken special care to give Nalanda University, which flourished from the fifth to 13th century AD, full credit for its excellence. This university had around 10,000 resident students and teachers on its roll at one time. These students included Chinese, Sri Lankan, Korean and other international scholars.

It was in the 11th century that the Muslims established elementary and secondary schools. This led to the forming of few universities too at cities like Delhi, Lucknow and Allahabad. Medieval period saw excellent interaction between Indian and Islamic traditions in all fields of knowledge like theology, religion, philosophy, fine arts, painting, architecture, mathematics, medicine and astronomy.

2.2.1 Colonial Period

The ideas and pedagogical methods of education during the colonial period, from 1757 to 1947, were contested terrain. The commercial British East India Company ruled parts of India from 1764 to 1858. A few eighteenth-century company officials became scholars of Sanskrit, Persian, and Tamil and promoted "Oriental" learning, which was classical, demotic learning in indigenous languages. However, they were outnumbered by "Anglicists," those who denigrated "Oriental" learning and advocated the introduction of institutions for Western learning based upon the British curriculum with English as the

medium of instruction. By the early nineteenth century, when English was made the official language of government business, British policy promoted a cheap, trickle-down model for colonial education. When the British crown abolished company rule in 1858, government universities existed at Bombay (contemporary Mumbai), Calcutta (Kolkata), and Madras (Chennai); about two thousand students studied at thirteen government colleges in all of British India, and another 30,000 students were in government secondary schools. Direct rule did not change the decision to deemphasize primary education to provide occupational training for young Indian men who took jobs both in the lower tiers of the government and in urban, Western-style legal and medical services.

Nongovernment schools established by Western Christian missions and Indian social and religious reform organizations provided the only opportunities for elementary education in the nineteenth century. American and English missionaries founded men's colleges, and by the twentieth century, Lucknow, Lahore, and Madras all had Christian women's colleges as well. Foreign teachers staffed these institutions, offering a Western curriculum in English with financial support for the children of Christian converts. Reformist societies also started schools, partly to provide Western education without the threat of Christian conversion. The curricula in private girls' schools ranged from the Urdu, Persian, writing, arithmetic, needlework, and Islamic studies of the Punjabi Anjuman-i-Himayat-i-Islam primary schools in north-western India to the Western-style liberal arts curriculum of Bethune College, founded by liberal Brahmo Samajists (Hindu reformers) in Calcutta. Even voluntary societies' members who wanted to provide educational alternatives for their children disagreed about the advantages and disadvantages of the colonial educational model for both content and the language of instruction.

When British officials who represented direct rule by the crown introduced modest self-government in the 1860s, they shifted financial responsibility for education to a growing Indian middle class. Educating urban sons for professions dominated local educational spending, to the detriment of rural and women's education. Families of respectable middling status usually chose to send their daughters to gender-segregated educational institutions once there were schools taught in vernacular languages with general curricula. While older historians narrated the "insidious, total and transparent" domination of the educational system by the colonial state, more recent scholarship delineates the "'creative' resistance" to state agency and suggests that there was a "combat" between "consciously opposed sides". As the nationalist movement gained supporters in the twentieth century, Indian leaders developed several nationalist educational paradigms to challenge the colonial model. Mahatma Gandhi wanted the state to teach basic literacy in vernacular languages to the majority of the population. Rabindranath Tagore, India's first recipient of the Nobel prize for literature, believed that the English language provided Indians access to the sharing of knowledge across international borders and that education should include the teaching of India's cultural traditions. The fight for freedom from colonialism pre-empted decisions about educational ideologies until after 1947.

2.2.2 Education - After Independence

After independence, education became the responsibility of the states. The Central Government's only obligation was to co-ordinate in technical and higher education and specifies standards. This continued till 1976. Prime Minister Jawaharlal Nehru (1889–1964) and other politicians made education a fundamental right in the 1950 Constitution. The central government supported affirmative action for formerly disadvantaged social groups by reserving seats in educational institutions for candidates from the scheduled castes and tribes.

However, state governments chose different educational emphases from the 1950s onward, which led to differing results. In the southern state of Kerala, for example, the Communist government emphasized public education, and by the 1990s, the overall literacy figure for both women and men was an impressive 90 percent. In general, however, the states' efforts resulted in modest improvements, with the 1990s estimates of national female literacy at 27 percent, still only half of the overall male literacy rate.

One of the most contentious colonial educational issues, the teaching of Western science and technology, continues to be problematic. Before 1947, Indian students were denied participation in the production of scientific knowledge, particularly because there was no "organic relationship between science-technology education and indigenous society" parallel to the European context allowed to develop within the colonial milieu. Teachers who promoted learning science through vernacular languages, working against the colonial tilt toward literary education in English, made little headway. In the late twentieth century, colonial shadows still coloured educational ideology, and the long-term pattern of underfunding elementary education had not changed. The constitutional pledge to provide free and compulsory education for all of India's children remains a distant goal for the twenty-first century, even as Indians who are technically educated and speak English have become one of India's prime attractions for global capital. The challenge of joining indigenism and universalism in India's education system remains.

2.2.3 After 1976

In 1976, education was made a joint responsibility of the states and the Centre, through a constitutional amendment. The center is represented by Ministry of Human Resource Development's Department of Education and together with the states; it is jointly responsible for the formulation of education policy and planning.

2.2.4 Development of the IITs

Pre independence developments: The concept of the IITs [Vrat, 2006] originated even before India gained independence in 1947. After the end of the Second World War and before India got independence, Sir Ardeshir Dalal from the Viceroy's Executive Council foresaw that the future prosperity of India would depend not so much on capital as on technology. He, therefore, proposed the setting up of the Council of Scientific and Industrial Research. To man those laboratories, he persuaded the US government to offer

hundreds of doctoral fellowships under the Technology Cooperation Mission (TCM) program. However realizing that such steps cannot help in the long run for the development of India after it gains independence, he conceptualized institutes that would train such work forces in the country itself. This is believed to be the first conceptualization of IITs.

Developments leading to the first IIT: IIT Act, 1961 traces the history of IITs and its developments as explained further. Dr Humayun Kabir encouraged Dr B. C. Roy, the Chief Minister of West Bengal to work on Sir Ardeshir's proposal for an IIT. It is also possible that Sir J. C. Ghosh, the then Director of the Indian Institute of Science, Bangalore, prompted him to do so. In 1946, Dr Kabir along with Sir Jogendra Singh of the Viceroy's Executive Council (Department of Education, Health and Agriculture) set up a committee to prepare a proposal, and made Sir Nalini Ranjan Sarkar the chairman. The Sarkar Committee was taking too much time, but Dr Roy did not wait for the Committee to finalise its report and started working on the interim draft itself. The 22 member committee (in its interim draft) recommended the establishment of Higher Technical Institutions in the Eastern, Western, Northern and Southern regions of the country. Possibly on the lines of the Massachusetts Institute of Technology (Cambridge, Massachusetts, USA), these institutes were recommended to have a number of secondary institutions affiliated to them. The draft also urged the speedy establishment of all the four institutions with the ones in the East and the West to be started immediately. The committee also felt that such institutes should not only produce undergraduates but should be engaged in research — producing research workers and technical teachers as well. The standard of the graduates was recommended to be at par with those from elite institutions abroad. They felt that the proportion of undergraduates and postgraduate students should be 2:1.

L. S. Chandrakant and Biman Sen in the Education Ministry played significant role in producing a blueprint for a truly autonomous educational institution. Sir J. C. Ghosh (later to be the first Director of IIT Kharagpur) ensured liberal provisions of the IIT Act allowing the IITs to work free from nitpicking interference from the babudom. It is largely because of the IIT Act that IIT directors were granted authority superseding even some parts of the government. On the ground Bengal had the highest concentration of engineering industries; the Committee suggested that an IIT may be set up in that state. This encouraged Dr. Roy. to use that fragment of a report in order to persuade Pandit Jawaharlal Nehru to push through a special Act to establish an IIT in Bengal.

With the recommendations of the Sarkar committee in view and on the basis of blueprint made by L. S. Chandrakant, Biman Sen, and J. C. Ghosh, the first Indian Institute of Technology was born in May, 1950 at the site of Hijli Detention Camp in Kharagpur, a town in eastern India. Initially the IIT started functioning from 5, Esplanade East, Calcutta [(now Kolkata) and shifted to Hijli in September, 1950 when J.C. Ghosh offered the place as a readymade place for the IIT. The present name 'Indian Institute of Technology' was adopted before the formal inauguration of the Institute on August 18, 1951, by Maulana Abul Kalam Azad. On 15 September 1956, the Parliament of India passed an act known as the Indian Institute of Technology (Kharagpur)

Act declaring it as an Institute of National Importance. Jawaharlal Nehru, India's first Prime Minister, in the first convocation address of IIT Kharagpur in 1956, said:

> " *Here in the place of that Hijli Detention Camp stands the fine monument of India, representing India's urges, India's future in the making. This picture seems to me symbolical of the changes that are coming to India."* "

The next four IITs: To counter the criticisms of setting up IIT in West Bengal, the draft report suggested that a second IIT may be located in the Western Region to serve the process industries concentrated there. It also added that a third IIT should be considered for the North to promote the vast irrigation potential of the Gangetic basin. Not willing to leave South out (and to make it politically correct), the draft report hinted that a fourth one might be considered for the South too. However, it offered no specific economic justification for the same. Pandit Jawaharlal Nehru is one of the main architects in setting up the institute in India.

When the pressure started building up to set up IIT in the West, Jawaharlal Nehru sought Soviet assistance in order to set up the institute in Mumbai. Krishna Menon (the then Defence Minister) and closest to the Russians, got Brig Bose appointed the first Director of IIT Bombay when it got established in Powai in 1958. As fallout of the prevailing Cold War, the Americans offered to help to set up yet another IIT. The way the Sarcar Committee had suggested, it was established in the North as IIT Kanpur (in Kanpur, Uttar Pradesh) in 1959. Dr Kelkar was the first Director of the institute.

At that time, the Germans had run up large trade surpluses, and they were persuaded to support an IIT in the South. The Germans had initially decided on Bangalore as the location but when they visited Madras, C. Subramaniam, the Education Minister, took them round the Governor's estate with frolicking deer roaming among hundreds of venerable banyan trees, and offered the space across the table. The visiting German team was considerably impressed by it and Madras got the fourth IIT in 1959 itself as IIT Madras.

R. N. Dogra the Chief Engineer of Chandigarh persuaded Prof M. S. Thacker, then Member of the Planning Commission to set up an IIT at Delhi on the ground that the country was divided into five regions, and all but the North had an IIT each. It was done on the basis of the logic that Uttar Pradesh and Madhya Pradesh constituted the Central Region. Hence, officially, Kanpur was located in the Central Region, not the North. This led to the establishment of IIT Delhi in 1961. The Indian Institutes of Technology Act was suitably amended to reflect the addition of new IITs.

Establishment of IIT Guwahati and IIT Roorkee: After the establishment of IIT in Delhi, there was a long gap in any notable development in the history of IITs. However in the beginning of the 1990s, widespread student agitations in Assam led to Prime Minister Rajiv Gandhi promising another IIT in Assam. Rajiv Gandhi agreed to it on the spot considering it a minor request although eventually it cost over Rs 1,500 crore. The IIT Guwahati campus started functioning in 1987. In the beginning of the 21st century, Dr Murli Manohar Joshi (the Education Minister of India) made University

of Roorkee into an IIT, making IIT Roorkee the newest IIT but the oldest institution amongst the seven in 2001.

2.3 RELATIONSHIP BETWEEN SPACE AND LEARNING

Learning is the central activity of colleges and universities. Sometimes that learning occurs in classrooms (formal learning); other times it results from serendipitous interactions among individuals (informal learning) as shown in Figure 2.1. Space—whether physical or virtual—can have an impact on learning. It can bring people together; it can encourage exploration, collaboration, and discussion. Or, space [Nancy, 2003] can carry an unspoken message of silence and disconnectedness. More and more we see the power of built pedagogy [Jamieson, 2000] (the ability of space to define how one teaches) in colleges and universities.

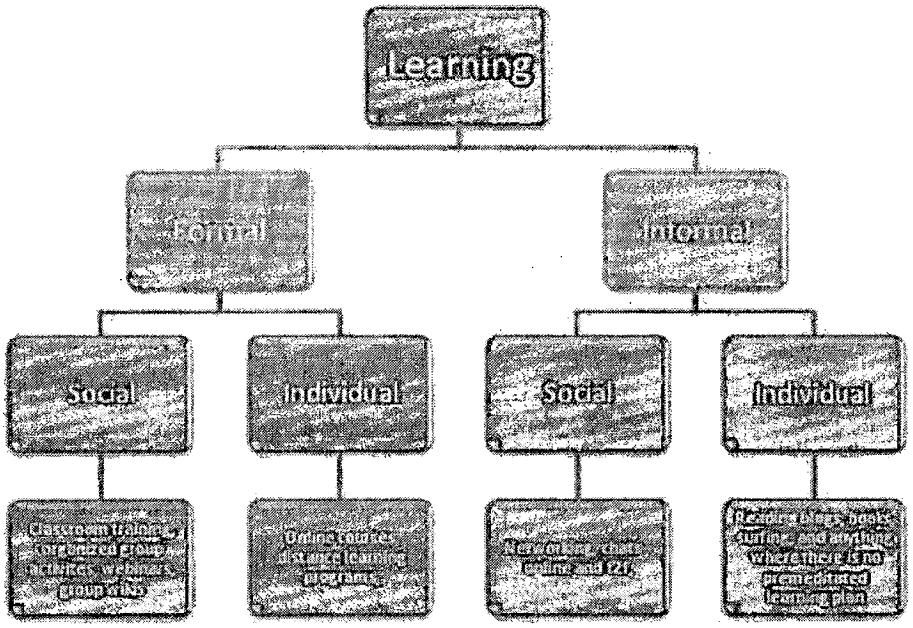


Figure 2.1 Different styles can be formal or informal and social or individual in each case

Today's students—whether 18, 22, or 55—have attitudes, expectations, and constraints that differ from those of students even 10 years ago. Learning spaces often reflect the people and learning approach of the times, so spaces designed in 1956 are not likely to fit perfectly with students in 2020. Many of today's learners favour active, participatory, experiential learning—the learning style they exhibit in their personal lives. But their behaviour [Bransford, Brown, Cocking, 2000] may not match their self-expressed learning preferences when sitting in a large lecture hall with chairs bolted to the floor. The single focal point at the front of the room sends a strong signal about how learning will occur. As of today the importance lies in the fact that there is a need to understand and to reconceptualise learning spaces to facilitate active, social, and experiential learning.

Information technology has changed what we do and how we do it. It would be hard to identify a discipline in which IT is not a necessity. Collecting, analyzing,

displaying, and disseminating knowledge typically involves IT. Retrieving information has become an IT function; students consider the Internet, not the library, their information universe. And, rather than trying to know everything, students and faculty rely on networks of peers and databases of information. Technology has also brought unique capabilities to learning. Whether by stimulating more interaction through the use of personal response systems or by videoconferencing with international experts, IT has altered learning spaces.

2.3.1 Learning Spaces

Learning space, for the purpose of this report, covers any space that is used primarily for directed learning activities, usually during a set time with a tutor present. Learning spaces can be large lecture theatres, seating over 300 students, or small seminar rooms, designed for ten or fewer. Configurations and equipment can vary considerably. These spaces include science laboratories, computer rooms, workshops and other practical teaching areas - such as experimental labs.

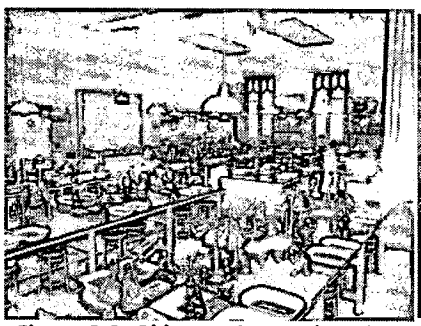


Figure 2.2 Old experimental setting

Figure 2.3 Similar setting after few years

Two examples of laboratory teaching spaces, as they used to be can be taken. The scientific 'wet-lab' in Figure 2.2 shows the traditional layout of such rooms. The traditional benches and equipment are designed around the need for experimental work, itself a pedagogic and technological innovation in its day, but leave little flexibility for other pedagogic scenarios.

Figure 2.3 shows a similar laboratory a few years later. There are now television screens within the laboratory and the lighting is more modern, but from a pedagogic perspective the room has changed very little. When looking at figures 2.4, which are different views of the laboratory in figure 2, the difference is very marked.

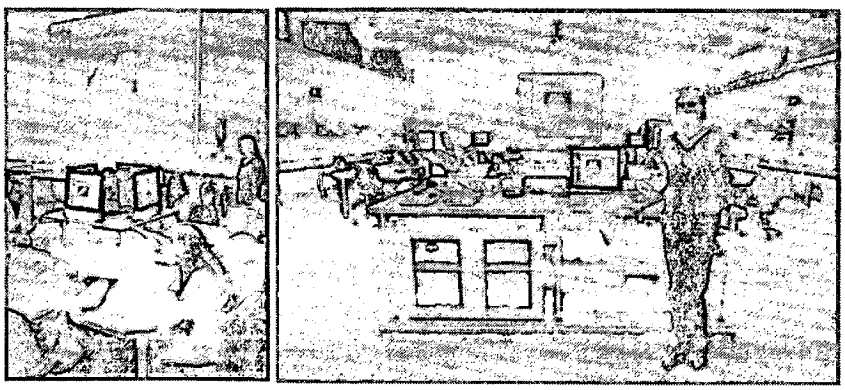


Figure 2.4 New laboratory settings

The first impression is the sense of space, although the capacity of the room has not been reduced. The white coats show that this is still an active wet-lab, but with computers being brought in alongside the experimental benches. The innovations here are simple and effective. Groups of up to twelve students work around 'island' benches, each with four computers. The monitors are on a raised shelf and the keyboards can be put on to the shelf below the monitor when not in use, or used on the bench. Figure 2.5 is taken from the centre of the room, with the other half being a mirror image, including a second projector. The use of learning technology is a truly embedded part of the learning and teaching, with a wide range of new pedagogic opportunities being added to the learning space.

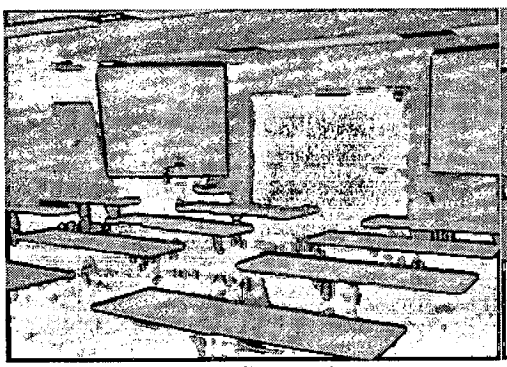


Figure 2.5 Earlier seminar room

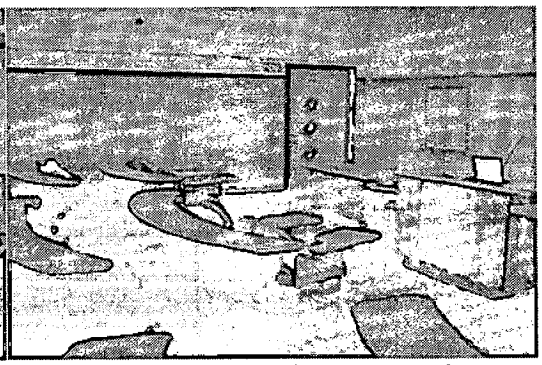


Figure 2.6 New seminar room setting

Figure 2.6 shows a familiar layout for a small seminar room. There are many positive features in this room; the furniture can be moved, there are multiple projection screens and a television. So this room does enable a variety of pedagogic approaches, which should not be lost when incorporating new technology, but it is not technologically friendly - with a lack of power and data for students and no desktop computer for teaching use. Figure 2.6 shows a similar room to that in figure 2.5, but in a more modern style. The aesthetic differences are evident, and should not be dismissed as merely cosmetic, but the real changes are in the new pedagogic opportunities that have been made available. There is now a lectern at the front, incorporating a modern desktop computer. This permanently fixed computer is linked to display equipment and the institutional network. There is a mixture of fixed and flexible seating, but perhaps most significant are the curved desks. These are designed specifically to facilitate group working as an embedded part of the teaching session.

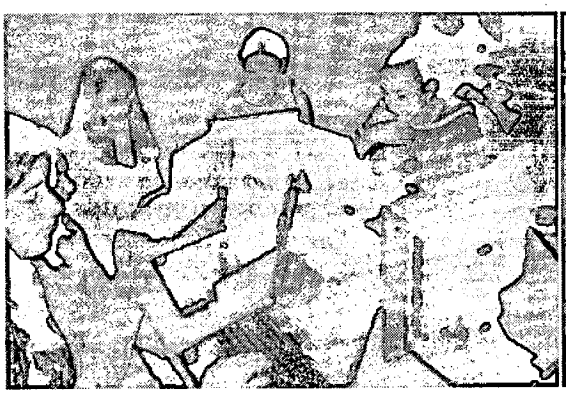


Figure 2.7 Group work setting

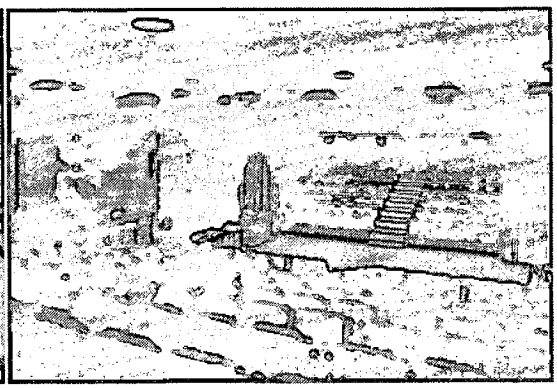


Figure 2.8 Lecture hall setting

The example in figure 2.7 illustrates group working taking a central role within a teaching session. The desks within this teaching space can be used without computers, but the introduction of power and wireless data to the rooms means that, when appropriate, students can work individually or in groups on networked computers. Larger teaching rooms allow scope for larger-scale innovation. Figure 2.8 shows a large lecture theatre set out in 'parliamentary' style. Sophisticated lighting and projection equipment is evident, but not immediately obvious is the fact that the tiered lecture seats are movable, meaning that this space can, in addition to its use for lecturing, be used for activities such as dance and drama. Furthermore this room can, when not needed for learning and teaching, be used as an exhibition space. Figure 2.9 shows the same lecture theatre from the same angle, however the room has now been divided and the display configuration changed to give a more conventional lecture arrangement, but with multiple display screens. The multiple display screens can be used to give all learners an optimal view of the same display, or to display different items simultaneously.

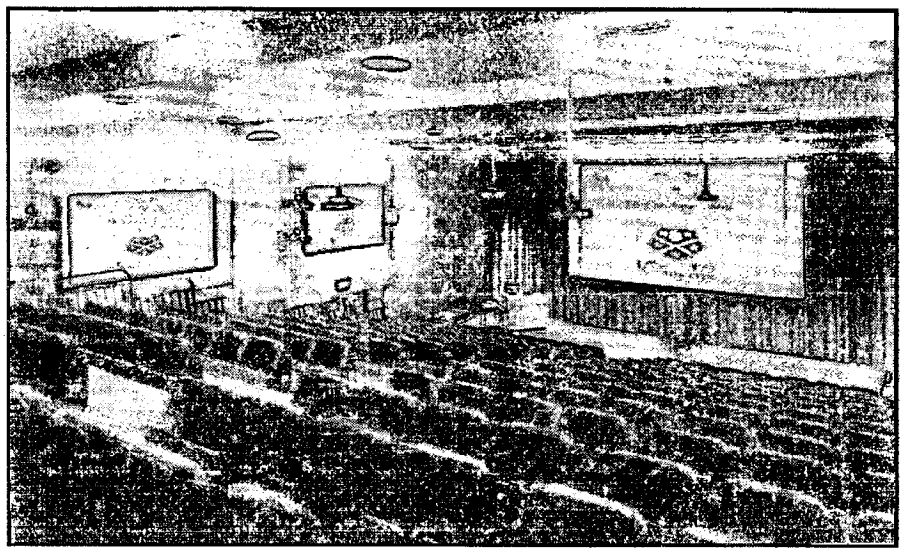


Figure 2.9 Lecture Hall setting in conventional arrangement

Another important innovation in the use of teaching spaces is distributed teaching and learning. Distributed learning might be considered a form of distance learning, however a distributed session involves linking entire classrooms with individuals or other groups, hence some of the learners are learning at a distance others are not. Figure 2.10 shows an example of a medium sized teaching facility, which is equipped for video conferencing. This facility allows medium sized groups to be co-located but to be taught, or for the tutor to teach, remotely with another similar sized group. Figure 2.11 shows another example of this in practice with a group of students working together, but located in Dublin and Birmingham.

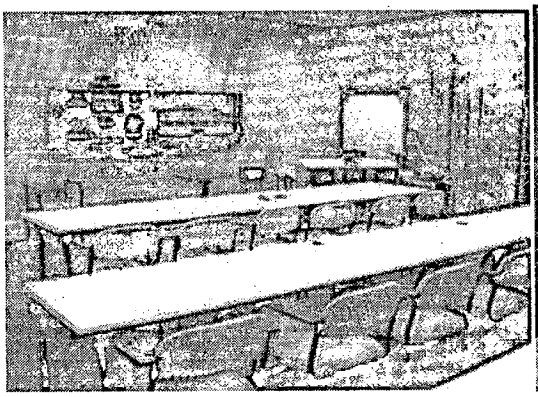


Figure 2.10 Medium sized teaching facility

Figure 2.11 In practice with student group

2.3.2 Formal learning spaces

Teaching and learning can take place in many different forms, from large lectures to intimate conversations. It is important to recognize the full spectrum of spaces [Figure 2.12] that support these activities in order to recommend improvements. This palette of spaces is meant to spark ideas and ensure that learning space improvements are well-balanced across a broad range.

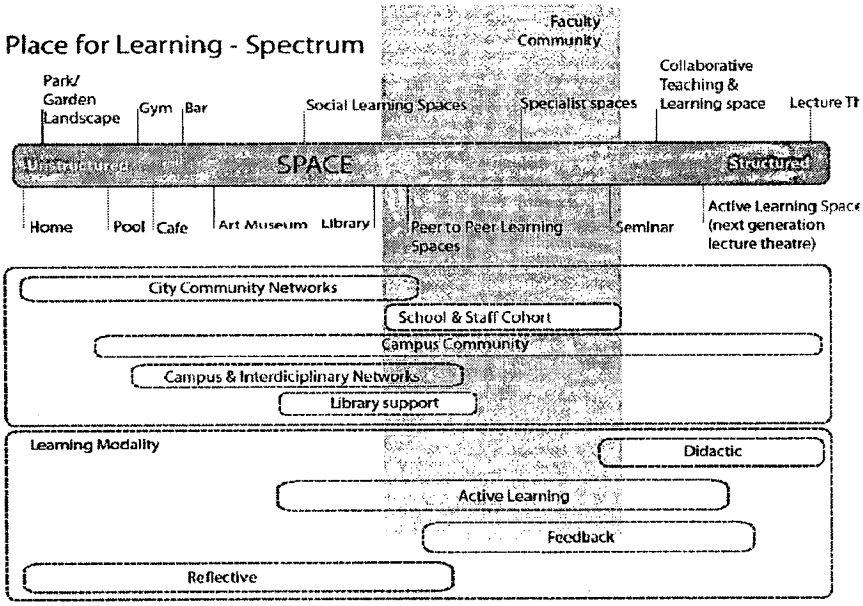


Figure 2.12 Learning spaces spectrum

2.4 STUDENT/LEARNER CENTRED TEACHING

Immersion and rotation in diverse learning activities: Quick rotation and immersion in interrelated learning activities enhances engagement and caters for learning diversity. Activities are structured around students' learning needs, are organised thematically and involve co-constructing knowledge, skills and understanding. The learning program is characterised by versatility, a blend of passive and active experiences and creative use of resources. Enhanced opportunities to engage with the community lend

authenticity to the learning experience. Learning environments can readily expand beyond the classroom [Taylor, 2005].

Professional learning in the learning space: A culture of learning supports and enables learning relationships to flourish between students and teachers, students and students, and teachers and teachers. The practice of shared teaching enables practitioners to learn from and with each other through coaching, modelling, and train the trainer approaches. Team work enables teachers to provide each other with feedback on new and emerging skills and practices, with the collective effort leading to consistency of approaches and building of a shared culture.

Active learning and positive relationships: Active learning leads to agile thinking. When the learning experience moves along a continuum from knowledge and understanding to skills and practice, then enjoyment of learning is enhanced and student engagement is more likely. Active learning [Strauss, 2002] involves the student in doing, thinking and interacting. In this way learning is focused on building student capabilities through knowledge of how to do something, the experience of doing it successfully, and knowing why it was important and what the next steps are. Positive relationships between students and teachers and students with each other are more likely to flourish through active learning experiences that are fun and purposeful.

Routine creative use and application of ICT: Ready access to resources including ICT enables teachers and students to experiment with new learning tools, engage in joint learning experiences and to diversify the demonstration of learning. Ready access to resources means that teachers and students need the knowledge and skills to use them for teaching and learning. Recognition of individual capacity and methodical development of capacity into demonstrated capability maximises the creative use of ICT as a tool to enhance learning outcomes and to diversify practice. Students and teachers can then use information and communications technology tools and techniques to plan, research, develop and communicate ideas. Sound ICT knowledge, skills and behaviours enable students and teachers [Canning & Banning, 2002] to access, process, manage and present information, model and control events, construct new understandings and communicate with others. Creative demonstration of learning can involve presentation using a variety of media, including performance. Students' learning experiences are organised so that they can collect information from a range of sources, demonstrate visualised thinking and creatively use ICT for problem solving and communicating in all areas of the curriculum.

Scaffolded learning: Scaffolded instruction involves "the systematic sequencing of prompted content, materials, tasks, and teacher and peer support to optimize learning" [Dickson, Chard, & Simmons, 1993]. The decisions that teacher teams make in response to a range of qualitative and quantitative student data are central to successful student-centred learning. It is important for the use of data to translate into pedagogy and curriculum with the built-in flexibility to meet the needs of individual learners. This is best achieved through scaffolding. Teachers scaffold learning programs to enable students to: Make individual and collaborative decisions about how they will undertake and develop learning tasks, Set relevant goals for their learning, to monitor their own progress and to demonstrate evidence of goal attainment. Students are then able to create relevant individual learning plans: Contribute to the development of clear criteria or rubrics for

assessment prior to the learning activity, Investigate what they already know in relation to the planned learning, Build on their knowledge in manageable steps, Build understandings about the process of learning, how, why and what they are learning and use this knowledge to inform improvement, Select and participate in learning activities that appeal, Demonstrate and apply learning in a variety of interesting and challenging ways, Participate in learning experiences that challenge them to apply and improve their ability to work as a team, Participate in a combination of teacher facilitated experiences and learner directed experiences.

Constructivist learning: Constructivist learning actively engages students in the construction of knowledge rather than passively receiving it. Ahead of the learning relationship teachers have collected data which outlines each student's knowledge, ideas and understandings. Teachers are then equipped to pose questions and present problems and to facilitate the process of learning by guiding students to help them find their own answers.

Individualised learning: Learning is based on the learning needs of each student. This involves pre-engagement [SFC, 2006] with the student and the curriculum, the establishment of a shared goal, active diagnosis of student needs and understandings, provision of tailored assistance, monitored pursuit of the goal, and the provision of mutual feedback. It is contingent upon the creation of an environment in which the students feel free to take risks.

Strong and practical team work: Teachers work collaboratively to design, develop, deliver and reflect on teaching and learning practice. Shared understanding of goals, priorities and strategies within the team, is reflected in practice. Development of new skills and a collaborative culture are the focus of team work, feedback, coaching and mentoring in teams. Modelling by teachers of genuine learning partnerships in teams fosters sound team approaches and attitudes and willingness to work collaboratively amongst students. The learning experience is more a participatory partnership with joint ownership and responsibility that can further be shared with parents.

2.5 BUILT PEDAGOGY

Educational architecture literature grounds itself in a conviction that the design of built spaces influences the behaviours and actions of individuals within those spaces. To a certain extent, these spaces embody the pedagogical philosophies of their designers:

" Designs for classrooms not only tell us much about the didactic means that were used in them; they also reveal the essence of the pedagogy that directed the educative efforts of past times " (McClintock 1970).

This passage implies that a well-trained eye can read these spaces for the pedagogies they facilitate. A classroom with neat rows desks embodies pedagogies or "tacit curricula" of discipline and conformity, whereas spaces personifying the flexible properties discussed thus far can be said to embody pedagogies of freedom and self-discovery. This is architectural embodiments of educational philosophies built pedagogy.

Built pedagogies operate along a continuum between discipline and autonomy. On the disciplinary side, they can restrict learning possibilities by not allowing for certain movements or flows. For example, desks bolted to the ground make flexible interpretations of spatial use extremely difficult, and they impose directions for how space should be used. In the middle of the discipline/autonomy spectrum, there are built pedagogies [Torin, 2002] that enable but do not require flexible behaviours: movable partitions and desks illustrate space left open to interpretative use. Finally, on the autonomy end, open classrooms invite and almost demand that individual's appropriate space to their perceived needs.

Like technologies, all spaces are underdetermined in that they send messages to users about appropriate behaviour yet remain open to degrees of interpretation [Pfaffenberger 1992]. Bolted desks can be unbolted, after all, but their particular affordance for "proper use" requires more energy to re-interpret than that presented by less rigid built spaces.

If spatial configurations can be viewed as systems comprised of built forms and artefacts, and these configurations of space can contain values such as discipline or freedom, why can't the same be said of technological spaces? In the architectural community, trepidation at taking this next interpretive step inhibits productive readings of flexibility and possibility in emerging learning environments. For instance, some educational planners posit that "Technology is value-neutral" [Fiske, 1995] or that they are merely "tools" [Brubaker & Graves 1993]. Such assertions ignore the ways that technologies become integrated into material infrastructures and create contexts for practice at least as much as other elements of the built world.

2.5.1 Pedagogical activities

The aim for building new or remodelled learning spaces must be to improve student learning outcomes. Decisions about learning space design must serve to support and enhance current and emerging pedagogies and new technologies because apart from family background, it is good teachers who make the greatest difference to student outcomes. Teachers have more impact than whole-school effects and particular types of pedagogies are linked to high quality student learning outcomes. [Christie, 2006]. It is difficult to make decisions about the design or redesign of a learning space without first envisaging the learning for that space.

2.5.2 Pedagogy for the 21st century

Campus leadership teams need to:

- Explicitly define the types of pedagogies the space needs to support
- Make sure the pedagogies align with the school vision for learning and support the notion of 21st Century learning.

Frameworks such as Productive Pedagogies [D.E.T 2002] and/or Bloom's Taxonomy can provide a metal language to discuss and define the types of learning activities that need to be in focus in a learning space. In particular, the Productive Pedagogies

Framework describes pedagogies such as problematic knowledge, higher order thinking, knowledge depth, connectedness, knowledge integration and problem based curriculum which are all examples of 21st Century pedagogies.

Below are some reflective questions that can help school leadership teams focus on the importance of pedagogy in the learning space design process.

2.5.3 Pedagogy connected with space

Innovative flexible space and furniture: Within one space students are able to engage in a range of activities at one time. Ready access to resources is available so that students can demonstrate learning in different ways. The opportunity for working alone, in a small group, or large group exists.

Multipurpose spaces: Spaces can be easily reconfigured [Wedge & Keams,2005] to accommodate different size groups from large to small to one-to-one. These spaces can also be used for parent and community interaction at different times of the day. The capacity to divide up the spaces is enabled through operable walls, mobile trolleys of resources such as laptop computers and mobile furniture.

Specialist focal points: Specialist focal points can be found in both large and small spaces. They are located adjacent to flexible space and are used for activities that can only happen in that space, such as cooking or certain aspects of technology or science.

Home bases, learning communities and neighbourhoods: A group of students occupies its own space, known as the home base, for most of the time. This group of students might co-exist with two or more such groups in a learning community. If the building accommodates different cohorts of students in separate learning communities then it is known as a learning neighbourhood.

Community orientation: Community orientation relates to spaces in a school that can equally accommodate and cater for different sections of the community. Co-located facilities, such as resource centres, can play an important role in meeting the needs of all developmental stages.

Accessible resources including ICT: A diverse range of resources has been identified to support teachers in meeting the individual learning needs of students in each learning program. These resources include ICT hardware, software, equipment, books, toys, and games. Resources support assessment [Johnson, 2005] for, as and of learning, and demonstration of learning outcomes including presentation. They also support teachers to plan, scaffold and deliver programs that cater for passive and active learning and enable students to demonstrate progression using a variety of media and tools. Teachers, students and support personnel have ready access to a variety of resources so that students can demonstrate learning in different ways. Multimedia and ICT are sophisticated, diverse and readily accessible to multi-age, flexible groupings of students. This includes projection devices, digital cameras, scanners, printers, hand held devices and interactive white boards.

Indoor/Outdoor learning: Access to external spaces and resources expands the range of active learning opportunities available to stimulate imagination and the development of social and motor coordination skills. Therefore, the connectivity between indoor and outdoor learning spaces should be fluid and conducive to exploration and activities in small or large groups [George, 2005]. Complementary indoor and outdoor learning environments diversify in the range of resources that students can use to demonstrate play-based learning, team work, social networking, authentic inquiry and physical fitness. The design of external facilities can support student learning needs at all developmental stages through the provision of soft, quiet places for reflection, equipment and resources to meet recreational and fitness needs, and seating and shelter to encourage social and recreational pursuits.

Welcoming entry and display: Clear signage denotes the entry to the school for the range of visitors who may be accessing the school for different purposes. The spatial relationships in the administration area can readily accommodate the needs of visitors for meetings, interviews, inquiries, waiting for teachers or students, refreshments and toilets. The entry to the school reflects the character of the school as a learning community and pathways around the school buildings welcome all stakeholders and are safe for staff and students. A welcoming entry [Brown & Lippincott, 2003] maximises the opportunity to display student work and cultural or community events. The design of the entry to the school minimises the potential for congestion and differentiates between students and members of the community. The capacity of all learning spaces to easily display a diverse range of student work safely and securely should be maximised. Social interaction is important in the learning process. Therefore a sense of 'audience' and spaces to display achievements for students, teachers, parents and the community are important considerations.

2.6 LEARNING MODALITIES

Learning modalities describes how students are physically grouped to facilitate a particular range of pedagogies as shown in Figure 2.13. The classroom of the past reflected the factory or production model in which the philosophy of the assembly line with its inherent efficiencies dictated the look and feel of the school. [Nair & Fielding, 2007] This model also assumes that most learning occurs through the transmission of knowledge from the teacher to student in a somewhat linear fashion.

Project-based – groups, individual - Preparing and presenting, Group brainstorming, Drafting and editing, Designing and testing, Peer feedback, Comparing and contrasting against criteria, Teacher and student presentations.
Whole class – explicit instruction - Group brainstorming, Drafting and editing, Peer feedback, Comparing and contrasting against criteria, Teacher and student presentations
Independent - Individual learning contracts, self-directed -Preparing and presenting, Drafting and editing, Designing and testing, Peer feedback, Comparing and contrasting against criteria, Teacher and student presentations

Research-based – group – small and large - Preparing and presenting, Group brainstorming, Designing and testing, peer feedback, Comparing and contrasting against criteria, Teacher and student presentations

Team work – collaborative - Preparing and presenting, Group brainstorming, Peer feedback, Comparing and contrasting against criteria, Teacher and student presentations

Discipline speciality - Group brainstorming, Model construction, Drafting and editing, Designing and testing, Peer feedback, Comparing and contrasting against criteria, Teacher and student presentations

Integrated curriculum - Group brainstorming, Drafting and editing, Peer feedback, Comparing and contrasting against criteria, Teacher and student presentations

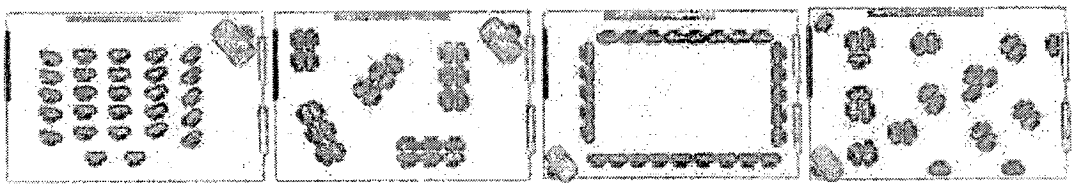


Figure 2.13 Learning Modality – the way students are grouped for learning experiences

2.6.1 Linking pedagogy and learning modalities

New or remodelled learning spaces can support 21st Century pedagogies by:

- catering for small and larger group activities, individual and research work plus student and teacher-led activities
- being flexible to support present and emerging pedagogies and facilitate different learning styles and teaching practices
- helping students create social and emotional relationships
- supporting a range of just in time technologies that will be increasingly mobile and wireless
- being open and connected to foster professional collaboration, group and project based work.

The revised model of Bloom's Cognitive Domain [Anderson & Krathwohl, 2001] is a well-known taxonomy of learning objectives and attempts to classify forms and levels of learning. The Table 2.1 provides a practical example of how schools can match learning objectives with learning modalities.

<table>
<tr><th>Blooms Revised Taxonomy</th><th>Example Thinking Processes</th><th>Example Learning Activities</th><th>Example Learning Modalities</th></tr>
<tr><td><u>Creating</u>

(Putting together ideas or elements to develop an original idea or engage in creative thinking).</td><td>Designing
Constructing
Planning
Making
Producing
Inventing</td><td rowspan="3">• Group research
• Forums
• Model construction
• Drafting and editing
• Designing and testing
• Individual research
• Group brainstorming
• Preparing and presenting
• Peer feedback
• Comparing and contrasting against criteria
• Teacher and student presentations</td><td rowspan="3">• Practical areas
• Display space
• Discussion spaces
• Small and large collaboration spaces
• Individual research areas
• Presentation spaces
• Outdoor breakout spaces
• Resource rich areas
• Small and larger group lecture space
• Individual work spaces</td></tr>
<tr><td><u>Evaluating</u>

(Judging the value of ideas, materials and methods by developing and applying standards and criteria).</td><td>Checking
Hypothesising
Critiquing
Experimenting
Monitoring
Judging
Testing</td></tr>
<tr><td><u>Analysing</u>

(Breaking information down into its component elements).</td><td>Comparing
Organising
Deconstructing
Attributing
Outlining
Structuring
Integrating</td></tr>
<tr><td><u>Applying</u>

(Using strategies, concepts, principles and theories in new situations).</td><td>Implementing
Carrying out
Using
Executing</td><td rowspan="3">• Individual research/work
• Discussions groups
• Teacher presentations
• Debates</td><td rowspan="3">• Small and larger group discussion areas
• Presentation space
• Individual work spaces
• Small and large group lecture spaces</td></tr>
<tr><td><u>Understanding</u>

(Understanding of given information).</td><td>Interpreting
Exemplifying
Summarising
Inferring
Paraphrasing
Classifying
Comparing
Explaining</td></tr>
<tr><td><u>Remembering</u>

(Recall or recognition of specific information).</td><td>Recognising
Listing
Describing
Identifying
Retrieving
Naming
Locating
Finding</td></tr>
</table>

Table 2.1 – Pedagogy and learning modalities

2.7 TRENDS IN LEARNING SPACE DESIGN

Significant trends in learning space design, both in new construction and in renovation, and relates them to learning theory and technological advances, can be identified. Three major trends inform current learning space design: Design based on learning principles, resulting in intentional support for social and active learning strategies, an emphasis on human-centered design, increasing ownership of diverse devices that enrich learning. These trends have been catalyzed by constructivism, digital technology, and a holistic view of learning.

The emergence of the constructivist learning paradigm [Brown & Long, 2006] has led to a focus on learning rather than teaching. It allows us to re-evaluate classrooms and to consider informal learning spaces as loci for learning. If learning is not confined to scheduled classroom spaces and times, the whole campus—anywhere and at any time—is potentially an effective learning space [JISC, 2006]. That holistic view of learning resents challenges, however. First, the demands on student time and attention continue to grow; even residential institutions have over-scheduled students. Second, learning doesn't just happen in classrooms; learning also occurs outside the lecture hall. New strategies for enabling learning and accommodating the multiple demands on student time have led to rethinking the use, design, and location of learning spaces.

The emphasis on learning [John, Ann & Rodney, 1999] means that we must also think about the learner. Learning spaces are not mere containers for a few, approved activities; instead, they provide environments for people. Factors such as the availability of food and drink, comfortable chairs, and furniture that supports a variety of learning activities are emerging as critical in the design of learning spaces—evidence of the second trend, giving consideration to human factors as integral to learning space design.

The rapidly increasing accessibility of digital technology also has changed learning space design. Digital technology [Jamieson, 2006] continues to advance at a frenetic pace, offering greater capability while simultaneously becoming more mobile and more affordable. Five years ago, most students purchased desktop computers; two years later, most purchased laptops. The implications are significant: more affordable and mobile technology facilitates greater access to content and resources. This enhanced access, in turn, has made it possible to implement a learning paradigm that emphasizes active learning, formative assessment, social engagement, mobility, and multiple paths through content. Although specific technologies may come and go, the enduring trend is technology becoming more capable, affordable, and mobile.

2.8 FACILITY DESIGN IN LEARNING SPACES

2.8.1 Acoustics

Good acoustics contribute to good learning environments. Poor acoustics can impact on a student's ability to learn and a teacher's ability to teach.

Good acoustics in teaching spaces make for quality learning environments. It is essential to ensure good acoustics are achieved when building new facilities or upgrading older buildings. Background noise and reverberation can create problems for students. Students can easily miss key words, phrases and concepts. Students with undiagnosed hearing problems have difficulty listening and concentrating in classrooms with poor acoustics. And it can be especially hard for students for whom English is their second language to understand and hear the teacher.

Adapting to different teaching methods

Many teaching spaces in older schools were not designed for current teaching methods. They do not have good acoustic qualities. The teacher used to stand at the front of the class so they did not need to be heard from all parts of the room. Now teachers move around, working with groups or individuals, and their voices need to be heard from all parts of the room.

Factors interfering with listening skills

Language skills are central to educational success. Listening is critical to the process of language skills and, therefore, to the learning process. Listening ability may be hindered by:

- ***Factors relating to the student***
  - The student may have an ear infection or glue ear or students with special education needs may have hearing impairments
- ***Environmental acoustic factors***
  - background noise – from both inside and outside the room
  - excessive reverberation within the room
  - low signal-to-noise ratio: ratio of teacher's voice to background noise level.

Understanding Sound

Background (ambient) noise: The natural level of noise in a classroom [Figure 2.14] when it is occupied is called the ambient noise level. High levels of ambient noise significantly reduce a student's ability to concentrate, and speaking over it can be stressful on the teacher. Research indicates the ambient noise level in classrooms ranges from 28–60 dB.

Signal-to-noise ratio: It is the ratio of the teacher's voice to the ambient noise [Figure 2.15]. The recommended minimum necessary for students to hear efficiently in a classroom is +12 to +15 dB.

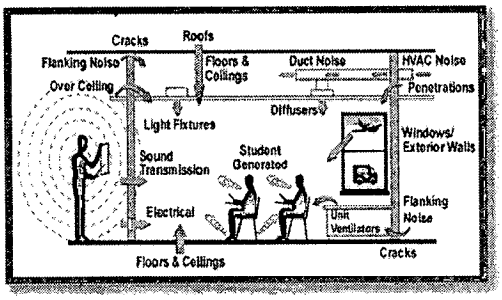


Figure 2.14 Ambient noise in classrooms

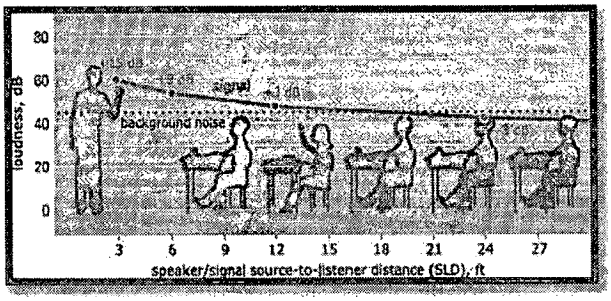


Figure 2.15 Signal-to-noise ratio

Reverberation time: Sounds bounce off hard surfaces, such as painted walls and vinyl floors, so that listeners hear several indistinct, overlapping versions, which smear the original sound. The sound continues for a time, reflecting around after it has stopped at its source. This is called 'reverberation' [Figure 2.16]. The length of time the echoes take to die away is called the 'reverberation time'.

Café effect: The combination of lots of ambient noise and a long reverberation time can lead to a situation known as the 'café effect' [Figure 2.17]. This is where a speaker raises their voice to be heard above the level of background noise.

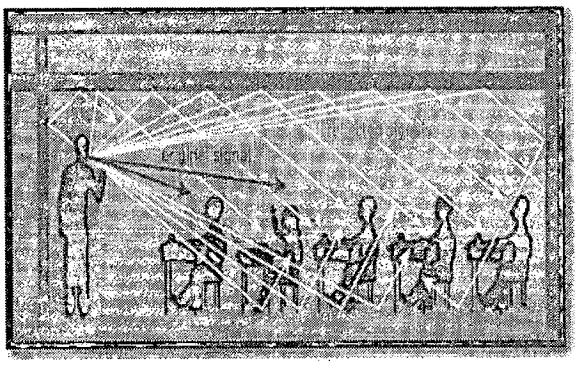


Figure 2.16 Reverberation

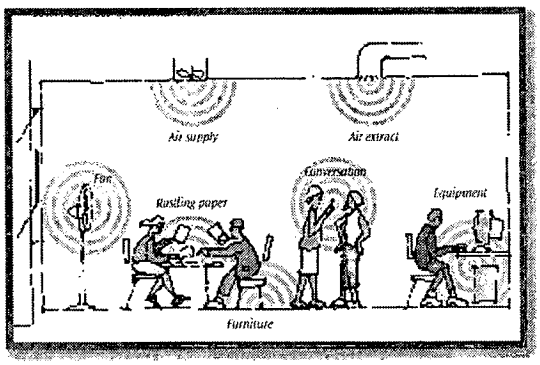


Figure 2.17 Cafe effect

Specialist Learning Spaces

Multi-purpose halls

Campuses have large multipurpose halls, which are used for a variety of activities, such as assemblies, theatrical productions, musical recitals and lectures. It is unlikely one space can have acoustics characteristics that are satisfactory for all these activities. The requirements for speech and live music are different to the requirements for other activities. Normal speech requires a much shorter reverberation time than that ideal for live music.

The most common problems with halls are:
• A high level of background noise.
• Excessive reverberation, often owing to hard surfaces and lots of windows. These mean there are usually high noise levels and speech clarity is difficult.

Achieving acoustics that are acceptable for most conditions in multipurpose halls requires flexibility to:
• change the sound characteristics of the area using curtains and screens.
• vary the layout to suit the purpose.

2.8.2 Lighting

Good natural light helps to create a sense of physical and mental comfort, and its benefits seem to be more far-reaching than merely being a source of light. This may be owing in part to the softer, more diffused, quality of natural light and its subtle changing value and colour which electric lighting does not have. Daylight provides a high quality of light for most visual tasks and is more accurate for viewing colours.

Students and teachers prefer natural lighting over artificial. They also actively dislike fluorescent lighting because of glare and flicker, although teachers acknowledge artificial light enables them to have lighting controll. [Weinstein, 1979]
Teachers feel that having adequate ways to control light within the classroom is critical, particularly:
• having separate lighting for whiteboards
•the ability to darken the room for projection
• having task lighting in specialised teaching areas
• eliminating glare.

The main aims of lighting are:
• ***Functional*** – so tasks can be carried out: accurately, comfortably, and safely.
• ***Amenity*** – to provide a pleasant, stimulating environment.

There are several benefits of good lighting in learning spaces including:
• energy savings
• improved teaching and learning performance
• better quality light
• health and wellbeing.

Understanding Light

Luminous flux or luminous power is the measure of the perceived power of light. Illuminance is the luminous flux density at a surface expressed as lumens per square

metre (lm/m2) or lux. The ability of the light to make colour look correct (compared to daylight) is expressed as the colour rendering index (Ra).

Specialist Learning Spaces

Multipurpose halls

Lighting requirements will depend on the activities in the room. Factors affecting the type of lighting used include:

- the high ceiling – spread of light and maintenance of luminaires becomes an issue
- need for black-out
- possible uses such as: drama or dance, lecture halls, meetings, assemblies or exams, gymnastics or games.

All or any combination of these possible uses needs a high degree of flexibility in the lighting design.

Type of space	Maintenance illumination lux	Lamp appearance group	Lamp colour rendering group	Maximum glare index	Comments
Multi-purpose halls					
• general use	160	warm or intermediate	1B or 2	19	
• social use	80	warm or intermediate	1B or 2	19	
• examinations	240	warm or intermediate	1B or 2	19	
• theatre use					special requirements
General classrooms	240	warm or intermediate	1B or 2	19	
Workshops	240				with task lighting
Art rooms	400 to 800	warm or intermediate	1A	16	see *Specialist Teaching Spaces*
Laboratories	320	warm or intermediate	1A or 1B	19	
Music rooms	320	warm or intermediate	1B or 2	19	
Textile craft rooms	320	warm or intermediate	1B or 2	19	task lighting
Gyms	320	warm or intermediate	1B or 2	19	see *Specialist Teaching Spaces*
Libraries	240	warm or intermediate	1B or 2	19	see *Specialist Teaching Spaces*

Table 2.2 Illumination levels in various learning spaces

For classrooms, suitable illumination levels are between 300 to 500 lux at the working plane. Good illumination is most important at desktop height. Illumination levels for most school spaces are assessed at a working plane about 800 mm above floor. [700 mm for desks and 850 mm for benches]

Technology rooms need similar lighting levels as classrooms [Table 2.3].

Lighting technology rooms	
Provide task-light lighting for close, demanding work with good colour rendering lamps	• some machines have built-in task lights • safety consideration
Provide low voltage task lighting for machines	• safety consideration
Avoid dangerous stroboscopic effect with machinery by using high frequency control gear for the luminaires	• small cost increase • high frequency controls avoid flicker • safer
Provide some feature lighting for displays	• provides interest and variety

Table 2.3 Lighting technology rooms

2.8.3 Ventilation & Indoor air quality

There is considerable research worldwide on the importance of good quality ventilation and the impact of poor indoor air quality. While this may not have been widely recognised as a major issue it is important that we acknowledge the potential for problems to exist. Campuses are designed to provide ventilation through opening windows. However, if windows remain closed the air quality will deteriorate and this may or may not be recognised by the occupants. Someone coming into the room from a well-ventilated space will immediately recognise the difference. Stuffiness and a build-up of CO2 may cause drowsiness. [Chickering &Gamson, 1987]

Designers, boards, principals, teachers and students consider that a well-ventilated classroom and the elimination of odours were essential elements of good design for learning [Table 2.4 & 2.5]. These included removing smells from dampness, chalk, poor student hygiene, old classrooms, accumulated odours in some specialist places and poorly maintained toilet facilities.

Teachers felt ventilation and air flow was critical overall, and that these were closely linked to their ability to maintain control over the temperature. Students also rated good ventilation, along with having rooms that were not too hot or too cold, as important in helping them learn.

Ventilation must:
• supply fresh air for breathing
• clear away pollutants and odours to improve air quality
• help remove excessive moisture in the air
• improve thermal comfort in warm weather by increasing air movement and removing heat.

Type of space	Number of people	Fresh air requirement (litres per second per person)
Classroom	30	8
Laboratories	30	10 [2]
Art, design, and technology rooms	30	10
Libraries	20	8
Multi-purpose halls	150	8
Gyms	30	10–13

Table 2.4 Fresh air requirement in various rooms

Occupancy category		Required ventilation, cfm per 1,000 sq ft		
		ASHRAE 62	ASHRAE 62.1	Change[1]
Education	Art classroom	300	380	+27%
	Classroom, ages 5 to 8	375	370	-1%
	Classroom, ages 9 and up	525	470	-10%
	Lecture classroom	975	550	-44%
	Multiuse assembly	1,500	810	-46%
	Science laboratory	500	430	-14%

Table 2.5 Required ventilation in learning spaces

The concentration of CO2 in a room [Figure 2.18] is often used as a guide to the quality of indoor air. Indoor concentrations above about 1,000 parts per million (ppm) CO2 indicate that IAQ is unacceptable.

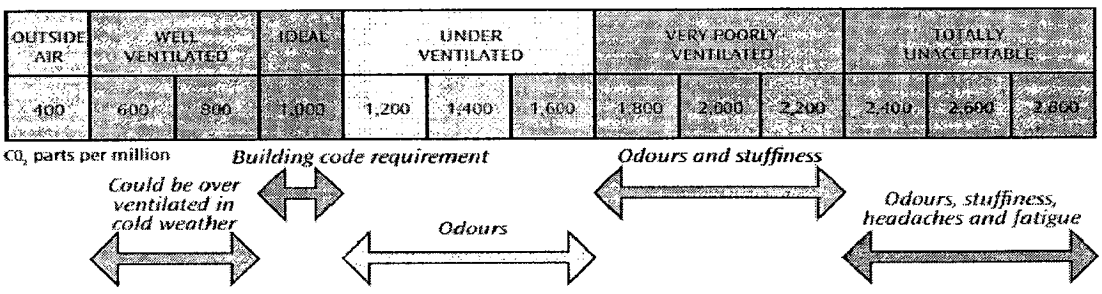


Figure 2.18 CO_2 levels to indicate IAQ

There are five basic control methods for reducing indoor air contaminants:

- provide good ventilation
- manage contaminants at source

• use materials with low contaminant emissions
• seal or enclose contaminants
• extract air at source.

Humidity is an important factor in controlling thermal comfort and air quality. While people cannot easily detect the level of humidity:
• high relative humidity (RH) – very damp air – can make people feel chilled in cold weather and hot and sticky when it's hot
• low RH (very dry air) can cause temporary dryness and discomfort in the nose, and skin can be dry and itchy.

2.8.4 Interior Design, Function and Aesthetics

When remodelling and upgrading spaces there is little point in investing significant funding to improve the internal ambience if the room is still not appropriate for modern teaching and learning or cannot accommodate new technology. A building may need major reshaping to make it function well and to achieve quality learning spaces. Other teaching spaces may be fine for current teaching and learning but deficient in acoustics, heating or ventilation. Here the greatest benefit may be achieved by improving these aspects.

The size, shape and flexibility of spaces are keys for positive learning environments.

In providing new buildings the challenge is to achieve an excellent internal ambience as well as a design that is flexible and functions [Valenti, 2002] well for teaching and learning. Many elements combine in the design of a classroom – the shape of a space, the impact of colour and texture, the layout of the furniture and its visual relationship to other spaces.

2.8.5 Heating & Insulation

The comfort of students and teachers depends on:
• good indoor air quality
• adequate ventilation
• appropriate thermal comfort resulting from an acceptable air temperature and relative humidity.

Air quality, ventilation and temperature are interdependent and must always be considered together. Adequate cooling for thermal comfort (whether active or passive) is closely related to heating and ventilation.
Students and teachers need to be comfortable in their learning/teaching environments to reach their full potential. Achieving personal thermal comfort for everyone is a difficult

issue because it is so subjective. A space may be within the normal temperature comfort band, but high humidity may make the occupants feel thermally uncomfortable. Thermal comfort also depends on such factors as personal metabolism and the amount of physical activity underway. Heating accounts for a large portion of a campus's costs, so it is important to ensure heat is used efficiently and not wasted.

2.9 TECHNOLOGY IN LEARNING SPACES

Display Equipment – Display equipment is still a very important part of teaching technology. That display equipment might be a data projector combined with a **'smart board'**, a whiteboard with a camera or a document camera and data projector, but is of continuing importance in teaching rooms. Some developments are already taking place; plasma screens have become a viable alternative to data projectors in smaller rooms; display equipment is becoming more sophisticated with multiple projection systems and some three dimensional systems coming on to the market.

Wired and Wireless Networking – to be fully exploited as devices for information and communication computers need network access. Wired networking still offers superior performance to wireless infrastructure, especially where computers are fixed and in high densities. Wireless networking is developing fast, but so is wired networking and so are the data needs of learners. So the 'rule of thumb' that seems to be developing is that where there are fixed computers they should be wired, where mobile computers are in use wireless access should be provided.

Electrical Power – The need for electrical power is still a weakness for mobile computing. Providing mains electrical power to individual places in large lecture theatres is expensive both in terms of capital and maintenance, yet without power, at least to small clusters of users, mobile computing will struggle to become fully embedded into learning and teaching. There are three trends which may help, [Linda & Barbara, 2005] at least partially, to address this problem. Firstly is the trend to reduce the power needs of computers, the net-powered computer is a good example of this but still needs a physical cable. The second trend is the improvement in battery technology, the inspirational position being the use of fuel-cell technology which could allow 40 hours or more of battery life. The third factor which may help is the potential for the use if induction loops power, such as is found commonly in electric toothbrushes. In this scenario a single, low voltage power supply could be made available without the need for mains wiring.

Flexible Furniture- The ability to reconfigure a teaching space, and the learners within it, is very important if we are to allow pedagogic flexibility. However, flexible furniture does not always mean moveable furniture. Fixed furniture can be designed to allow different working styles and different groupings of learners. Flexible furniture should also allow for the technology that may need to go with it.

Interactive Technology – consisting of:

- ***Collaborative software*** – collaborative software allows users, with some sort of networking technology available to them, to share programs, diagrams, text

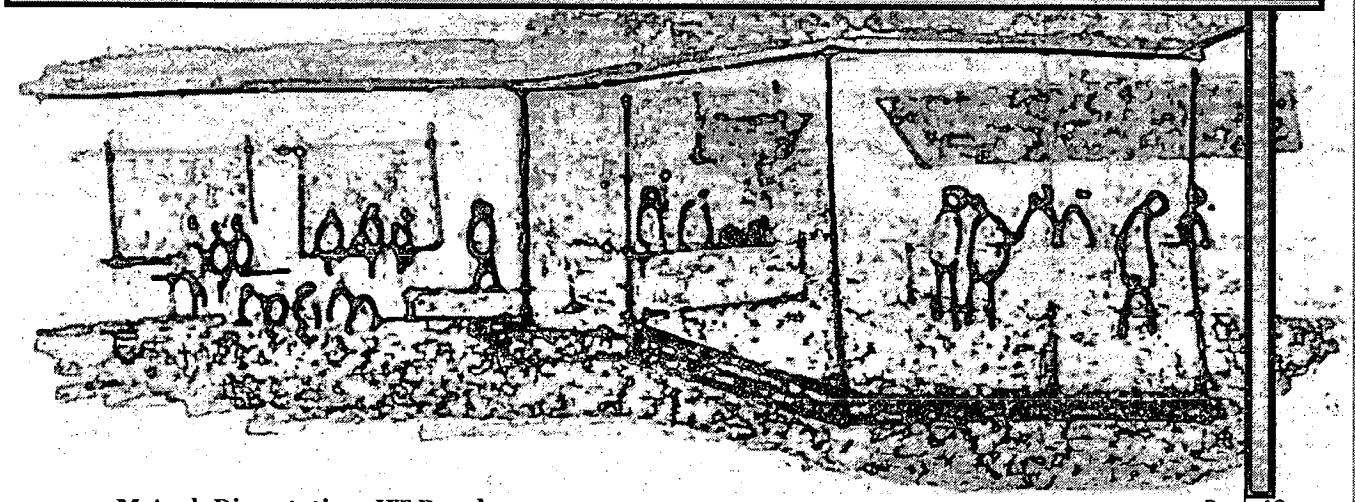
and presentations with each other and with other learners and tutors participating in the same activity.

- ***Video Conferencing*** – Video conferencing is often a native feature of collaborative software, and is an effective way for physically remote learners to speak and interact in a natural way.
- ***Audience Response*** – Audience, or personal, response systems bring learners who would otherwise have had the opportunity to be passive into the centre of teaching activities. Audience response systems are teacher-led but involve the learner in a powerful and relevant way.
- ***Document Cameras*** – There is a vast array of information that is available in digital format, but for the foreseeable future a significant proportion of information will not be readily available electronically. A document camera allows any text, drawing or other object to be displayed to large groups of learners with minimal preparation or as an ad-hoc response to learner needs.
- ***Printers*** – In the same way that document cameras allow us to bring physical objects into the digital world, so printers allow us to being digital objects into the physical world. The need to print is reducing, but at present that is at least counter-balanced by the increase in material available for printing.

2.10 SUMMARY

The literature data was covered in this chapter which formed the base for the next chapter in which the relevant primary and secondary case studies has been identified. The primary two cases have been discussed first followed by the secondary cases.

3.0 CHAPTER
SIGNIFICANT CASE STUDIES



3.1 INTRODUCTION

There are many examples of campuses that have redesigned existing space or created new space as part of the process of changing learning environments. Significant cases both primary and secondary have been identified case studies to study how the design of spaces can support and enhance the learning and teaching process.

3.2 VIDYALANKAR INSTITUTE OF TECHNOLOGY

3.2.1 Design Narrative

The project needed ability to engage a complex design program in an urban, developing country context. The challenge was in articulating the requirements of four distinct engineering faculties within the same building and establishing network accesses to shared amenities. The design had to be simple and intuitive, of equitable use, have flexibility, involve low physical effort, work within context and constraint, communicate ideas visually, be experimentally satisfying, conform to restrictive building codes, demonstrate environmental sensitivity and importantly, to enable future-forward learning concepts.

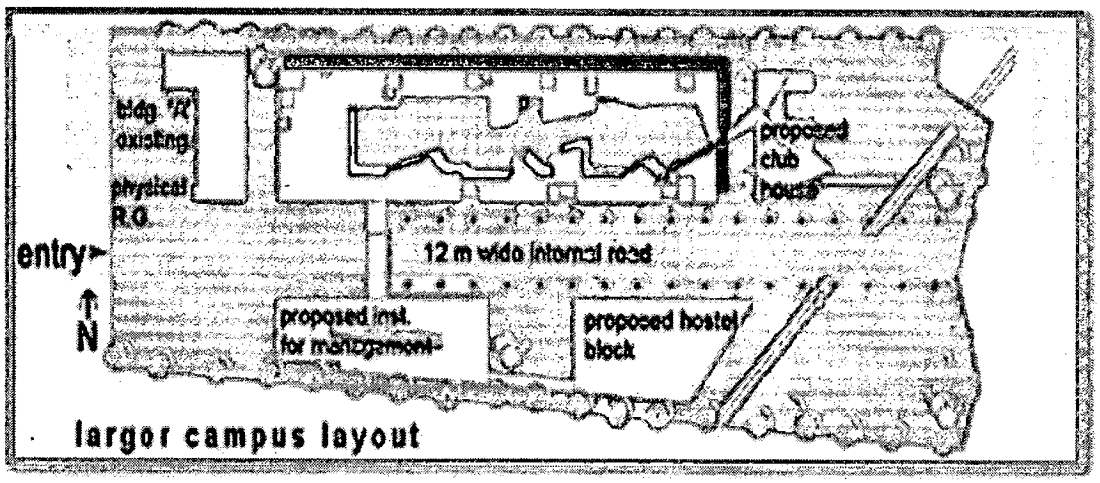


Figure 3.1 Campus site layout

This image {Figure 3.1] orients the institute as per its larger geographical location and consecutively as per the site. Since it is situated in the tropical region special attention was paid to the sun path as well as direction of the monsoon rains. The external louvered skin as well as the opening between the blocks were designed to make the structure breathe and at the same time to protect it from harsh climatic conditions. The roof encompassing the building was also lifted 14' above the final floor to allow hot air to escape from the top.

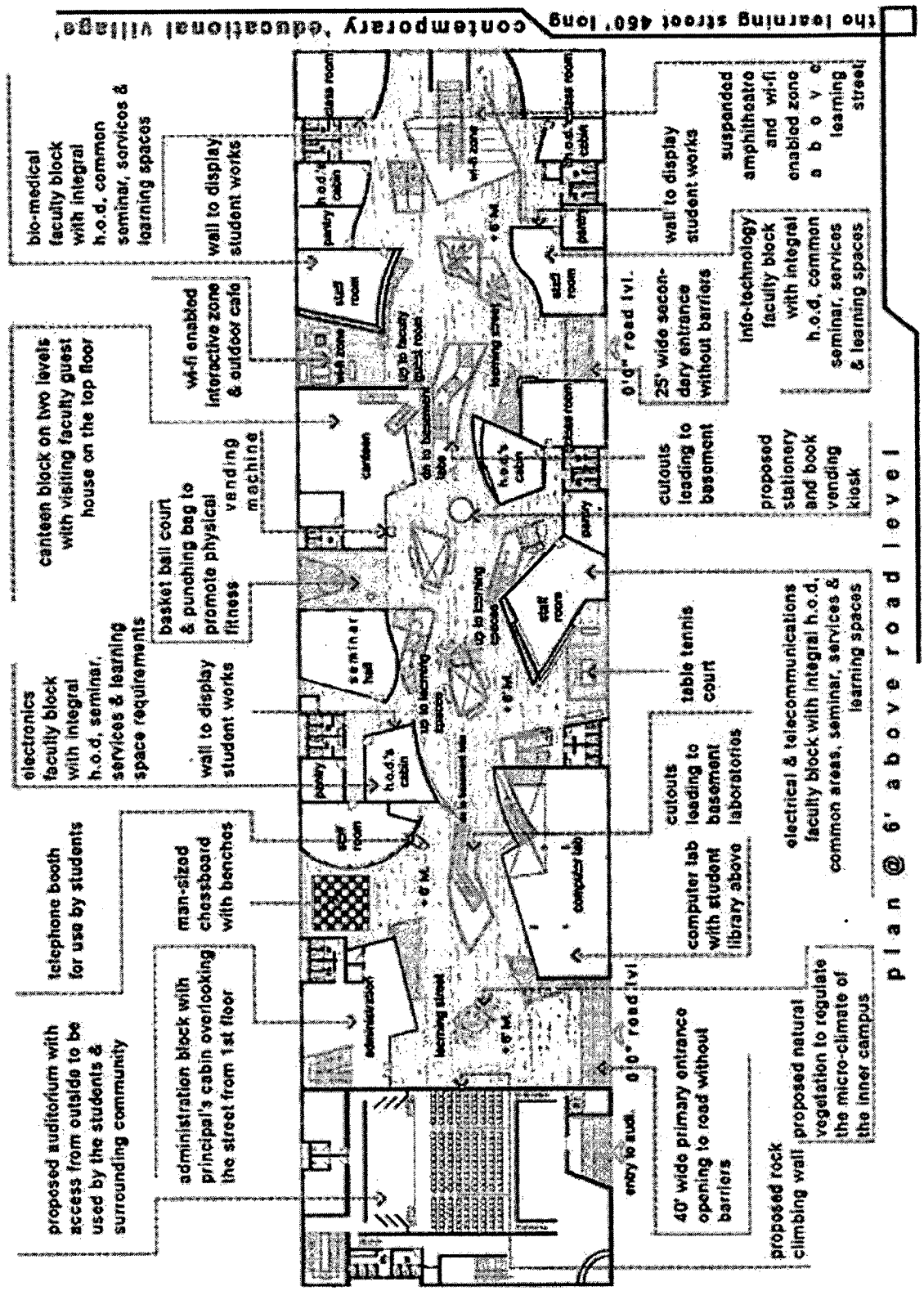


Figure 3.2 Entry level plan (6' above road level

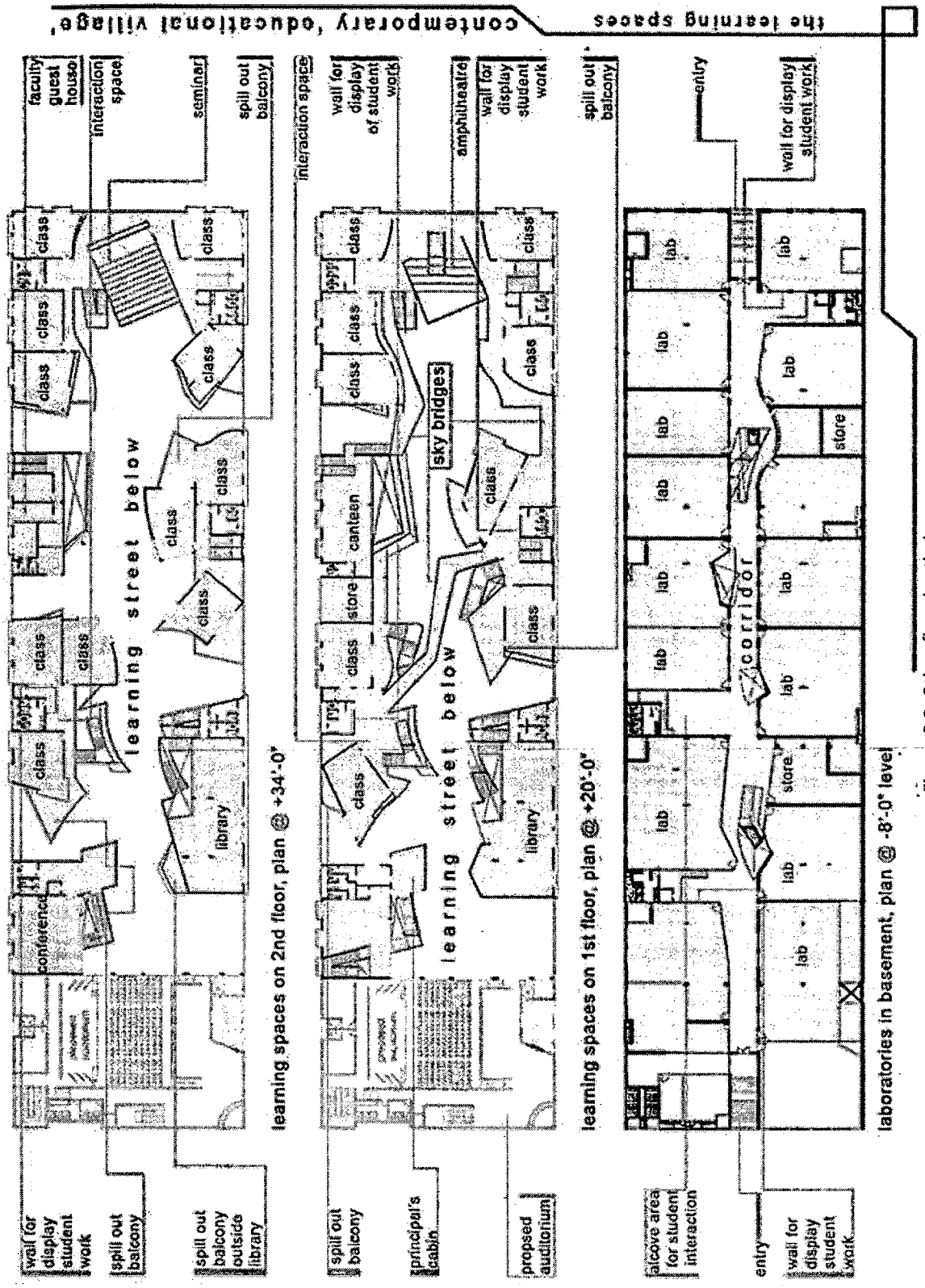


Figure 3.3 Other floor level plans

Eschewing monumental verticality, the design experiments with horizontal urbanism and hit on the idea of an **'Educational Village'** built within a container [Figure3.2]. This literal minded village has various groupings of similar requirements in clearly definable structures with a main **'Learning Street'** as the central organizing device as well as hospitable site for spontaneous student interactions. This complex of open public spaces, enclosed semi public spaces and private areas has the spatial connectivity of open plan interiors encouraging egalitarian, communal learning experience. Each programming requirement such as administration, library, several engineering faculties, canteen etc. are individual blocks situated on either side of the inner street. Each such block functions as a self contained facility with its own faculty, library, learning spaces and connected at various levels with adjacent structures. This street at six feet above ground level sits on a basement containing laboratories, a shared resource between different faculty blocks. Staircases in cut-outs on the street lead to the basement below. The building container opens with forty foot wide main entrance and a smaller subsidiary opening to the road outside with no barriers for unrestricted entry.

Clusters of classrooms with student interaction zones tucked in-between function as 'Learning Suites'. Each asymmetrical classroom provides the opportunity to introduce soft seating, teaming zones. Many classrooms have 'Spill-out Balconies' that open into the inner street [Figure 3.3]. Wherever required, flexibility to combine two classrooms to form one large space has been provided. Each such learning space has two side windows for natural light and ventilation. The design maintains the intimacy of the human scale and provided numerous activities to promote interaction. Tucked in the alcoves between the blocks, a man sized chess-board, a table tennis court, half a basketball court, a street side café with the canteen block, couple of phone-booths, a book kiosk and a graffiti wall, student work display areas, and a suspended amphitheatre. The act of appropriation of these public spaces by the students becomes a source of cultural energy.

The building's public face is a deceptively quiet, porous polycarbonate skin evoking the metaphor of its industrial neighbourhood. The skin is engineered to ease glare and yet allow the building to be naturally aerated. Use of recycled materials such as packing material obtained from shipping containers and reengineered sleeper wood from railway tracks in raw form intensify the sense of space.

3.2.2 Design findings

Learning Street & Transparency: The entire facility is open plan and the **'Learning Street'** acts as the central organizing device [Figure 3.4] as well as hospitable site for spontaneous student interactions. It is possible to see the entire learning street almost any location in the building. Sitting in a classroom, one can watch the activities happening in the street and at the same time, be connected with the outside. Large clear glass windows openings maintain transparency and visual connectivity.

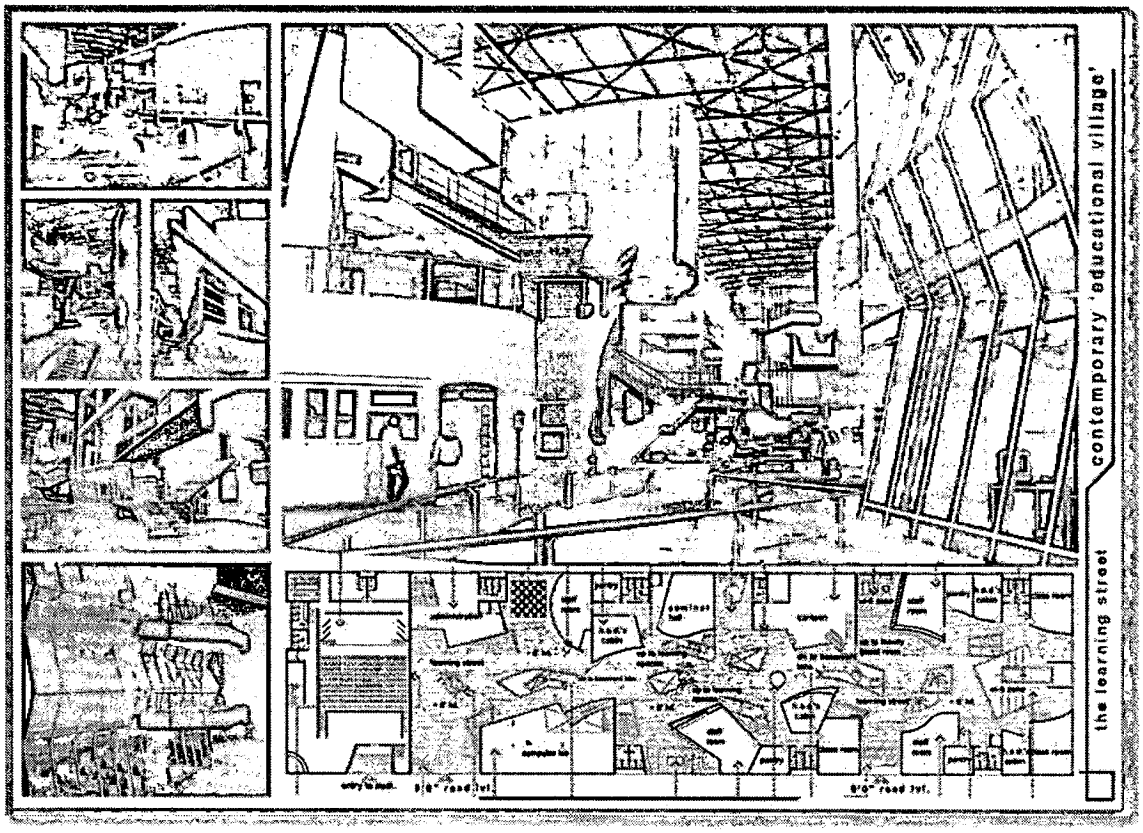


Figure 3.4 Learning street

Traditional Classroom: There are formal learning areas. These classrooms serve the needs of the structured component of the curriculum. However, the asymmetrical nature of the spaces [Figure 3.5] designed allows for insertion of huddle spaces within the formality of the larger classroom. Most of the classrooms open out to interaction zones or spill-out balconies. And, sometimes they have flexible partitioning to allow larger groups to participate in same activity.

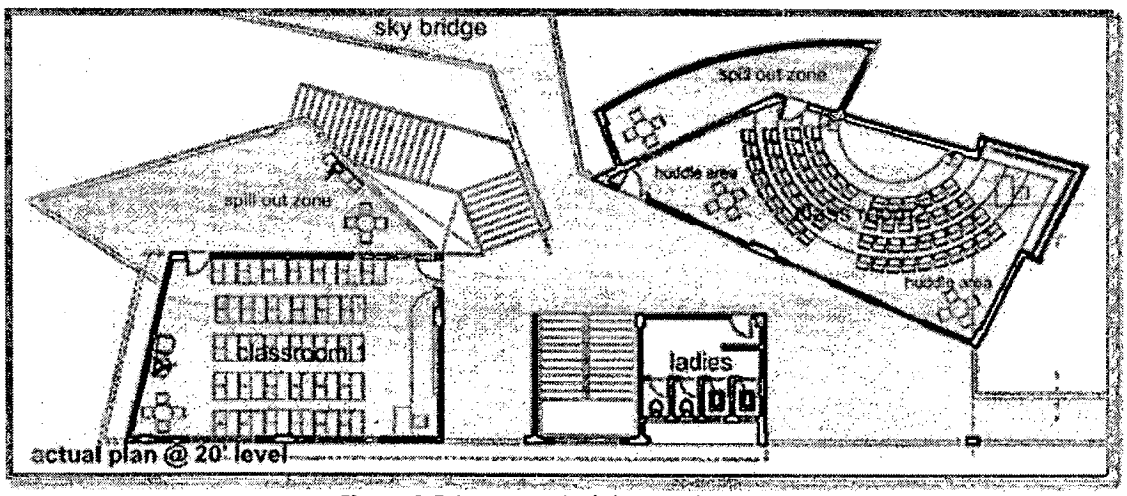


Figure 3.5 Asymmetrical designed spaces

VIT has a total of 22 classrooms which are fully air-conditioned and has ensured that all the classrooms are very spacious [Figure 3.6 & 3.7] so as to make the classroom comfortable for all the students in the class. Also each classroom has an over-head

projector which is used by the professors and the students during presentation lectures and classroom seminars.

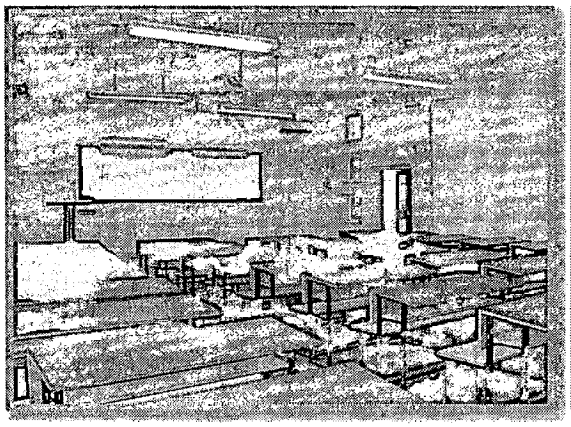


Figure 3.6 The classroom at VIT

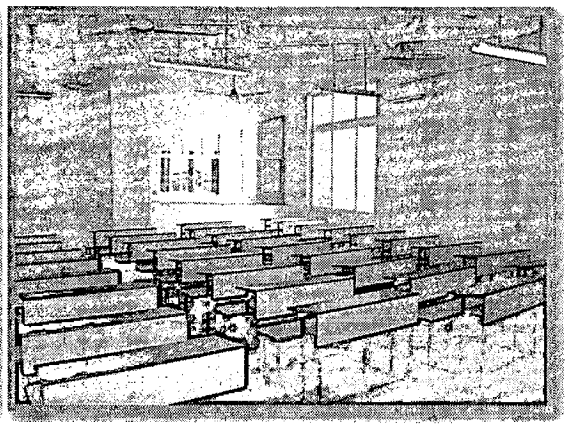


Figure 3.7 Well lit and ventilated spaces

Flexible Spaces: The classrooms have flexible partitioning to allow larger groups to participate in same activity. A conference room at the top floor of the admin block also functions as an exhibition space for display of student work. A collapsible partition between classrooms [Figure 3.8] allows the space to be reconfigured to seminar requirements. The amphitheatre, when not in use by students for cultural & social activities, transforms into a net cafe. Thematically, the concept of multiple uses of spaces runs through the entire design.

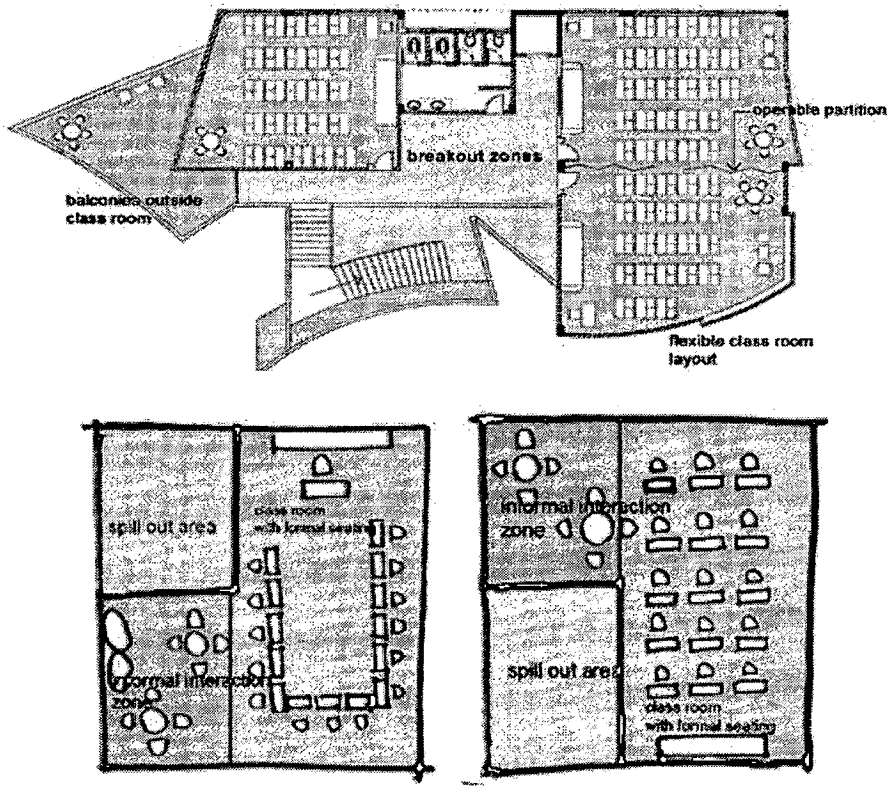


Figure 3.8 Flexible spaces: with movable furniture and breakout zones

Indoor-Outdoor Connection: This building is part of the larger campus outside. Designed to obliterate the conventional clear distinction between inside and outside [Figure 3.9], it has a porous, open character. By introduction of outdoor plants inside, it would take the concept further. The act of walking down the learning street is one of observing built form of individual units interspersed with 40 feet x 40 feet vistas of outside. A lot of the individual rooms have view of both inside as well as outside.

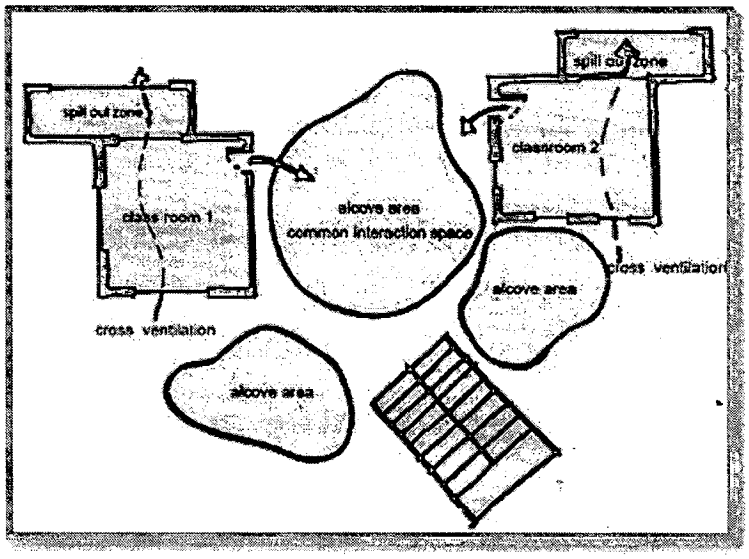


Figure 3.9 Connectivity of learning spaces with other informal areas

Formal Learning Spaces: Seminar Halls are one of the major assets of an institution. VIT has made every effort in creating 3 Seminar Halls that are fully equipped in every aspect. The other spaces include meeting rooms, conference halls, studios, and media rooms. Labs and other experimental rooms are located at the basement level. Technology rooms are also provided along the learning street.

Other Learning Spaces: The institution is dedicated to the advancement of science and technology. The fact that it recognises the role of arts and humanities in overall development of individuals reflects it enlightened, progressive stance. The entire basement is occupied by laboratories, a shared resource for all the different faculties. The corridor connecting the labs is a scaled down version of the street above, with alcoves for interaction, asymmetrical walls, space for display and cut-outs in ceiling to bring in natural light. Even the labs are designed to derive natural light and ventilation. The basement is only partially underground. Ventilators light up the space. The attention paid to the design of the labs and the connector space is intense. It demonstrates the importance that the college accords this space [Figure 3.10].

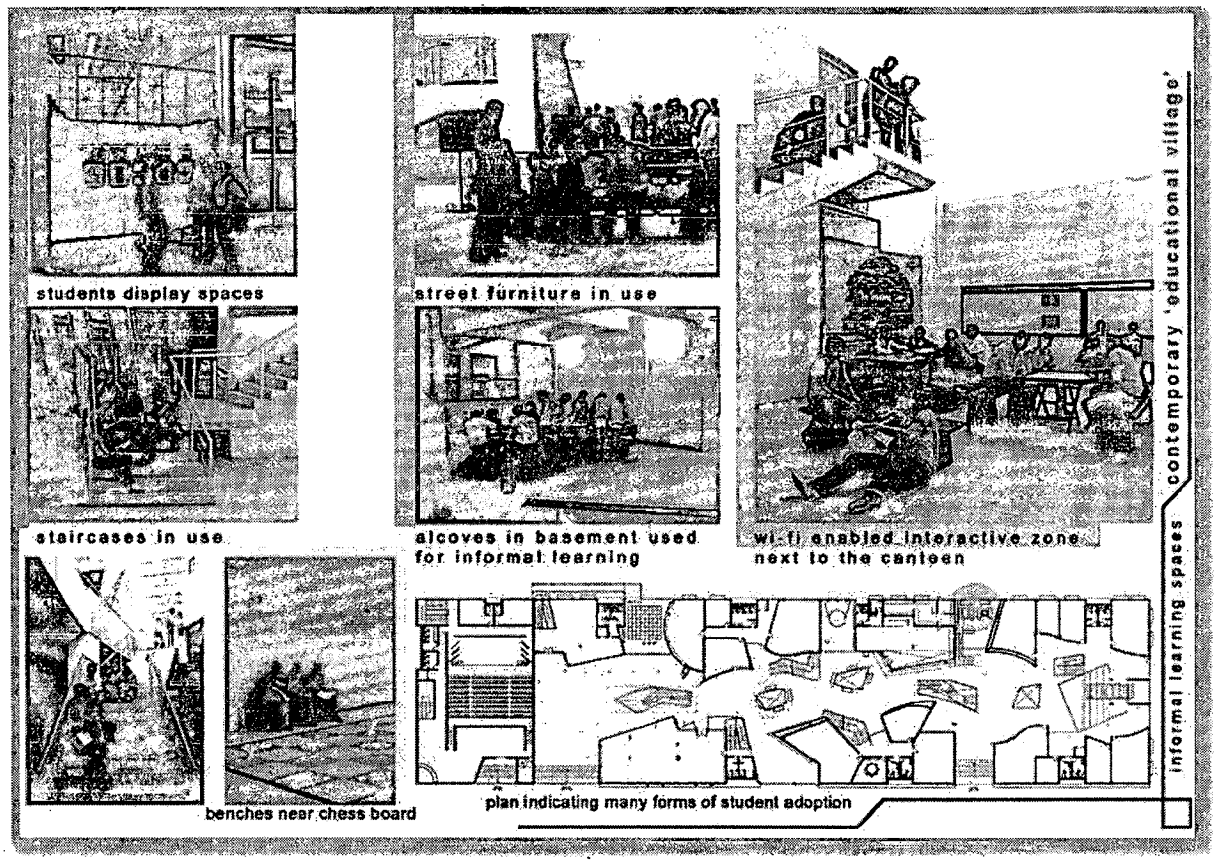


Figure 3.10 The various informal settings in the campus

Designing for Multiple Intelligences: The design has potential to develop much intelligence. While this may not happen in overtly obvious ways, there are embedded cues and opportunities.

A man sized chessboard- Logical, mathematical ability.
Amphitheatre- Musical ability.
Basketball Nook, Table Tennis Court- Sports ability.
Spaces that break from orthogonal rigidity-Spatial ability.
Green vegetation inside- Naturalist ability.
Interaction zones- Social ability.
Nooks and alcoves-Self discovery.
The alcove next to the canteen and the amphitheatre space are presently WI-FI enabled. Students carry laptops and work in these areas. The entire learning street also has the facility.

Local Signature: The fact that it is an institute of technology committed to progressive learning is embedded in the architecture and design. The building technologies adopted and used the choice of materials and finishes etc. state that at a subliminal level.

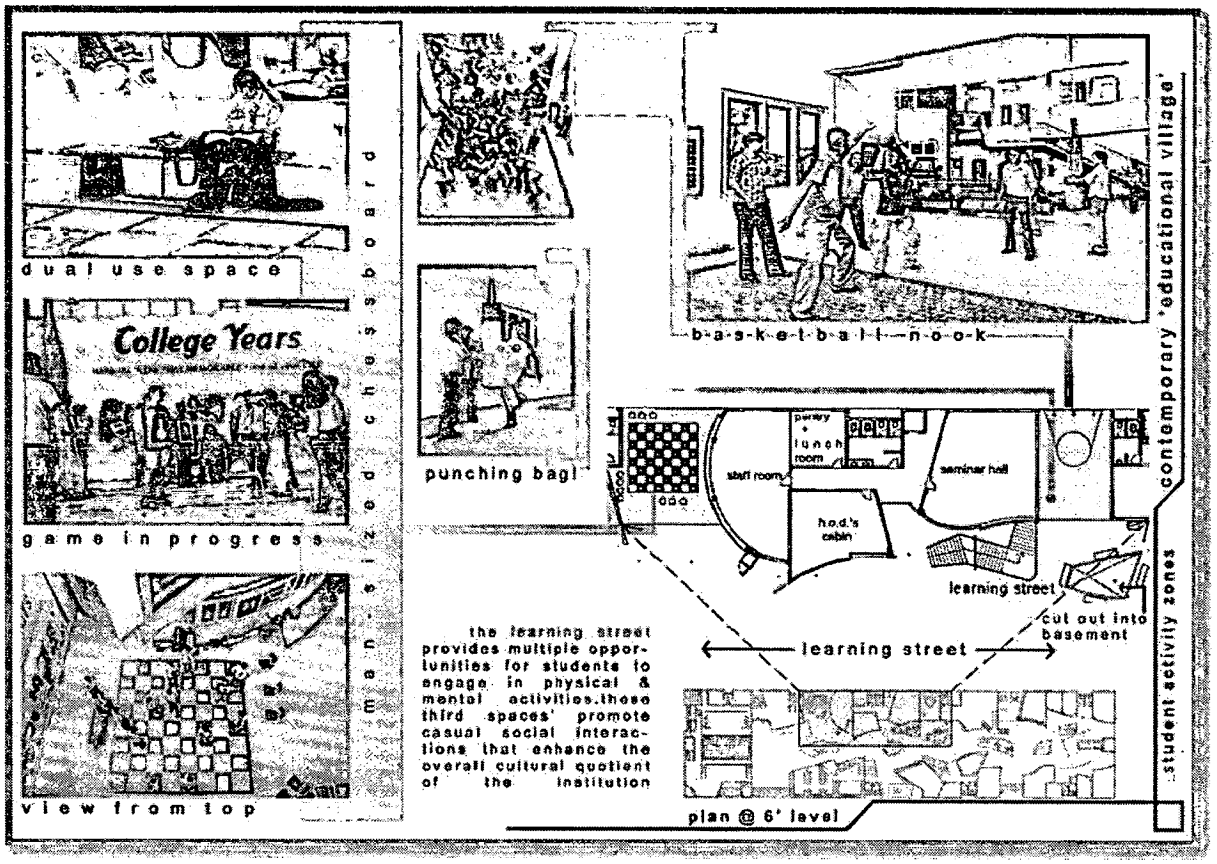


Figure 3.11 Other recreational areas in the campus

Bringing It All Together: This building addresses the needs of the institution at a micro as well as macro level. From the part to the whole, the design ideology remains consistent. At the individual self sustained block level the requirements are fulfilled and progressive design ideas are cleverly incorporated. Each unit is as eloquent an expression of the fundamental concepts as the whole. The interaction between blocks at the street follows the same sense. The manner in which an inner street communicates with the road and community through un-barricaded openings carries the idea forward. The design is consistent and true.

Other Design Features

Watering Hole Space: The whole design really is about encouraging casual, social interactions between students, faculty and the community. The students are encouraged to display maturity and accept the open culture as an advantage of learning here. The entire learning street, the full 450 feet length with alcoves, nooks and corners is an inducement for social interaction. The break-out spaces between classrooms, spill out balconies and odd shaped learning spaces, all carry the essential theme.

Cave Space: The nooks, alcoves and quiet corners on the street provide have the potential to be adopted by students for multiple activities. At some times of the day, these can function as cave spaces. With ready availability of net connection and facility to carry library reading material to the street, these spaces can be hospitable for quiet

contemplation. On the upper levels, the spill out balconies outside classrooms and interaction zones within classroom clusters as learning suites function as such spaces. On an average day, one can find students studying in the unlikeliest if places; below amphitheatre, sitting on staircases and on sky bridges connecting individual units.

Campfire Space: The very nature of the design has created many kinds of spaces that can be used for unstructured learning exercises [Figure 3.11] or events. Outside most classrooms, we have provided spill out areas that can accommodate small group of students. Within each cluster of classrooms, irregular shaped interaction zones can potentially be used for such sessions. The suspended amphitheatre is another such area. On the learning street itself, nooks and alcoves with casual, comfortable street furniture may tempt the educators and students to interact.

Connected to the Community: The building has been designed to be porous, no gates or barriers to keep out the surrounding community. The WI-FI zones are free for use. In the second phase, an auditorium will service the needs of the institution and the community alike. The entrance to the auditorium has been deliberately provided from the roadside and not from inside the college. It is for the community to accept it as their own. Infact the institution believes that the auditorium would be more frequently used by the people and organisations from outside the institution. It has the potential of becoming a local community anchor.

Sense of Belonging: Within the larger building envelope, self sustained faculty units function almost as independent learning communities with necessary requirements fulfilled within the block itself. This conceptual departure allows for intimacy and interaction to develop at micro and macro levels. Effectively, it humanizes the environment by making it easier to relate to the scale. Bio-medical 'family' as a faculty block, for instance, is a part of the 'village'. Students have the opportunity to adopt the college at multiple levels first their family community, knowing the resident educators, other students and owning the alcoves, interaction zones etc. and then being part of the cluster with shared amenities.

Responsibility to the Environment: Buildings are a primary source of pollution that leads to urban air quality problems, climate change, habitat destruction, and overfilled landfills. The motto was to design and construct the building prudently, so that it uses a minimum of non-renewable energy, produces minimum pollution, and uses as little extracted material resources as possible, while at the same time increases the comfort, health, and safety of the people who study and work in it. This involved integrating the project designing, planning, and engineering, in order to work with, not against nature i.e. to incorporate nature's "free" services (wind, sun, thermal properties, greenhouse principles, light, etc.) to create a high quality indoor environment while circumventing as much damage to the ambient environment as possible.

Sustainable Elements and Building as 3-D Text: The building maximizes the advantages of natural light and ventilation. It does not require electrical lighting or air conditioning to function in normal conditions. The materials used in construction locally available and extremely cost effective. The finishes and claddings are resilient, low maintenance. Quite a few of them are of recycled origin. The logical, intuitive clarity of

the construct and the interdependent relationships between requirements are clearly articulated. This has been achieved by a certain economy of means. High performance is embedded in the design. For an institution dedicated to furthering technology, the architecture and construction had to evoke and demonstrate the potential of building technology to improve the quality of environment. Suspended seminar hall and amphitheatre, projecting principal's cabin, classrooms that cantilever 25 feet, walls that bend and curve defying gravity, escape from orthogonal rigidity, and all design interventions carry that thought. The entire structure dispels pre-conceived notions of design and construction. For students, this built environment challenges them to look beyond the obvious. Sometimes the most effective lessons are the ones learnt indirectly.

The Institute building fulfils all the norms laid down by AICTE. The building is divided in different blocks to suit the administrative & educational requirements

- **Administrative Block:** Reception area, Administrative office, Accounts office, Principal's office, Trustee's office and Conference Hall
- **Computer Centre and Library:** Central Computing Central Library - Reference Hall & Reading Hall
- **Educational Block 1:** Class rooms, Tutorial rooms, Seminar Halls, Departmental Offices, Departmental Library, Staff rooms, Toilets, etc.
- **Educational Block 2:** Class rooms, Tutorial rooms, Seminar Halls, Departmental Offices, Departmental Library, Staff rooms, Toilets, etc.
- **Educational Block 3:** Class rooms, Tutorial rooms, Seminar Halls, Departmental Offices, Departmental Library, Staff rooms, Toilets, etc.
- **Educational Block 4:** Class rooms, Tutorial rooms, Seminar Halls, Departmental Offices, Departmental Library, Staff rooms, Toilets, etc.
- **Cafeteria and Guest House:** Cafeteria, Lunch room, Guest rooms and a sick room.
- **Laboratories:** All the Labs are located on the ground floor of the building

3.3 TERI UNIVERSITY, NEW DELHI

3.3.1 Design Narrative

The TERI University aspires to contribute globally by serving society as a seat of advanced learning and to promote learning through teaching and through creating and sharing knowledge. The University commits itself to academic excellence and an environment which would encourage personal and intellectual growth. A truly green campus, it puts into practice the very principles it teaches in its classrooms. An architectural delight, the campus has been planned to provide a setting that enhances learning, while simultaneously showcasing the concept of modern green buildings.

The TERI University [Figure 3.12] provides world-class facilities and resources to its students and faculty so as to usher in innovative and multidisciplinary research. Spread on a plot of two acres, the 80,000 sq ft university campus is located at Vasant Kunj in South Delhi. The campus has been planned to provide a setting that enhances learning and showcases the concept of modern green buildings. It mainly comprises an administrative block, an office block and a hostel block.

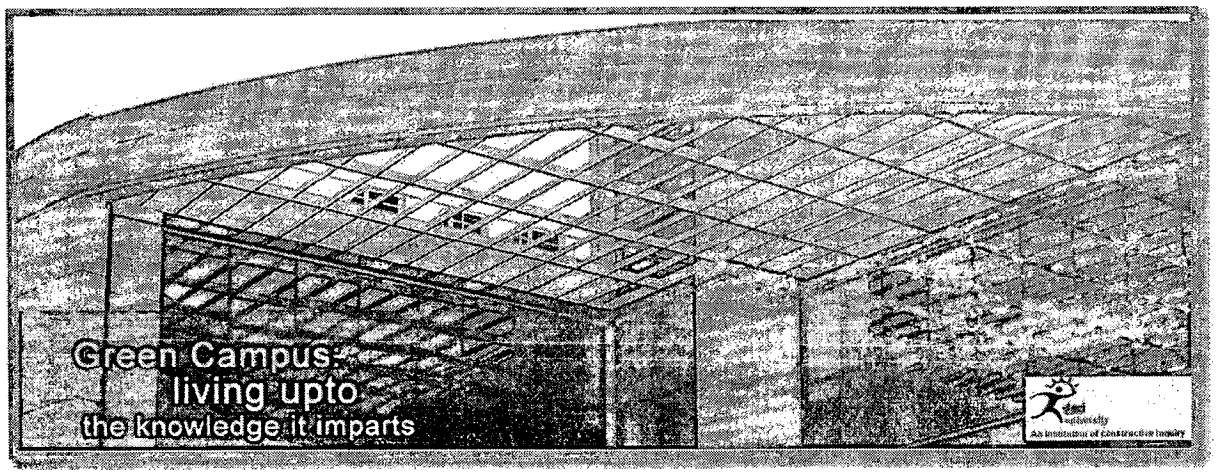


Figure 3.12 Teri University Building

Passive solar design is an important feature in the design of the building. The planning and orientation of spaces and building blocks ensures glare free daylight in all regularly occupied spaces. All the linear blocks [Figure 3.13] are oriented in the East-West direction with shorter facades facing the sun. Most of the south west facing walls are kept blank in order to protect the building from the harsh south west solar radiations. Where the south west walls have opening, they are protected by means of pergolas or projected balconies. The east, west and south facades of the building have minimum glazing. The shading devices are designed such that the windows are completely shaded during the summer, which also contributes to reduction in cooling energy demand of the building. Energy efficiency is further enhanced by insulation of the walls and roof; and use of high performance window glazing to minimize thermal gain. The central atrium is proposed to be covered with automatic adjustable louver system (Vergola). It can be kept

in such an angle as to block the solar radiations during summer and to allow ample sunlight during winter. The louvers can be kept closed during the rainy days so as to prevent rain water from entering the atrium. The system is further to be integrated with photo voltaic panels.

The walls that are exposed to the harsh solar rays have a stone cladding which is fixed to the wall by channels. The air gap between the wall and the stone cladding by itself acts as an insulation layer. On the facades rock wool insulation is also provided in the wall. Energy efficiency is further proposed to be enhanced by insulation in the roof slab.

The predominant wind direction is taken into account in designing the open spaces. The hot air from outside moves into the central court, where it passes over the water body and fountain. The air thus gets humidified and cooler. This makes the central atrium area always cooler than the surrounding exterior.

In areas where daylight is available, fixtures have been fitted with continuous dimming electronic ballasts. These fixtures are controlled by light sensors, which automatically dim the connected fixtures to achieve uniform illumination required for the task. In areas with non-uniform occupancy, Occupancy sensors that can turn off the lights when the space is unoccupied have been installed. This kind of sophisticated lighting system has a potential of saving 70% lighting energy demand. The campus has an efficient artificial lighting system designed for minimizing the energy consumption without compromising the visual comfort in the building. The system takes advantage of day lighting wherever available.

Use of efficient double glazing window units helps significantly reduce the heat gained through window glazing in the summers and the heat lost in the winters without compromising on the day lighting integration and the levels of visual comfort.

The campus is also equipped with three types of cooling systems, integrated to take advantage of different innovative technologies to achieve energy efficiency. They are discussed briefly as under.

- Earth Air Tunnel (EAT)
- Variable refrigerant volume systems (VRV)
- Thermal storage

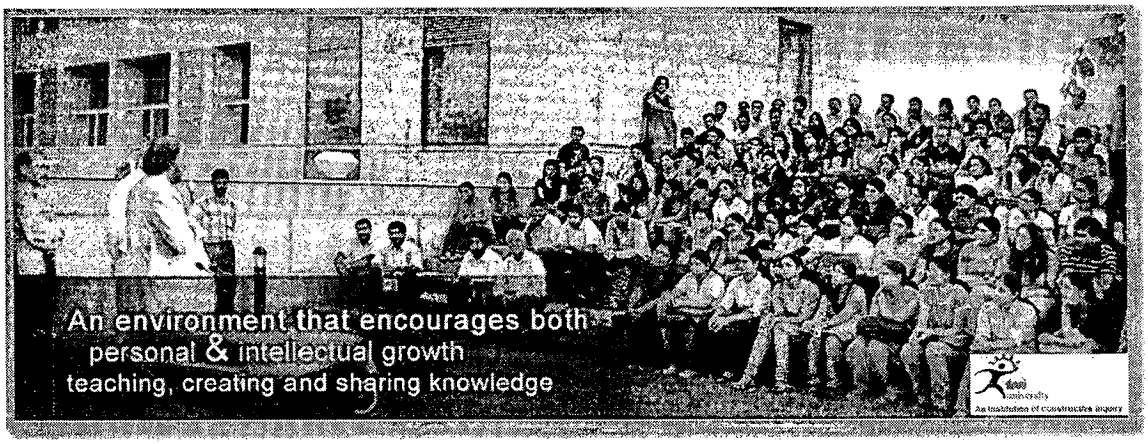


Figure 3.16 Open to sky amphitheatre at TERI

Lecture halls: A platform of interface

- Teri provides state-of-the-art lecture halls [Figure 3.17] with a seating capacity for 100 people that act as a common ground for students, faculty, and corporate personalities for regular interfaces, conferences and other events.
- At these platforms, you will come across various global thought leaders, academic gurus, corporate heads, sharing their corporate experiences with you
- For events of a smaller scale, the Seminar Halls, equipped with advanced presentation tools, are the ideal venue.

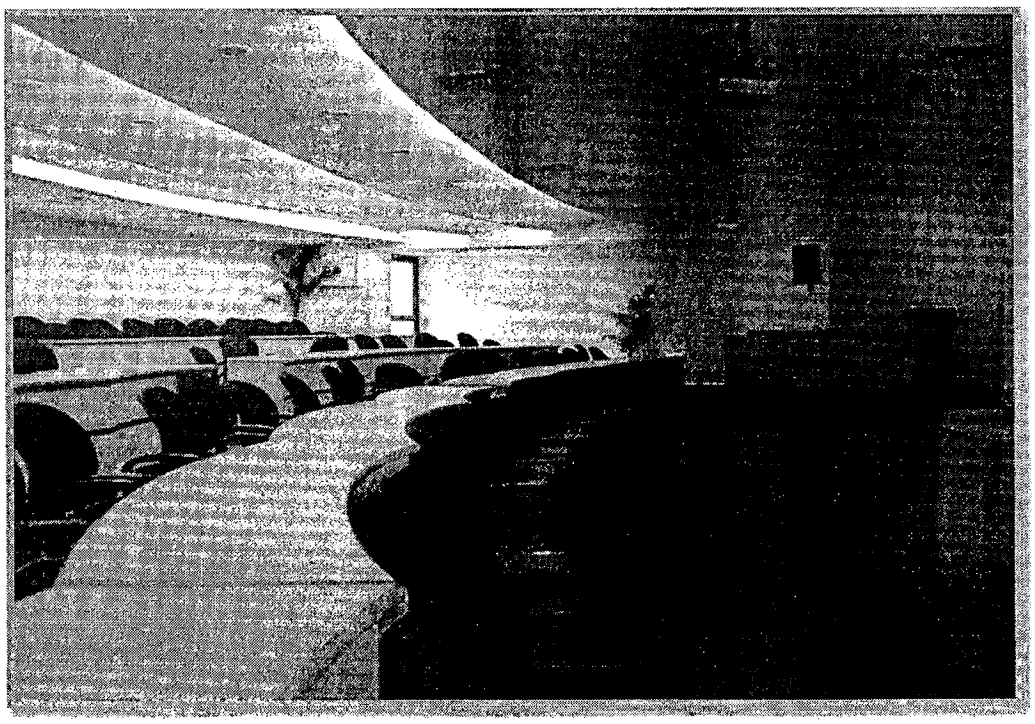


Figure 3.17 Lecture halls : a platform of interface - TERI

Laboratories: Training grounds for budding professionals

Teri has the state-of-the-art labs [Figure 3.18 & 3.19] that allow the students to experiment and bring to practice what they have learnt in theory.

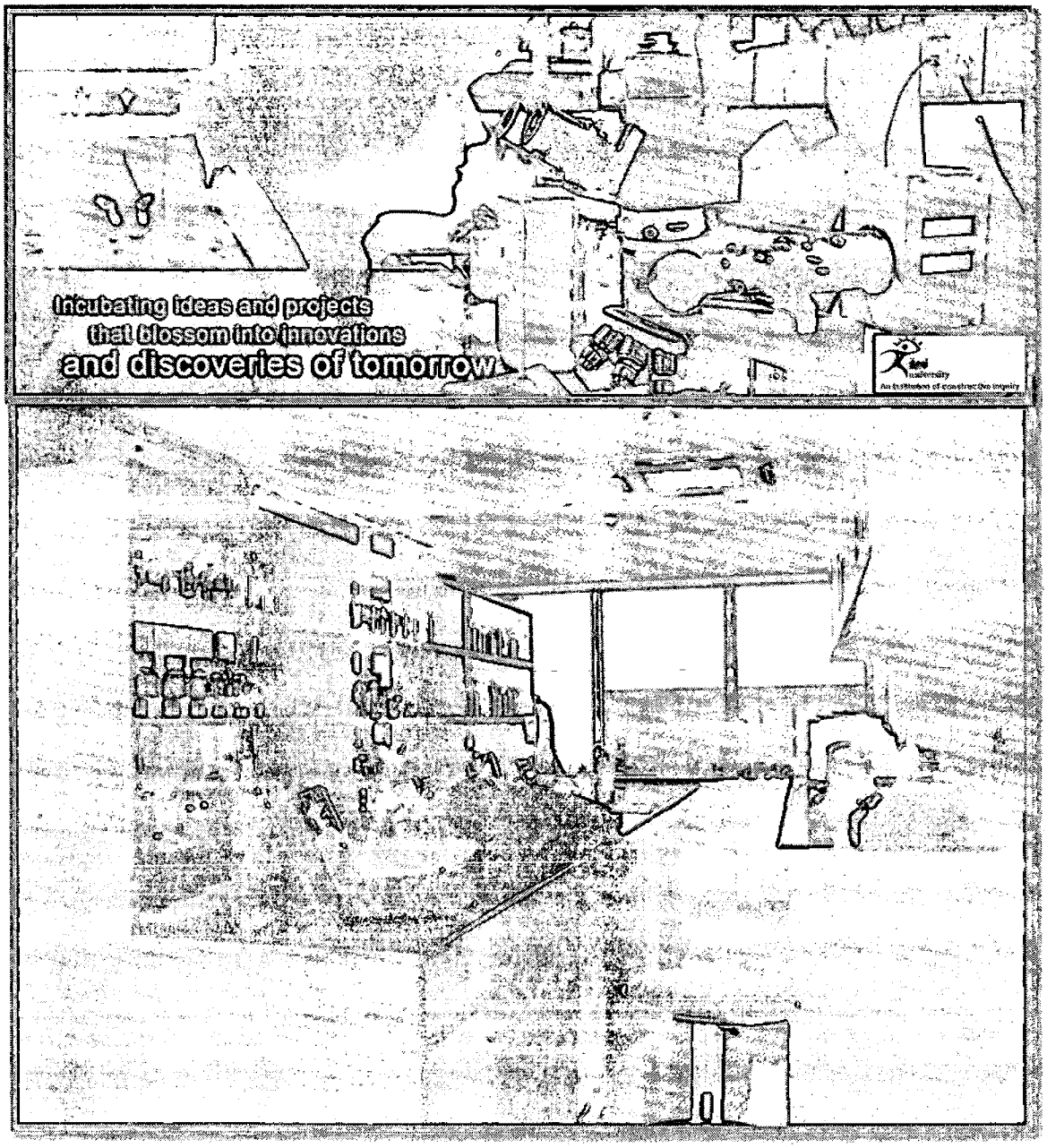


Figure 3.18 Lab spaces are well designed and naturally lit- TERI

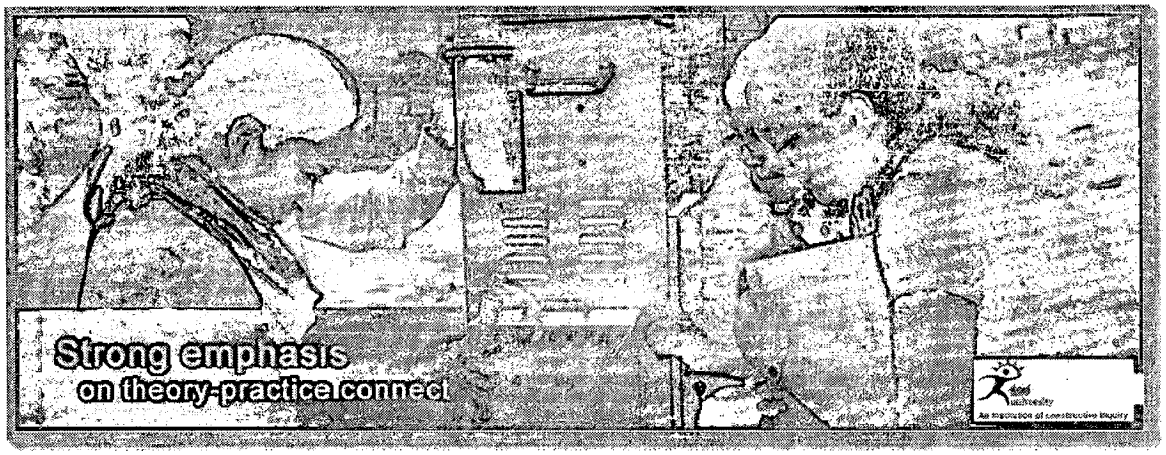


Figure 3.19 Theory-practice emphasis – pedagogy more hands on setting oriented

Computing Facilities: Imparting knowledge in the most hi-tech environment

- The TERI campus is inter-connected through a highly secured Virtual Private Network, where PCs are inter-connected to the internet.
- The campus has state-of-the-art computer centre that provide computing facilities comprising of the latest HP/IBM machines linked to a wide range of software, communication and print services.
- Campus is fully wireless and students in many programmes are can use laptops to help them access the world anytime, anywhere. The Intranet enables close on-line interaction between faculty and students for online interaction

3.4 WHITMAN SCHOOL OF MANAGEMENT/SYRACUSE UNIVERSITY, NEW YORK

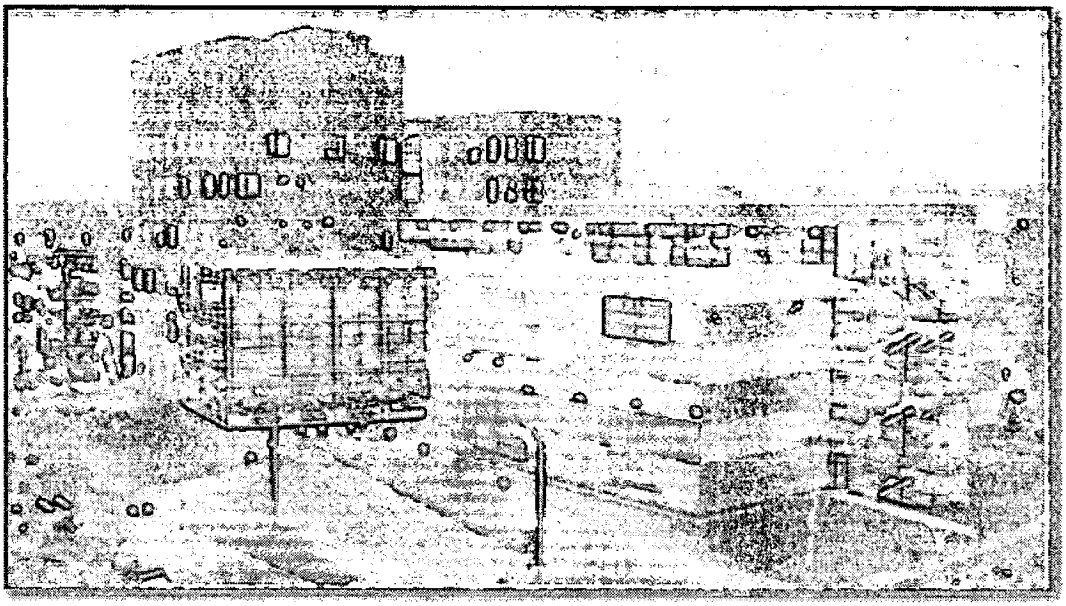


Figure 3.20 Whitman School of Management , New York

3.4.1 Design Narrative

This School of Management is the first major building project completed under this private University's new campus plan. The new 165,000 square foot building–a crucial step for the School [Figure 3.20] to enhance its competitiveness–contains classrooms, auditoria, ample space for team meetings and collaborative activity among its 1400 students, as well as dedicated distance learning facilities and executive space. The primary design element, a central communicating circulation corridor with a grand stair, maximizes program connectivity and daylight penetration of all the interior spaces. The design integrates the most up-to-date technology, including a sophisticated building management system, and allows flexibility for future developments, one of many considerations in creating a lasting, forward-thinking, and sustainable building for this School of Management.

The building includes: 22 classrooms / 200-seat auditorium / 20 team meeting rooms / undergraduate and graduate computer clusters / 11 centers and institutes / 12 student clubs and organizations / Career Center / The Lubin Visitor's Center. The School fosters a strong sense of community, with special study areas for undergraduate, graduate, and executive students help build identity and cohesion, while the Ilene and David Flaum Grand Hall, the Milton Room, the Olsten Café, and comfortable conversation areas tucked throughout the building encourage casual interaction among faculty, students, staff, alumni, and visitors.

The new building boasts many spaces for innovative and collaborative research, including: The Ballentine Center, with sophisticated software that prepares students for financial careers on Wall Street, and an integrated space for the school's endowed

research centers and institutes. Students, faculty, and staff of the School of Management enjoy learning and working in a building that is not only the jewel of the University campus, but is in many ways serving as a model for other business schools contemplating new construction.

3.4.2 Design Findings

Context: The building responds to the campus's recent expansion into downtown and forms a new gateway to the University. The diverse scale of the surrounding neighbourhood includes an 11-story hotel, an assortment of low- and mid-rise commercial and University buildings, fraternity houses, and a parking garage. To establish a new urban fabric, the project team separated the building into distinct volumes, each with its own function and expression, connected by a multi-level internal street - or "spine." This ensemble of three volumes and circulation elements creates a modernist brick, metal and glass composition that engages the scale and character of the surroundings and diminishes the stark contrast between the hotel and the main campus.

Pedestrian access and circulation: The primary entry point is situated near the center of the University Avenue street-front. Within a landscaped forecourt, a fan-shaped ramp draws the pedestrian traffic from the main campus up to the elevated first level, connecting directly to the spine. The circulation spine [Figure 3.21] unifies the composition, brings clarity and orientation to the occupants and, through its diaphanous façade, animates the building both day and night. Stairs extend the spine's glass enclosure beyond the volumes at the north and south ends. Designed to give identity to the exterior, a 4,000 square-foot multi-purpose glass atrium is the heart of the ensemble. Aglow with natural light and adorned with interior trees, the atrium provides an ideal lounge/study/special event area with a strong sense of place. At night, the atrium's transparency opens the building to the street, offering dramatic views of the campus and downtown.

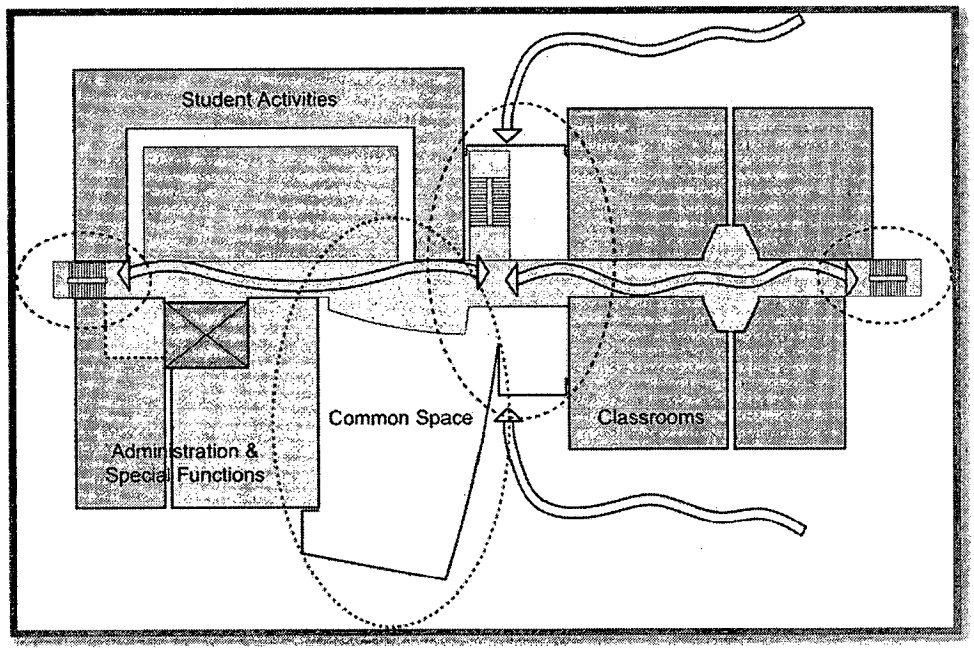


Figure 3.21 Scheme depicting circulation and zoning

Interior spaces: The finishes of the building balance a dignified corporate ambience and a free-spirited student learning environment. Elements of the building's structural steel frame are expressed throughout, creating an awareness of the building's "bones" and giving a sense of its integrity. The character of the central spine orients with day lighting at its center and ends, distinctive artificial lighting, a metallic ceiling, and a sparkling terrazzo floor. Each floor [Figure 3.22], with its own programmatic function, is colour coded at key entry portals and accent walls to enhance orientation and reduce the need for additional way-finding applications. Natural daylight penetrates nearly every space in the building with the emphasis on common and circulation areas; this creates almost a constant link to the outside.

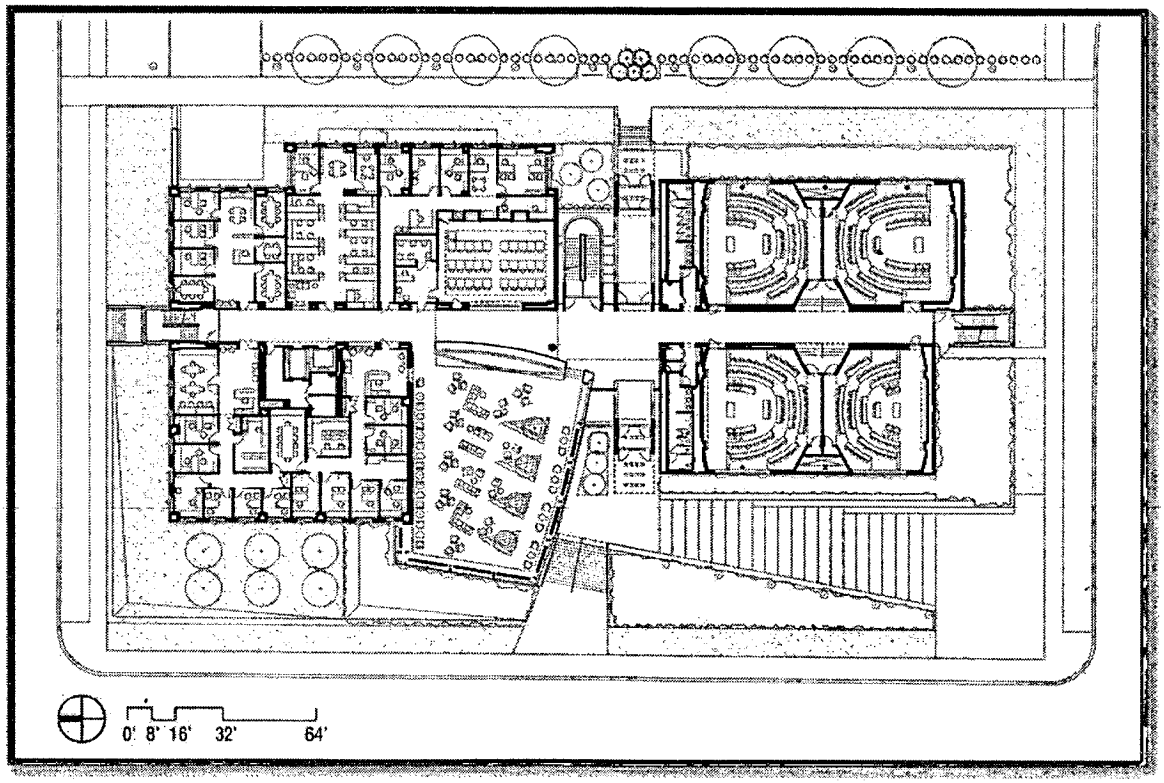


Figure 3.22 Floor plan

Teaching spaces: Expressing the essence of the building's function, the classrooms [Figure 3.23 & 3.24] are clustered in a volume as a "machine for teaching." This three /four-story element is set back from the street and framed like a jewel-box between the hotel and the masonry components of the ensemble. Straddling each side of the spine where students congregate between sessions, each classroom accommodates 35 to 75 students and is tiered in a horseshoe shape to facilitate interactive learning. A custom wood-panelled "teaching wall" creates a focus and framework at the front of each space while incorporating state-of-the-art audio/visual and IT equipment. Windows provide daylight into the four floors of above-grade classrooms. Dimmable lighting accommodates various modes of teaching, video projection, and broadcasting.

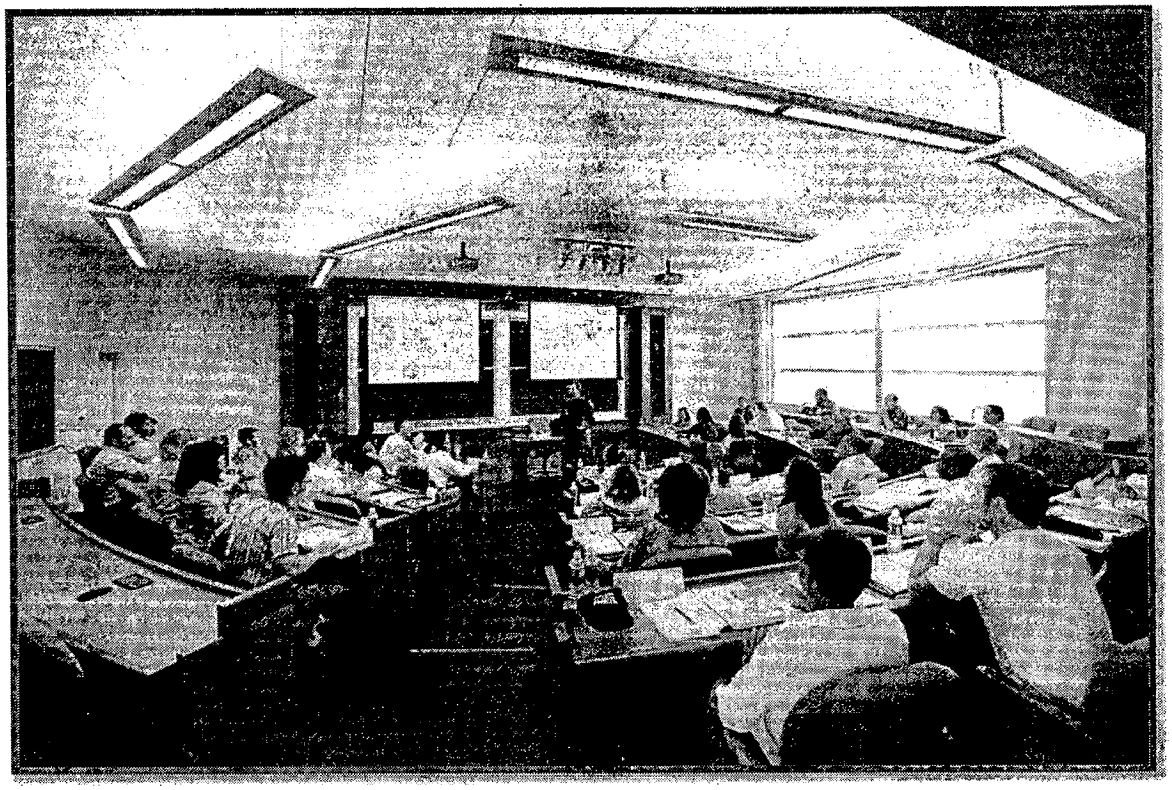


Figure 3.23 Case study room at the management institute

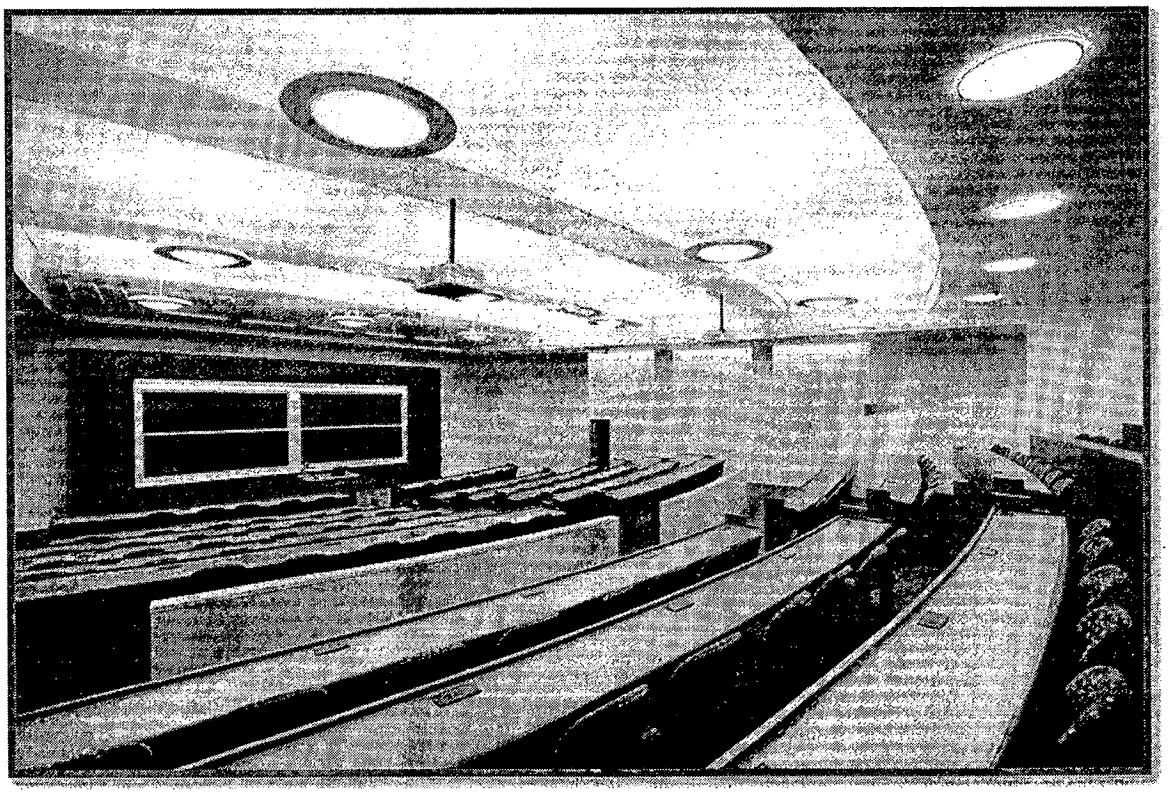


Figure 3.24 Lecture hall at the Institute

Programmatic concept: Each of the primary curriculum programs — Undergraduate, Graduate and Executive — occupies its own floor in the building. This includes administrative offices, student activity and breakout rooms, and classrooms. Common functions, such as the cafeteria and special teaching spaces, are interspersed on these floors to assure a degree of interaction between students of different programs. The faculty offices and support facilities clustered in the taller, masonry volume on the top two floors, provide calmness away from major activity and ensures camaraderie and communication between academic departments, while remaining accessible to students. The concourse and first floor levels provide spaces for reception and other common uses as well as classrooms shared with the University as a whole.

Sustainability: In addition to having a very high-performing envelope to minimize energy usage, the building uses right-sized building systems, under-floor air displacement in the classrooms, radiant cooling and heating in the atrium space, highly efficient air filtration and distribution and a sophisticated building monitoring system. All materials specified, such as carpet, paint, furniture and ceiling tiles have low-VOC content, and a high content of recyclable materials is used throughout. Construction and maintenance practices comply with the highest standards and to ensure that the building retains its sustainable quality throughout its life-time. The building is designed to adapt to changing social and academic needs, assuring its timelessness and relevance for the University.

3.5 UNIVERSITY OF QUEENSLAND

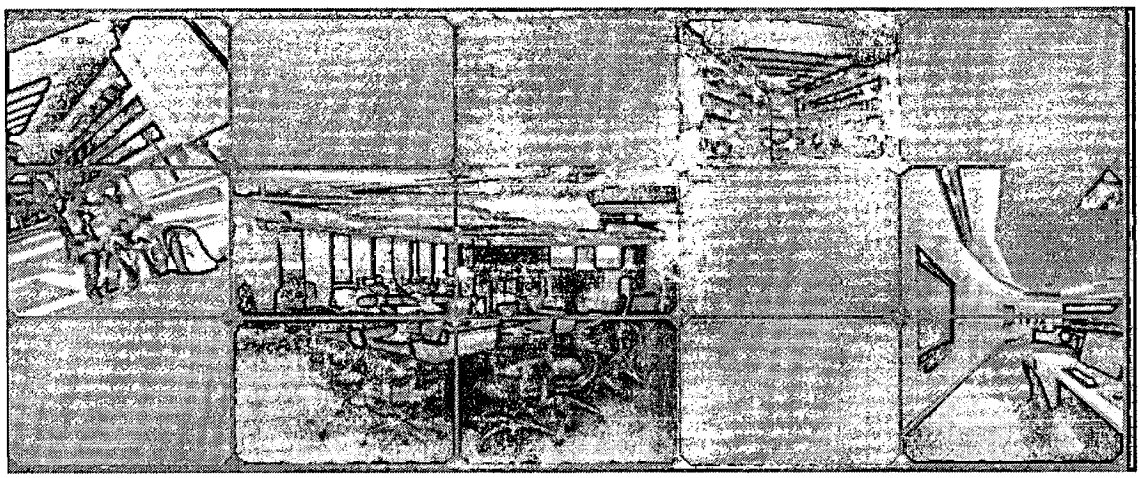


Figure 3.25 Queensland University- a peek into the learning spaces

3.5.1 Design Narrative

The University of Queensland [Figure 3.25] is one of Australia's leading broad-based, research intensive universities and is committed to the excellence of learning experiences and outcomes for its students.

A key objective of the University is to provide a high-quality learning environment that encourages independent learning and peer-to-peer interaction. To meet this objective, the University, in recent years, has invested in new teaching and learning spaces that are recognised as international benchmarks for excellence and innovation. Furthermore, it has supported the provision of advanced teaching spaces intended for multiple uses that incorporate formal and informal requirements.

The University's Advanced Concept Teaching Space (ACTS) Lecture Theatre in the $52 million General Purpose North 4 building on the St Lucia campus opened in 2008. ACTS has attracted worldwide interest with groups from Europe, the United States, the Middle East, and Asia visiting to study its unique learning concepts.

The Advanced Concept Teaching Space (ACTS) was conceived as a concept and technology demonstration space that would establish The University of Queensland at the forefront of research into Teaching and Learning infrastructure.

With 100 seats, ACTS has the look and feel of a modern lecture theatre but it also hosts futuristic IT and AV systems designed to maximise communication and interaction allowing new concepts in pedagogy and technology to be implemented, tested and evaluated with large student groups. This new facility boasts teaching technology not expected to be commonplace elsewhere for at least a decade. ACTS, which has been funded from the Australian Commonwealth Government's Learning and Performance Fund, has a major role to play in meeting the goals of The University of Queensland's Teaching and Learning Enhancement plan.

A key objective of this plan is to:

Enrich all aspects of the teaching and learning environment [and] continue to place a high priority on teaching space upgrades and the development of state-of-the-art teaching and learning spaces.

While ACTS is in itself a state of the art teaching and learning space, the lessons learned from its ongoing operation and evaluation will inform and direct the University's own practice when building and refurbishing teaching and learning space. It is also expected that ACTS will play a key role in enabling research into new pedagogies, new teaching technologies and teaching space design. ACTS is squarely aimed at advancing the pedagogy of one-to-many teaching; lectures and seminars.

ACTS [Figure 3.26] uses new technology to maximise the opportunities for interaction between teacher and students; amongst students and between students and the learning materials. A primary goal is to find ways to open new communication channels during teaching sessions. Crucially, this includes being open to integrating 'student-supplied' technology. Increasingly, students are using a variety of technology in their lifestyles and learning, and ACTS explores ways to integrate this using wired and wireless networking and direct USB connection.

Figure 3.26 Advanced Concept Teaching Space

The goals of ACTS are:

- Identify the best emerging technology and test it in real teaching situations
- Use the lessons learned to improve future lecture theatre design and optimise the use of technology in these spaces
- Create opportunities for research into tertiary teaching
- Use the lessons learned to inform and direct the University's own teaching practices

• Provide the possibility of developing intellectual property in the systems and technology implemented in ACTS

ACTS will be a laboratory for teaching technology and is capable of rigorously evaluating each new practice. It will allow the best emerging technology to be tested and adopted into mainstream UQ teaching spaces.

3.5.2 Design Findings

Pedagogy: While the University has rightly attracted plaudits for its pioneering work in creating spaces tailored for teaching using collaborative modes, it has been recognised that teacher-led instruction (such as the lecture format) remains a crucial and much-used pedagogy.

ACTS proposes to explore what can be done using technology to develop teacher-led instructional approaches within a university setting. At the beginning of the design process, the chairs of the UQ Faculty Teaching and Learning Committees were surveyed to determine the kinds of facilities and technologies that academics were most interested in for teaching. The process involved gauging the utility of current technology as well as soliciting reactions to a list of evident future trends in teaching technology.

The academics were also asked about the amount of time which they consider reasonable for the preparation of teaching aids and materials (such as PowerPoint slides, polls and other in-class material) and the utility of real-time feedback from students in class. At each stage, additional comments were sought and open-ended questions probed for new ideas.

The pedagogical ideas and reactions to trends which emerged were used to inform the design and provide an initial roster of technology features. The suggestions were evaluated in terms of improving or opening new channels of communication and these were organised using constructivist principles. Three kinds of interaction are important in this regard: between students and other students; between student and teacher; and between students and the learning materials. As a result, the features and technologies in ACTS aim to open new channels of communication and to permit new kinds of interactions to occur during class sessions. Some aim at making it practical for teachers to gain extra feedback from students, some allow for student to student interaction during class and some new ideas are aimed at providing new ways for students to interact with the learning materials.

Teacher-Student Interaction: Clearly, there is still a role in teacher to student interactions for the use of a projection screen and consideration was made in the space design for this to be a prime element but attention was also given to ways of enabling a 'back channel' from students to teacher. Activities in this axis included instant polling which enables students to vote on questions, encouraging involvement and also providing teachers with immediate feedback on student understanding of key concepts. Other techniques identified as worthy of trial included anonymous interaction in the form of

submitting questions via instant messaging which may allow teachers to better manage queries without interrupting the delivery of material.

Figure 3.27 New channels of communication and to permit new kinds of interactions to occur during class sessions.

Student-Student Interaction: Academics consistently identified a need to allow students to break into small groups for short periods to discuss matters raised in the presentation and to become active in their participation. With this in mind, attention turned to how the traditional (and space effective) tiered seating could be adapted to allow ad-hoc small groups to form.

Student Interaction with Learning Materials: Consideration of this axis led to a number of possibilities for improvement. Students should ideally be able to record and annotate the materials being presented and perhaps be able to access different 'layers' of content which has been prepared in advance. It seemed likely that if students were given individual displays, then facilities like translation [Figure 3.27] and access for visually and hearing impaired students may also become more accessible and effective.

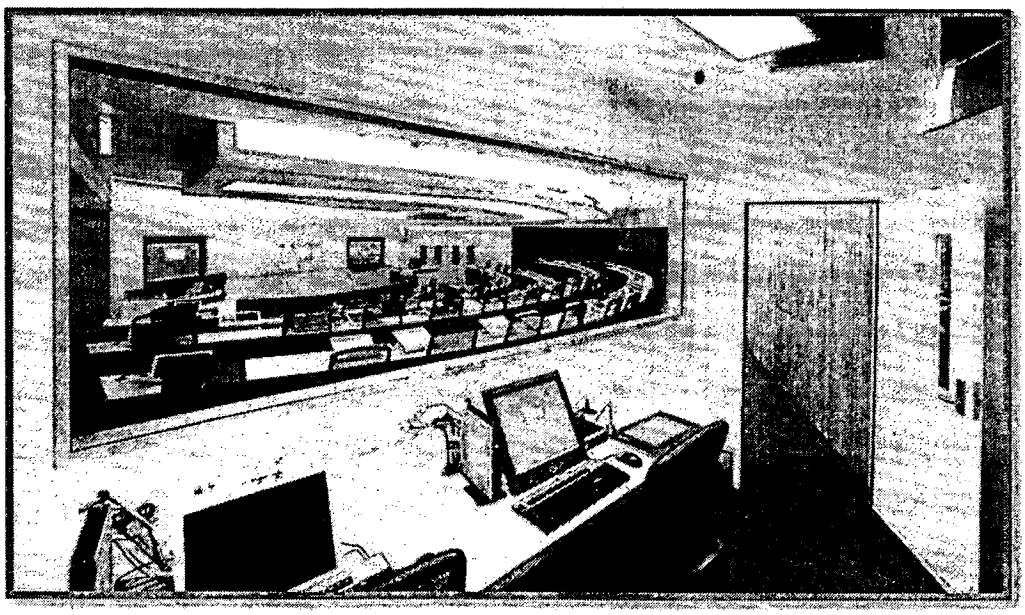


Figure 3.28 The Techno-classroom

Space: ACTS is situated on Level 1 of the General Purpose North 4 (GPN4) building designed by Richard Kirk Architect and ML Design (in association). The space contains several novel elements in its specification. Before construction, and after extensive consideration of the kind of activities required, the general arrangement of the space [Figure 3.29] was documented by Hamilton Wilson (Wilson Architects). This generic plan became the basis for the detailed design work carried out by Richard Kirk Architect.

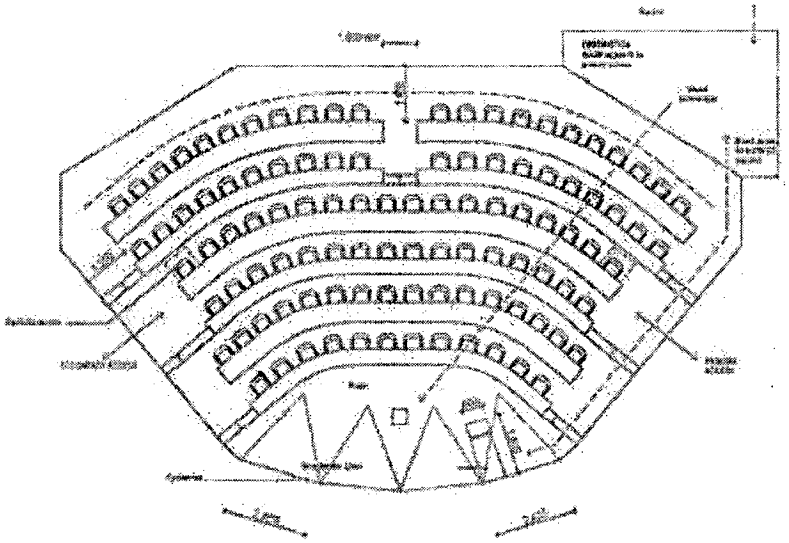


Figure 3.29 Scheme layout of the Lecture hall

In planning the spatial aspects first considered the pedagogy, which was determined to be primarily a lecture profile, with the didactic mode taking up 80% of the time. The cohort in this mode was to be 100 students. The remaining 20% of time was considered to be available for small group discussion with a cohort of four.

In response, the design specified a tiered theatre but with a double row of desks per tier and swivel chairs on castors. This would allow collaboration between groups of four with two in each row of the double tier. To accommodate this, the rear desk was made wider and the desktop tablet displays were mounted on swivels. In addition, care was taken to provide an adequate circulation zone.

The Teaching Stage: The teaching stage was laid out to be as flexible as possible with two 'lecterns' (one either side) and three screens for displaying content to the class. Two of the screens retract to reveal plasma displays which function as electronic whiteboards. Care was taken to provide monitors at the front of the stage so that the instructor could view material on all three screens without needing to turn their back on the audience.

Observation rooms: Since research into teaching methods and technology was a prime function of the space, a spacious observation room was provided at the rear of the room. Wide windows and access to video cameras allow researchers to carefully monitor how students use the various technologies provided. In addition, the observation room has

a duplicate computer and control system to allow an operator to assist in complex presentations.

Technology: Although the 1500m² ACTS has the look and feel of a traditional lecture theatre, it hosts futuristic systems [Figure 3.30] designed to maximise communication. This includes a number of specific directions for researching new ideas and infrastructure in the lecture setting.

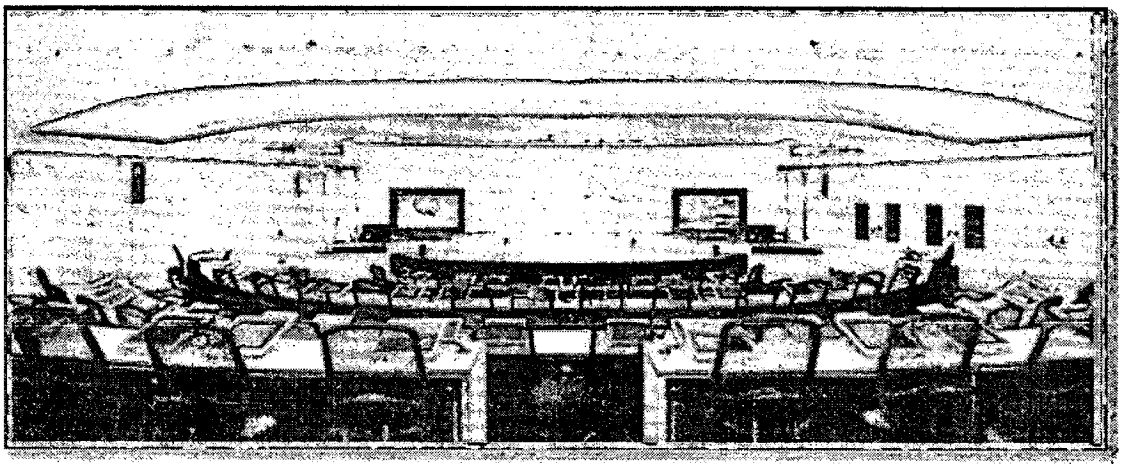


Figure 3.30 The ACTS hosts futuristic systems designed to maximise communication

Audio-Visual in ACTS: *Advanced Control Systems:* The emphasis of the automated control system is its ease of use and a design philosophy that places the needs of the teachers first. A primary goal is to have all of the hardware and software systems controlled from a single AMX touch screen interface. Touch screen buttons will not only control hardware like switchers but will also 'reach through' the computer operating system to launch specific features within a software program on the attached PCs. A single button press will be enough to launch an instant poll on the student touch screens, or to launch translation software that will render a PowerPoint file in six different languages. When the PC is displayed on screen, the touch screen can function like a mouse so that individual browser links, when displayed on the monitor, can be launched by pressing with a finger. In a first for this kind of technology, AMX Anterus RFID identification tags are used to set preferences in the control system so lecture setup can be automated. Instead of a log-in password, academics may carry an RFID badge so that as soon as they enter the space, the control system will recognise them. The AMX controller will be programmed to 'learn' the individual preferences of each identified user and quickly set up the room to reflect their needs.

Information Technology in ACTS: A major technology innovation has been to place a tablet style PC interface at each seat. This has been achieved using a pen driven tablet which communicates via a networked thin client to a rack mounted array of over one hundred HP blade PCs. The PC technology in ACTS is based on Hewlett Packard's Consolidated Client Infrastructure, a technology that combines server style reliability with high level desktop performance through the use of HP Remote Graphics software.

As there are no moving parts in the Thin Client devices, this also creates a silent environment for teaching.

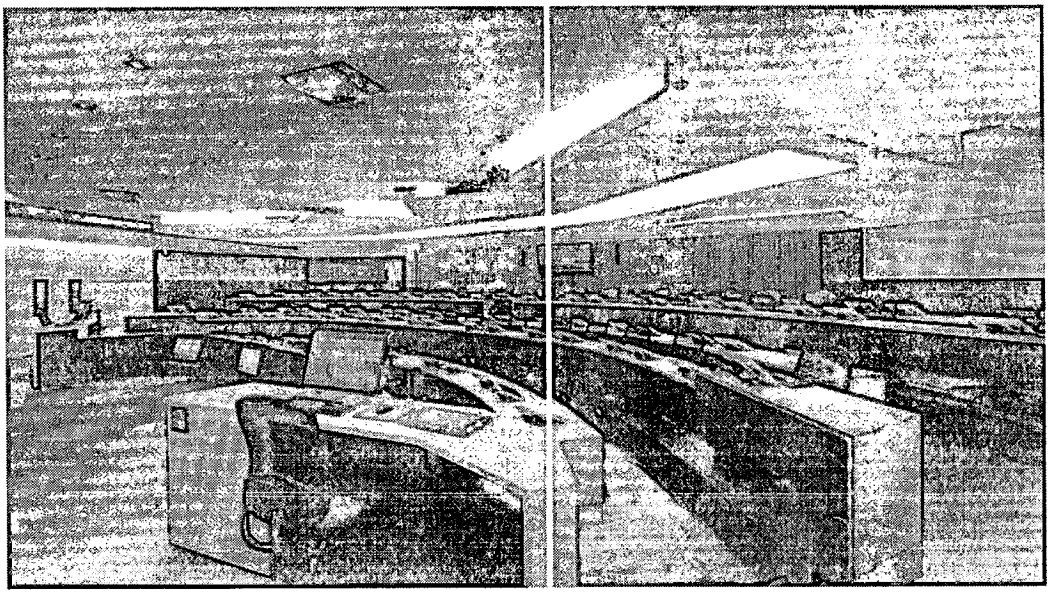


Figure 3.31 IT in ACTS- tablet style PC interface at each seat

The student interface [Figure 3.31] which combines a HP Thin Client with a Wacom 15" tablet gives the user uniquely flexible control over the educational software environment. The student touch screen functions both as a display and as a control/response system allowing a host of innovative services, which can be tailored to each teaching requirement:

- Look ahead and review
- Polling and voting responder
- Enable anonymous questions
- Download to disc
- e-Learning system integration
- Automated language translation of PowerPoint slides
- Information capture for research

ACTS systems allow students to self-guide through lecture material and to review and preview content, or branch off into specially prepared supplementary material. Students are provided with language support in the ACTS through an automated translation system that allows students to instantly search for unfamiliar terms.

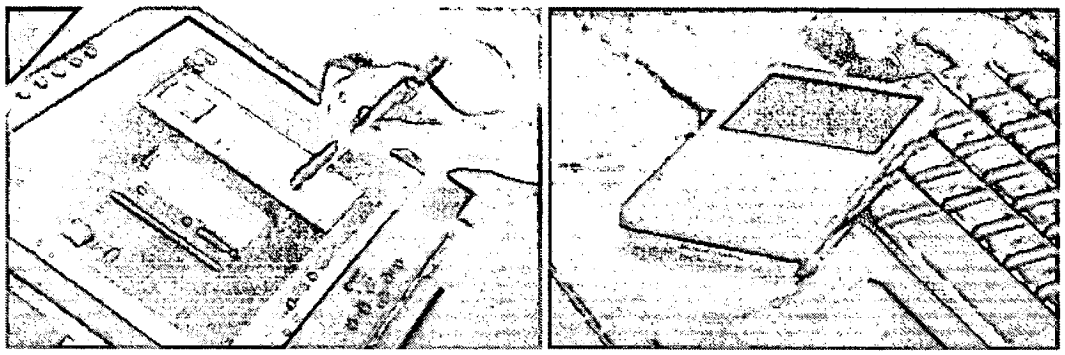


Figure 3.32 Integration of portable devices

Integration of Portable Devices: A primary goal of the experimental systems in ACTS is to allow students to use whatever technology [Figure 3.32] they prefer in their learning – from iPods to PDAs, mobile phones to laptops. An important part of the project will be to research and test a variety of ways in which students can use these portable devices to participate in class activities.

• Assignment work, brought to class can be uploaded so it may be displayed via the projectors for class comment and discussion

• Portable devices, connected via the network or USB can be used by the students to participate in polling, or to share applications

• Using various software options, recordings of lectures may be made available to students, complete with graphics. By capturing content from electronic whiteboards and graphics tablets 'worked examples' (including handwritten formulae) can be recorded as they happen to allow student review at a later date

• Other content such as readings, references and more can also be downloaded, saving time and resources and enriching the learning experience.

Innovative Lighting Design: Lighting is used not only to direct attention and enable note taking, but as a deliberate artistic design element to inspire and motivate. The award winning lighting design by Jared Lilywhite of Connell Wagner is flexible enough to cater for a wide range of applications in the space from lectures to conference sessions to d-Cinema film exhibition and beyond. Accent lighting highlights architectural features to produce a series of very distinctive looks which can be varied according to the time of day and the nature of the functions in the space at that time.

Enabling Research: Integral to the space is an observation room which also functions as a third control point. An identical 24" touch screen allows a technical aide to assist with smooth operation of the systems and provides full preview and monitoring from the same screen. Additional thin client facilities are networked into the student PC systems for researchers to observe and gather data regarding patterns of interaction and educational outcomes.

Innovative teaching & learning spaces

The University of Queensland has in recent years attracted significant attention from both within Australia and internationally on the quality of the teaching spaces being provided for staff and students.

Not only has it made major investments in dedicated spaces for novel pedagogies, but has also pursued an aggressive policy of updating and adding new facilities to existing teaching spaces of all kinds. Another focus [Kenneth, 1999], spinning off from the work on collaborative teaching and learning has been the growth of student learning centres – dedicated spaces for students outside of timetabled classes. ACTS is considered to be a capstone project to establish The University of Queensland at the forefront of research into Teaching and Learning infrastructure.

New Pedagogies: Collaborative Learning

The Collaborative Teaching and Learning Centre [Figure 3.33] (opened in 2005 in the Sir James Foots Building, St Lucia) is a world first in the provision of dedicated space for teaching in collaborative mode. The six CTLC spaces, ranging from 20 to 90 seats, foster collaborative approaches to teaching and learning, both internally in the small and large collaborative teaching and learning spaces and externally through the videoconferencing and access grid rooms. These purpose designed and built spaces offer the ability to teach using collaborative pedagogies that are impractical in 'traditional' teaching and learning spaces [Ken, 2003]. The novel architecture and exciting technology of this unique centre sparked national and international interest and the centre has been visited by literally hundreds of academics and administrators from more than sixty Universities. The initial spaces have been rigorously studied and evaluated and The University of Queensland has continued the development of innovative collaborative teaching spaces into further generations with the opening of spaces at the Gatton campus and in the General Purpose North 4 building at the St Lucia campus.

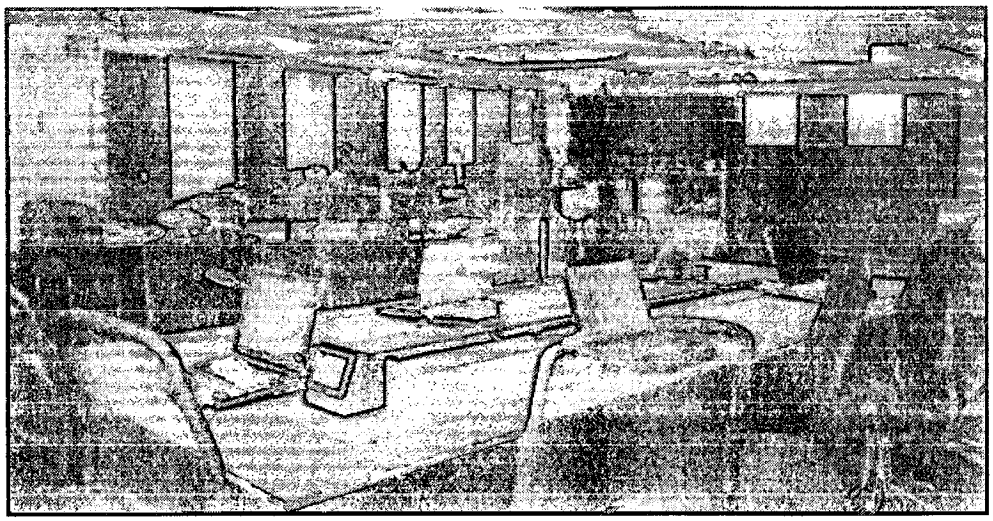


Figure 3.33 CTLC space foster collaborative approaches to teaching and learning

Student learning spaces

Lessons learnt from the evaluation of the CTLC (Collaborative Teaching and Learning Centre) have also informed the design of a number of other original, student focused learning environments.

These spaces, used for independent and group oriented study and assignment work, have been developed within Faculties and Schools [Figure 3.34] to serve particular cohorts and also incorporated into libraries such as the newly refurbished Biological Sciences Library.

The first student learning centres were dedicated to first year Engineering and Science students respectively with centres for Chemical Engineering and Journalism under construction and more planned.

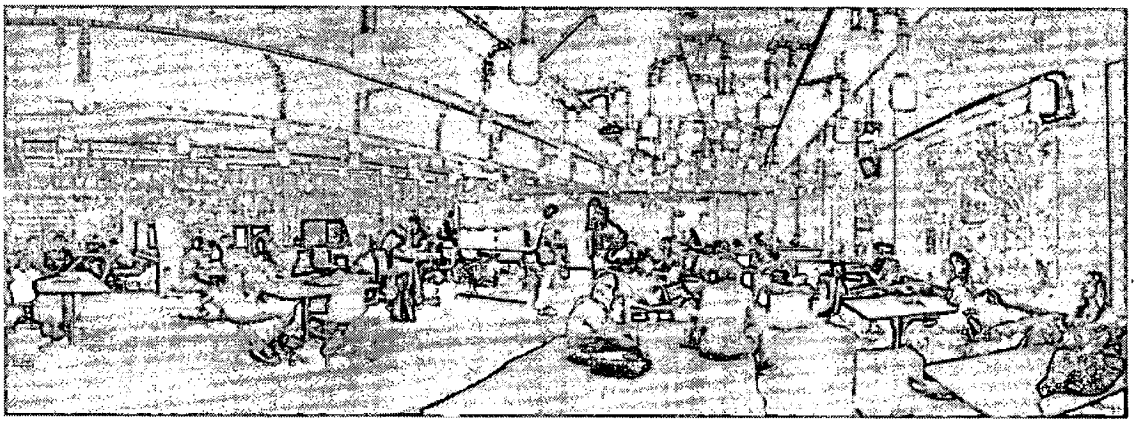


Figure 3.34 Spaces used for independent and group oriented study and assignment work, have been developed

Continuing Refurbishment of Teaching Space: The more than 160 centrally timetabled lecture theatres and seminar rooms are carefully maintained and refurbished when needed, usually on a 12 year cycle. Major spaces which have been completely refurbished in the past four years include raked theatres in the Social Sciences, Anatomy and Engineering buildings as well as the classic 360 seat Abel Smith Theatre. Special care is taken to sensitively treat teaching spaces in the heritage listed buildings of the Great Court precinct and these spacious, high ceilinged rooms have become showcases of modern teaching technology and space design. Standards for AV and IT fit-out of teaching spaces are reviewed every three years and current standards provide for wireless internet access, lectern PCs, data projectors and integrated control systems in all centrally timetabled rooms. Between refurbishments, a rolling four year program of regular replacement of key technology such as PCs and data projectors keeps the rooms up-to-date.

Practical Teaching Spaces: Specialist teaching spaces, such as laboratories, are the responsibility of the faculties. The first-year Chemistry laboratories and the newly built Counselling Practice rooms in the Chamberlain building are outstanding examples of purpose built practical spaces. Gatton campus is about to undergo a massive expansion

with new Veterinary anatomy laboratories and the innovative Gatton e-Learning Laboratory already in design stage.

New Facilities in Teaching Spaces: Major new capabilities added to several existing central teaching spaces include intercampus Videoconference teaching spaces (between Gatton and St Lucia) and a comprehensive and integrated lecture recording system. Phase I of the lecture recording system, installed in 2007, serves the 13 largest theatres with a combined capacity of around 4,000 students. Both screen content and voice can be recorded and automatically made available to enrolled students in a variety of formats for replay on PC, iPod and so on. Following careful evaluation and an on-line survey of over 1000 students, an additional 25 lecture spaces will be progressively equipped in 2008/9.

3.6 KEY LESSONS FROM THE CASES

The significant case studies give an idea on the various aspects of design for learning spaces. Flexibility and spaces adaptable to multi-pedagogical methods are crucial and played a vital role in design in most of the cases. Integrating technology into these spaces has also been attained efficiently. The designs in each case gave room for teachers and students to breathe and work collaboratively and learn effectively. The overall concept learnt is to develop areas that keep educational issues, learning experiences, and the role of technology and information resources at the center of space plans. The basic premise is that the effective design of learning spaces can facilitate student engagement, and thereby enhance teaching and learning.

Another interesting lesson is that the Learning Studio model has emerged to replace the traditional "**space-challenged**" classroom. It features flexibility, collaborative social interaction, integrated technology, comfort and ambiance, and facilitates engagement between teachers and students. The new learning environments in each of the cases discussed feature flexibility, space for collaborative and social interaction, integrated technology, comfort, and ambiance.

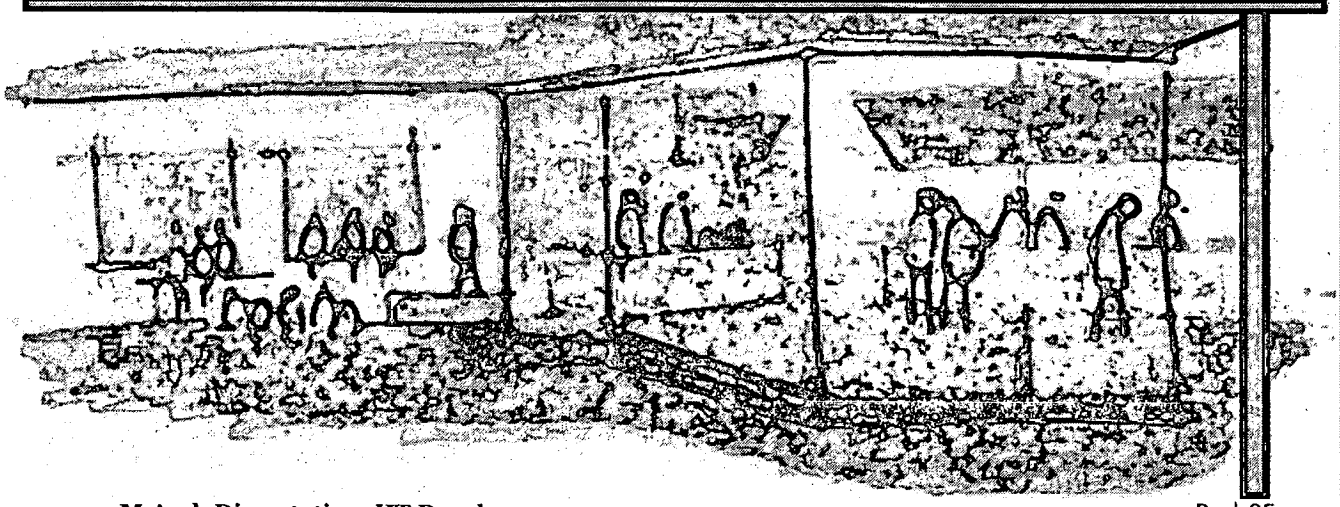
Based on the ideas or design finding findings generated from case strong themes can be identified for design and hence a "vision" can be developed to guide the development of learning spaces in the new generation institutions, as a declaration of a shared sense of purpose, to express ideas about how the designer views the learning space to be created.

3.7 SUMMARY

Through the analysis of the various case studies, an understanding of the various approaches and aspects to learning space design is attained. An idea on the different parameters to be considered for an effective learning experience is also obtained. The next chapter discusses about the study area, Indian **Institute of Technology, Gandhinagar**.

4.0 CHAPTER

STUDY AREA: IIT Gandhinagar



4.2 SOCIO-ECONOMIC & CULTURAL ASPECTS

4.2.1 Socio-economic aspects

Parameters	Gujarat
Capital	Gandhinagar
Geographical area (sq km)	196,024
Administrative districts (No)	26
Population density (persons per sq km)*	258
Total population (million)*	50.7
Male population (million)	26.4
Female population (million)	24.3
Population growth rate 1991-2001 (%)	22.7
Sex ratio (females per 1,000 males)*	920
Literacy rate (%)*	69.1
Male (%)	79.7
Female (%)	57.8
Life expectancy at birth (2006-10) Male (years) Female (years)	 67.2 71.0

Source: Socio-Economic Review of Gujarat, 2007-08
*Census 2001

Table 4.1 Socio-economic facts of Gujarat

4.2.2 Cultural aspects

There are four groups of people who came to inhabit this land at different points of time and now form the majority here. Jats came from a place in Iran called Half (to be known latter as Jat) and they were herders by occupation. Around five hundred years ago they came to Kutch and Sind in search of new grazing pastures and settled there. Those who joined agriculture called themselves Garasia Jats and those who continued their ancestral occupation were known as Dhanetah Jats, and those who chose to study the Koran became Fakirani Jats.

The Harijan is the name given by Mahatma Gandhi to the Meghwals, who originally came from Marwar in Rajasthan. They are the masters of weaving cotton and wool as also embroidery and appliqué work. The Ahirs came with Lord Krishna from Gokul in Uttar Pradesh.

Most of the communities of Ahirs began with selling ghee and milk and are now spread all over the state. Crafts in Gujarat are a way of life, a process that transforms even the most mundane object of daily use into a thing of beauty. The skill of the Gujarati craftsperson-be it a weaver or a metalworker, a woman who embroiders for herself or a potter who creates pieces of art out of clay-is bound to leave one spellbound. Wood carving is another important craft in Gujarat, evident in the many elaborately carved temples, havelis (mansions) and palaces as well as objects of daily and ritual use. Utensils are another area where the crafts persons of Gujarat have excelled. Gujarat is also famous

for its terracotta work, especially votive terra-cotta figurines which one can find by the hundreds at small shrines built in forests, along roads, outside villages, on lonely hill-tops and under large trees, especially in south Gujarat. Jewellery is yet another fascinating craft in Gujarat. Each tribe or clan has different types of ornaments and each of them has retained the uniqueness of these ornaments.

Performing Arts and Culture form an important means of expression of the Indian ethos. Different states practice different dance forms, classical music and have their own share of folklore. Programs are organized to showcase these performing arts and artists, who have kept these age old art forms alive, through their practice of it. The Performing arts in Gujarat are some of the most colourful and the performers in question are great exponents of their specialized arts. The different regions of Gujarat come alive, especially during Navratri, which is considered to be one of their prominent festivals. Many forms of dances are performed during this time, which are steeped in the fragrance of legends and romance – Raas is one of them.

4.3 ARCHITECTURAL CHARACTER OF THE AREA

Gujarat had evolved a very rich and unique tradition of architecture and sculpture that had attained fame all over the country and attracted notice from foreign visitors. Hindu and lain architecture had reached the pinnacle of perfection and artistic excellence between the 11th and 13th centuries as evidenced by some of the finest and most exquisite specimens of Gujarati architecture that flourished during the Solanki and Vaghela period.

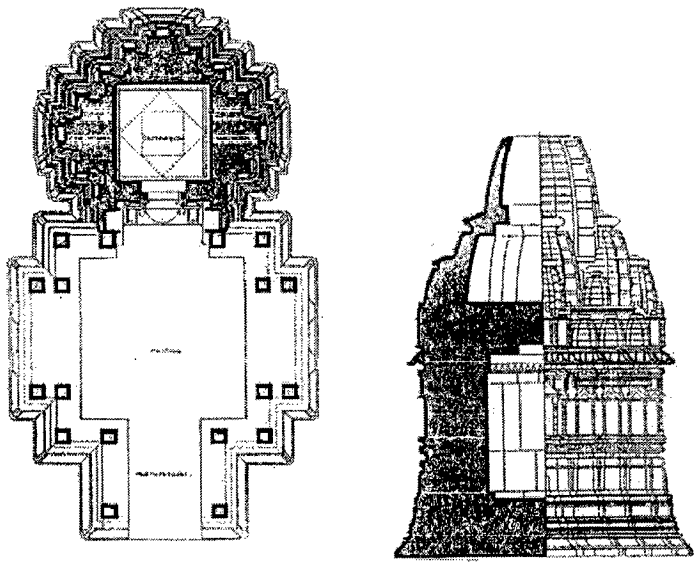


Figure 4.2 Shiva Temple at Sander near Mehsana in north Gujarat is a small but important example of 11th century Solanki period architecture of Gujarat

The beginning of all the flourished in Gujarat is to be traced to temple architecture, which developed under the patronage of successive rulers who constructed some of the magnificent shrines of the time. Rudramahalaya at Siddhpur, Maha Meru

Prasad at Somnath, Surya Mandir or the Sun Temple at Modhera and the marble temples at Mount Abu and Kumbharia were constructed and adorned by the same motif of ornamentation in design and form. Later, when Gujarat came to be ruled by the Sultans, Mughals and Viceroys, the Saracenic influence came to be powerfully felt. While the Muslims in India adopted all the forms of art and architecture that were basically indigenous, certain innovations to suit the tenets of Islam were introduced in the structure they erected through the local craftsmen.

The process of assimilation which was, thus, at work evolved in Gujarat a truly synthetic style of architecture unique in details of ornamentation and decorative art.

The style of architecture which developed in Gujarat during the Muslim period was unquestionably the most beautiful of the provincial styles of Mohammedan architecture in northern and western India. It differed largely from that evolved in northern India, where large and majestic structures were erected by the Mughals on a vast and extensive scale. Though Gujarat was content with structures of modest dimensions they were marked by a high degree of perfection in their execution and artistic excellence. The device of introducing light and air through perforated screen and window, tracery with panels ornamented by a rich variety of geometrical and floral designs were unique. The subdued light and coolness in the entire atmosphere, it produced, were at once pleasing and soothing. Ornamentation of various parts, minarets, balconies, domes and niches was superb and matchless in richness of details and artistic elegance. The shaking towers of Ahmedabad are still the wonders of the world. Forts, palaces, temples, mansions, mosques, mausoleums, Artistic Carving of Idols on Stone gateways and step-wells which exist to-day in and around Ahmedabad are the vivid memories of the skill and dexterity of those who executed them.

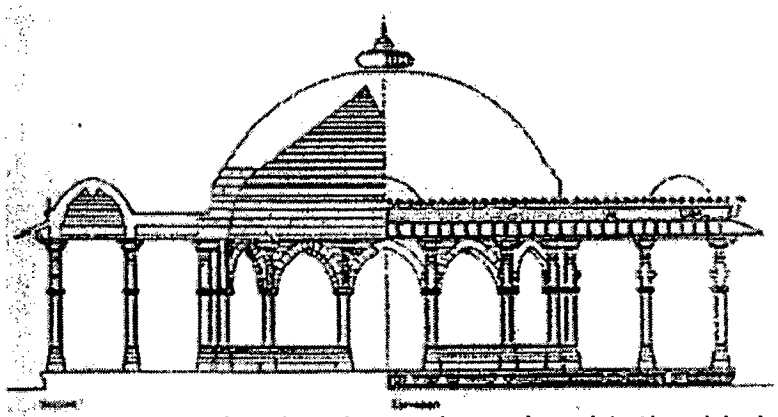


Figure 4.3 The period of Muslim rule Sayeed Usman's tomb in Ahmedabad

The post independence era in India brought in European masters to infuse new spirit in traditional but changing society awaiting new revival through a united country. Englishmen while working lately in India were guilty of neglecting the local traditions and not being able to revitalize the evolutionary trend for its upgradation. In their later efforts, English architects saw "the germs of a movement becoming observable, which suggest that a trend in the direction of reviving the styles of architecture indigenous to India is in contemplation, and it is hoped that some genius will arise who will combine the beauty and the spirit of the old national art with the methods and ideas of the new

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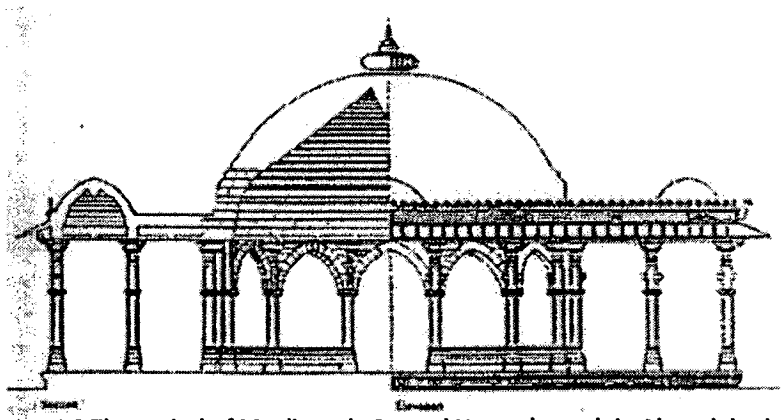

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age." But this was not the thinking of the new leadership of India at the time of independence. It was still necessary to look west for progress. And the masters invited to plan an Indian city and its 'democratic' institutions - to inspire the India of future. These masters did not believe in what English architects, after years of their experience in India started believing in. New masters planted ideas of modern movement, which were not acceptable to even the progressive westerners - the new expression - the alien one - in new material which was industrial - and an environment which did not induce any cohesion - were all untenable but in vague as it got patronage from those leaders who suddenly became benefactors of people at large and took the community at large as their subjects, as only the feudal lords would do. However, this was going to be the 'universal' vision of built environment and architecture of future for India.

Figure 4.4 Ahmedabad old city of 17th century onwards exemplify the collective communal life style

Gujarat progressive as always in absorbing new currents had nobility, which got convinced about this new idea and was instantaneous in inviting these masters to give new expression to institutions. By then city authorities and the merchant associations were powerful patrons and the new cultural institutions promoted by them were awaiting new, modern expressions. Advent of the modern architecture in Gujarat in 50s was almost contemporary to what was happening in Chandigarh. And Ahmedabad already got a major share of Le Corbusier's projects in terms of private houses and institutions, the similar number he hardly built anywhere in a single city even in Europe.

The modern architecture - individualistic, different, universal and stating designers' will lifted ego of the patron. Its total aloofness was seen more as a virtue rather an aberration from indigenous. As work of architecture of another culture these buildings represented qualities of individuals in its making, but the type of format it offered for

usage had no basis excepting fulfilling function. This did trigger off series of influences in the field of architecture and instantly following developed in terms of younger generation, Indian architects claiming western leanings and associations with masters and modern movement- followers followed and the scene of the architectural field went on getting disoriented as none of the works that followed had seriousness and promise of either new interpretations nor attitudes, which ever appreciated real needs of people at large. The new industrial material introduced by modern masters became the only acceptable material without ever acquiring the back-up technology that went with it. Local crafts were completely sidelined. Building activities became labour oriented (as against craft) and the processes became more and more detached. Architecture as an art was getting replaced by building as trade.

4.4 CLIMATE OF THE PLACE

Gandhinagar has a monsoon climate with three main seasons: summer, monsoon and winter. The climate is generally dry and hot outside of the monsoon season. The weather is hot from March to June when the maximum temperature stays in the range of 36 °C (97 °F) and 42 °C(108 °F), and the minimum in the range of 19 °C (66 °F) and 27 °C (81 °F). It is cool but never really cold From November to February, the average maximum temperature is around 29 °C (85 °F), the average minimum is 14 °C (57 °F), and the climate is extremely dry. The southwest monsoon brings a humid climate from mid-June to mid-September. The average annual rainfall is around 803.4 mm (32 inches).

4.5 SITE DETAILS

The site for the IITGn campus is located at Chandkheda, in Nasmed village in Gandhinagar district, 35 kms approximately from Ahmedabad. The 608-acre site selected is close to Thol Lake.Sabarmati river flows adjacent to this site.

The site extent is 608 acres. However the stretch is divided by the Palaj village which comes within the entire site. Hence the constraint in design is that the entire stretch would be divided into two sections. On one side of the site the river Sabarmati flows and hence a 60m setback would be applicable along the river side. The major area of the campus development could be on the left section.

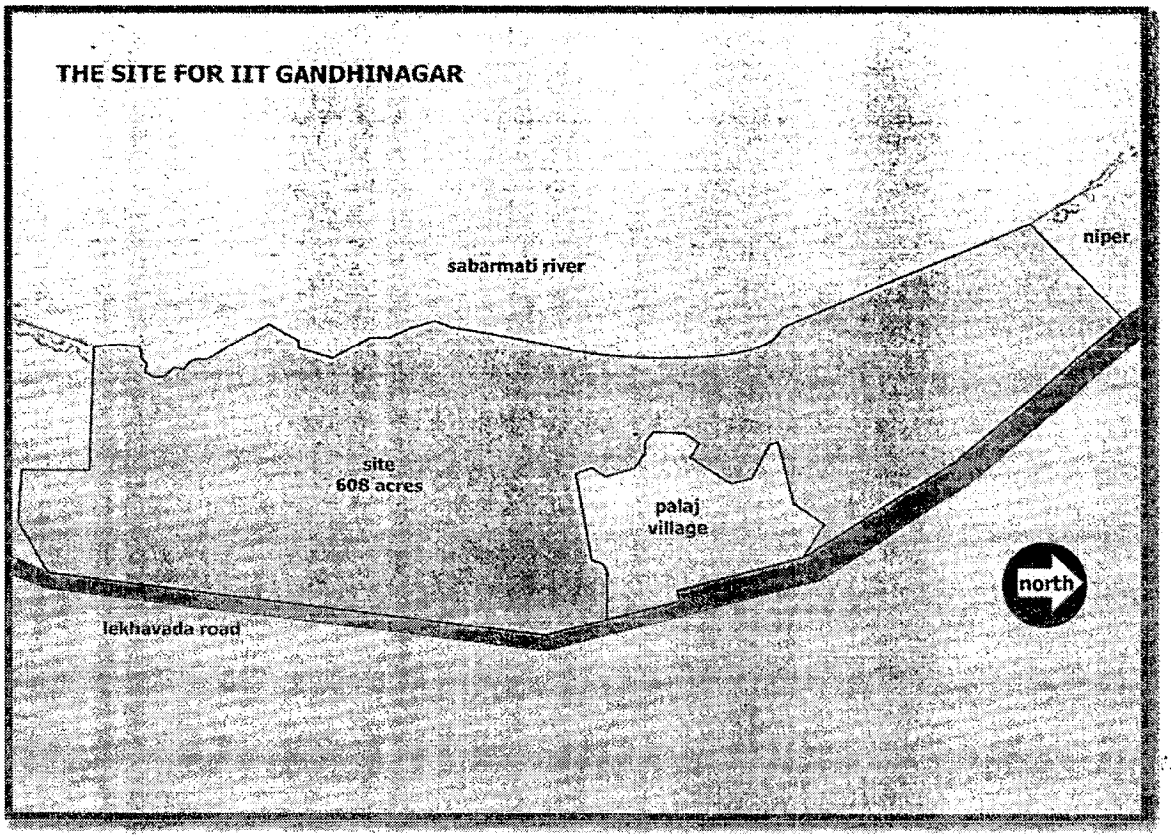
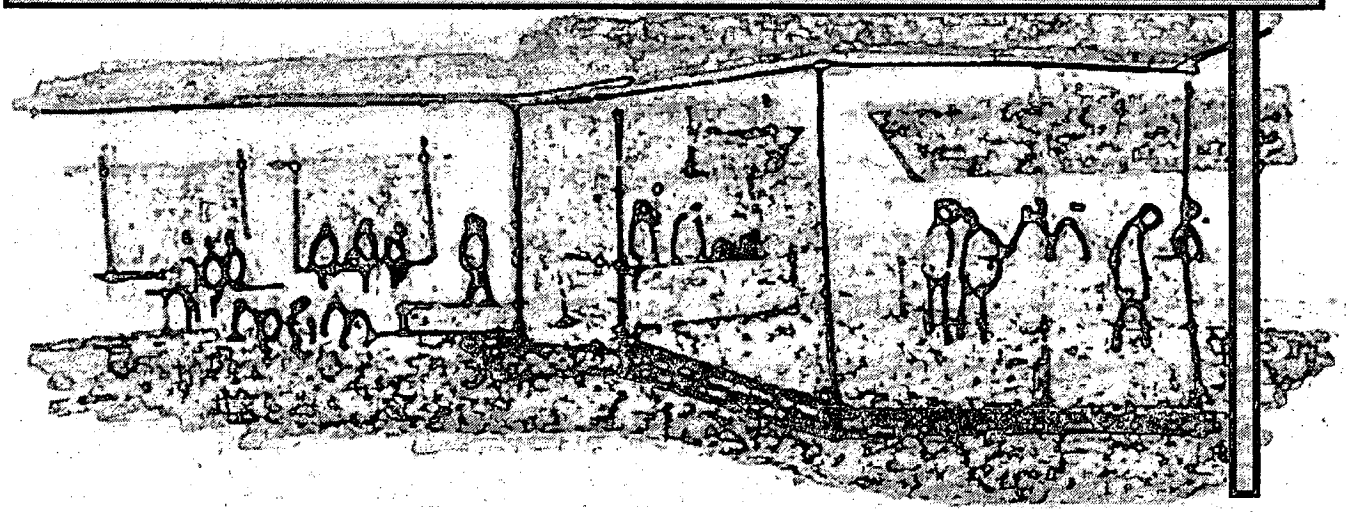


Figure 4.5 Site plan for IIT Gandhinagar campus

4.6 SUMMARY

The study area has been discussed in this chapter. The next chapter analyzes the data that has been collected, both secondary and primary to develop an analysis model that forms the basis for formulating the design guidelines for formal learning spaces.

5.0 CHAPTER
ANALYTICAL MODEL DEVELOPMENT



is necessary so that we know the existing campus learning spaces so that we can identify the strategies for design effectively. The final stage is the ***Strategy development*** where the strategies on which the design guidelines evolve are identified and guidelines formulated on its basis. The steps involved in the model and the method of analysis and its outcome has been summarized in the table below.

STAGES	ANALYSIS METHOD	OUTCOME
Vision formulation	Vision framework : core theme & key enablers' matrix.	Identify the design implication and thus the needs.
Need Assessment	Critical analysis of the cases , space inquiry surveys, personal interaction.	Identify the palette of formal learning spaces. Identify " strategy filters"
Strategy development	Use of " strategy filters "	Design criteria based on the identified filters.

Table 5.1 The steps in the analytical model

5.2 FIRST STAGE – VISION FRAMEWORK

This process is the primary task that defines visions' for the learning precinct and establishes the **VISION FRAMEWORK** that forms the foundational guiding principles for the same in the campus. These aspirations become a lens through which we study and assess the current campus, its people, places, infrastructure and processes. This framework is in order to help address and respond to recent reforms in Higher Education, changes in students' demographics, new developments in information technologies, and pedagogical innovation. From research and analysis, conducted principally during the literature study and consolidated input from a variety of sources, three core themes that covered a broad spectrum of issues was developed. These themes reflect the different dimensions of learning spaces and represent the challenges to achieve the Vision.

The ***core themes*** [Figure 5.2] for the Vision framework - **Space & symbol, Culture & values, Standards & practices** - was identified by knitting together information that consisted of gathering, review, and analysis of both existing background material and data to help inform design and planning decisions with qualitative and quantitative investigations. The key focus areas which helped identify these themes included the impact of physical space on learning, the trends in learning and pedagogy and new environments and the relationship between technology and learning in the present

5.2.1.2 Culture & Values

A full-scale commitment to higher education involves creating a campus climate or culture that reinforces what students learn in their courses and extra-curricular activities. The campus culture is a powerful source of socialization, even for commuting students. Students are socialized through their perception of the institution's norms, including peer norms, and their habitual participation in routine practices and communal events. As valuable as it is for an institution to create a cohesive culture that supports students' civic development, it is also critical for the culture to include strong support of intellectual, moral, and political open-mindedness.

Academic integrity is one clear and essential expectation for higher education, so it is worth paying special attention to how this norm is conveyed and enforced. Strong honour codes and the kinds of conversations they stimulate not only help deter academic dishonesty, they can also foster a climate of trust, civility, self-restraint, and mutual respect. Creative attention to academic integrity can also help foster an awareness of the critical place of integrity and trust for communities more broadly. Colleges and universities must create a vibrant sense of mission and a distinctive culture that supports students' civic understanding and engagement. By design we can create notable physical features or special locations that reflect the institution's mission and values.

5.2.1.3 Standards & Practices

The vision framework must have incorporated the best and most appropriate of the various national and international standards and practices when determining the guidelines. However space standards have not changed to reflect the enormous changes in technology, pedagogy, or research on how people learn. It is time for a fresh look and make sure the vision for the learning precinct accommodates these changes. One of the benefits of space standards and practices is that they provide a consistent measure applied in a variety of different circumstances. The use of the word "standard," however, carries the implication of having been vetted and accepted as right or appropriate, hence must include the new demands as well.

Most facility standards today are based directly or exactly on standards developed in the late 50s and early 60s. Some facility standards have not changed in over 50 years, even though dramatic change in technology, teaching, pedagogy, research, and our understanding about how people learn should have affected at least some of them. This enduring nature of standard shows the difficult evolution and slow response for facility standards in ever changing circumstances. Hence from the stage when vision is set attention must be paid to this and this also considered as one of the core themes for the visionary framework.

5.2.2 Vision matrix

The vision matrix tabulates [Table 5.2] the key enablers for the three core themes by various design approaches.

Design criteria for learning spaces in technical institutions

CORE THEMES	VISION & NEED	KEY ENABLERS	IMPLICATIONS
	•Consolidated and integrated academic core with a "network of places" for learning, discovery and discourse between students, faculty, staff, and the wider community.	Intersperse "specialized" spaces with "multipurpose" and "between" spaces and also foster faculty-student interaction.	•learning corridors. •nodes and links. •co-locating departments of similar functions and/or interests. •flexible workspaces linked to research facilities. •creating critical mass especially at ground level.
	•Define space needs to meet projected growth and potential demand for new ways of learning and pedagogy.	Create comprehensive learning environments that respond to variety of teaching modalities and technology.	•modern, functional, flexible, stimulating learning spaces. •versatility in supporting different teaching modes – orientation, location of boards, projection screens and other display devices, configuration of furniture.
SPACE & SYMBOL			
	•Enhance the intellectual environment	Robust support structure for learning and teaching technology.	•providing innovative & high quality facilities. •providing group resources by function. •effectiveness of technology – multiple configurations, ease of access, "instant on" and "works-every-time", help desk support.
	•Strong image and identity for the academic precinct.	•Incorporate and integrate the latest thinking in the design of spaces. •Create " signature spaces"	•creating a sense of place, ambience •establishing landmark buildings •providing showcases for work •provide innovative building and architectural types to create variety and interest
	•Foster new relationships on campus and strengthen attitudes.	Accomplish diversity and density of space types and uses. Include a balance of "communal" and "territorial", "formal" and "informal" spaces.	•connect and engage through active frontages to the campus spine and adjacent outdoor gathering spaces. •diverse range of spaces – from large activity areas to small semi-private study nooks.
CULTURE & VALUE	Promote listening and communication.	Establish a variety of spaces that support a range of niche types including disciplines, student activity groups etc.	spaces for •social and learning interaction. •collaboration. •shared experiences. •public displays.
	Demonstrate that a sustainable environment is central to our lives and our work and promote ecologically sustainable development.	•Embody environmentally sensitive design principles. •Adopt building design guidelines which include energy efficiency to achieve high green star ratings.	•emphasising a walk able campus •climate responsive design. •use materials sympathetic to the natural environment. •provide landscaping of native species with vibrant foliage and colour.
PROTOCOLS & STANDARDS	Address deficiencies to bring up to basic standards.	•User comfort in all aspects of facility design. •Work efficiency to be fostered.	•Area per person within different spaces. •Lighting--natural/task •Acoustical control •Thermal comfort

Table 5.2 Vision matrix

5.3 SECOND PHASE - NEED ASSESSMENT

Needs assessment is the process for determining and addressing needs, or "gaps" between current conditions and desired conditions.

Based on the literature study on various learning spaces, pedagogy styles etc desired conditions for a well designed learning precinct can be understood. After which there is a need to understand the existing scenario in the campuses. Understanding existing learning spaces, projected growth, changing demographics and pedagogies through direct observation, surveys, data and personal interaction is critical before vision can become effective strategies. The assessment of learning space intends to address the use of physical space that accommodates formal as well as technologically based learning. An eloquent case can be made to explain the relationship between learning spaces and learning.

The objectives of the need assessment phase are:

- **Clarify the purpose of the project.**
- **Demonstrate value or effectiveness in present campuses**
- **Measure satisfaction in present cases**
- **Identify needed changes**
- **Develop a guidelines based on strategies identified for new campuses**

But how do learning spaces enhances learning? There is a need for assessment data to answer this question. The analysis determines the learning that enhance student learning and support the faculty's pedagogical strategies. Learning is facilitated through the pedagogical efforts of the faculty; both faculty and learners are supported by learning space. Therefore, appropriate assessment targets are:

- **learning space setting**
- **learning activity**
- **teaching methods**

Learning, which occurs in different forms of instructor-facilitated setting, and others are now recognized as an important part of the overall learning environment. Learning settings include learning centers and physical spaces that facilitate group and individual academic activities and computer-assisted learning. Technology has also redefined the meaning of learning space by changing our notions of place and time. Integrating these aspects for the assessment study involves two steps as described below.

5.3.1 Analysis method

The need assessment has been carried out by two inter-related steps [Figure 5.3]. Initially from the literature database and case studies, a set of findings are drafted out which carves out the platform for conducting the space inquiry surveys and interviews.

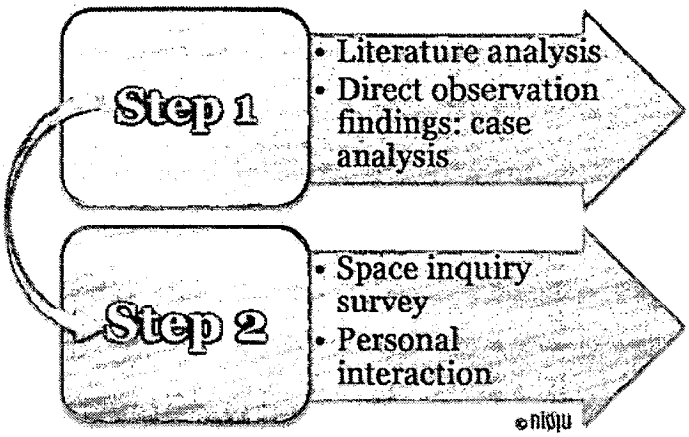


Figure 5.3 Need assessment steps

Case studies, as a direct observational method, determines usage patterns in learning spaces, accompanied with photographic studies to capture observational data across time and in multiple settings with natural intrusiveness and using modest resources. This approach quantifies faculty and students' use of space, including their interactions with the physical and human environment. Direct observation offers a validity check for interpretations from other measures like literature review.

The learning space inquiry was carried out through surveys and interviews. The surveys tapped the perspectives of a larger number of students and were instrumental in cross checking the findings with those from other above mentioned measures. The survey forms were prepared separately for the faculty members as well as the students to generate both quantitative and qualitative information. Interviews were carried out with academicians etc to explore the users' experience of spaces. They provide insight into how faculty and students respond to a particular space, how their views of each other change in different spaces, and how their views of learning are related to a specific space. While this approach relies on individual memory and interpretation, it also allows for a deeper understanding of individual reactions to spaces.

5.3.2 Critical review of the case studies

Analysis from the cases forms the basis of surveys and interviews. The findings have been critically analysed on the basis of to what extent the design has been able to achieve or make a stand on the core themes of the vision framework, namely Space & Symbol, Culture & Values and Standards & Practices.

5.3.3 Interview summary

5.3.3.1 From the Director, IIT Gandhinagar

Dr. Sudhir K. Jain is an outstanding academician, accomplished leader in academic administration and a reputed engineering consultant. He is a world renowned expert in the field of earthquake engineering and structural engineering. He received his B.E. degree from the University of Roorkee and MS and PhD degrees from California Institute of Technology, Pasadena, USA. He is on the Faculty of Civil Engineer, IIT Kanpur since 1984. He accepted the position of Director, IIT Gandhinagar in June 2009.

5.3.3.2 Summary of the Discussion

The need for flexibility and agility in furniture, technology, and space were the topics discussed with the director of the institution. Also, to design spaces with the uses in mind from the students' perspective; include buildings with inspiring spaces 24-hours a day to match students' study habits and needs; and continually make annual improvements to maintain buildings throughout the entire learning environment. He expressed the necessity of using the most recent research on effective pedagogy and integrating it with what faculty and students want technology to do for them, within the confines of a physical space.

He mentioned an effective learning space should include rooms that are technology enabled, innovative and wireless, while also incorporating natural lighting and functional furniture. Citing the Harvard lecture hall example he tells how technology makes it possible that the teacher knows each n every student by his place and hence more interaction possible.

5.3.4 Analysis from learning space survey

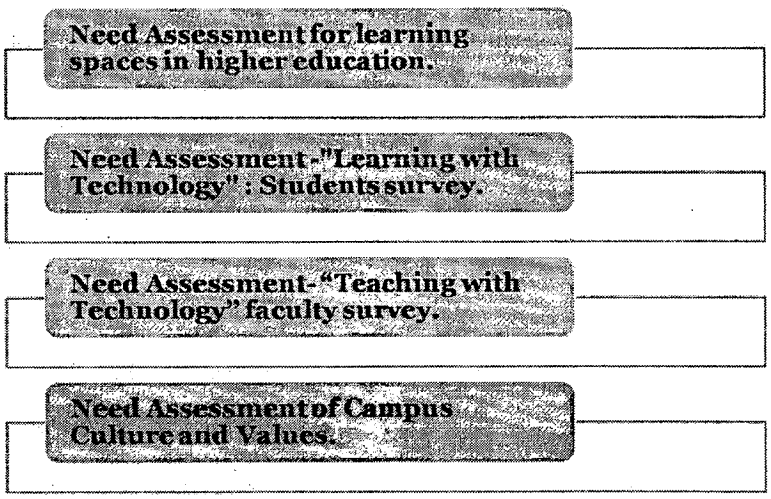


Figure 5.4 The learning space survey list

5.3.4.1 Survey Design

The learning space survey part has four online surveys [Figure 5.4] and was prepared out for both the students and faculty community. The survey was conducted in various institutes like the IITs, NITs and TERI University. Four survey forms, two

common to both students and faculty and the other two respectively for students and faculty separate. (Refer Appendix A-D).

A total of 124 participants responded for the survey which includes 73 students, 37 faculty members and 14 architects and designers.

The detail of each survey form is explained further.

Need Assessment for learning spaces in higher education- This survey was intended to understand how pervasive the trend toward learning-centered space design is on campuses today and to understand their spatial quality which is crucial to a rich learning experience, and was designed to get the opinion from both the student and faculty community as well as from the architects and designers.

Need Assessment -"Learning with Technology": Students survey- This survey intended to do a gap analysis between student and faculty recommendations for resource priorities relating to technology in learning spaces in their campus.

Need Assessment -"Teaching with Technology": Faculty survey – This survey has been designed to explore how faculty use technology as a teaching tool, and to what extent faculty encourages student use of technology primarily through online resources and incorporation of images and/or multimedia as part of lectures or formal presentations.

And finally as per the vision framework the culture and values in the campus was also a very crucial theme in design and hence - ***Need assessment of campus culture and Values*** - was made part of the assessment. Efforts to shape and strengthen campus culture and value should be informed by and consciously directed toward any Institute's larger mission and values. That is, the campus environment should reflect the Institute's core mission and values, and should foster attitudes, relationships, and actions that directly or indirectly promote those values. These values are a part of the design of campuses and its spaces especially the learning/teaching spaces and hence the survey was formulated to assess how members of the Institute community contribute to that mission with regard to campus culture.

5.3.4.2 Detail analysis of the findings

The survey results are analyzed on nine aspects which are as shown in the Figure 5.5. The details of each aspect are explained further, which formed the basis for identifying the design strategies for formulating the design criteria for formal learning spaces.

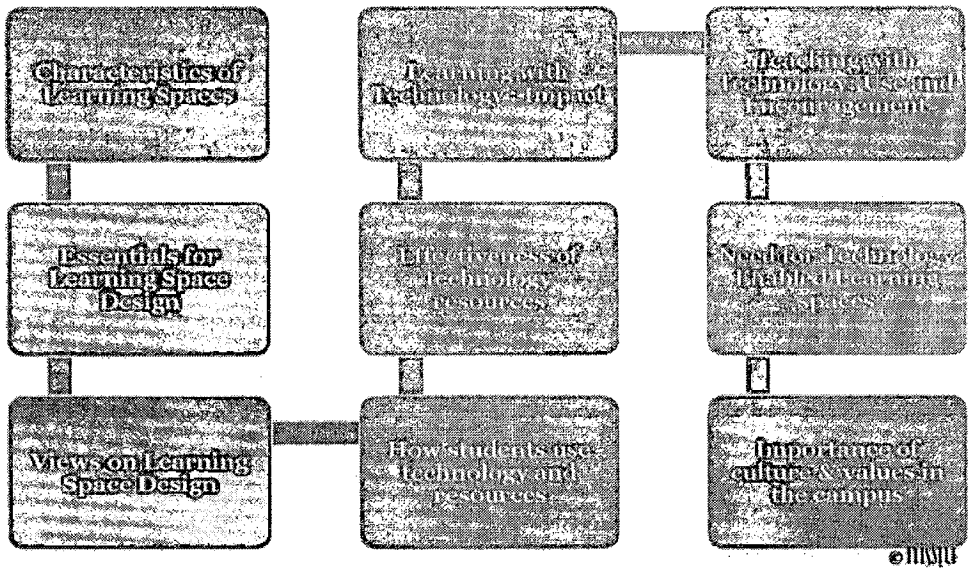


Figure 5.5 Aspects on which the survey findings are analyzed

- **Characteristics of Learning Spaces**

Respondents indicated that the adaptability of learning spaces was the most important characteristic for them to possess on campus. It received the highest number of respondents who indicated that it was **most important** [Figure 5.6]. Spaces that support collaboration, interaction, and engagement ranked second as most important in a learning space on campus. Sustainability of learning spaces ranked third in importance and safety and physical well-being got the least among the six options.

Healthful spaces ranked first as the characteristic on which campuses were **performing best** in their learning spaces and adaptable spaces ranked second. Respondents believe adaptability is the most important factor for their campus' learning space. Respondents were more positive about how well learning spaces are performing on sustainability, as seen with a better average ranking for the performance versus the importance of sustainability. However, sustainability and social spaces did rank last on performance in learning spaces.

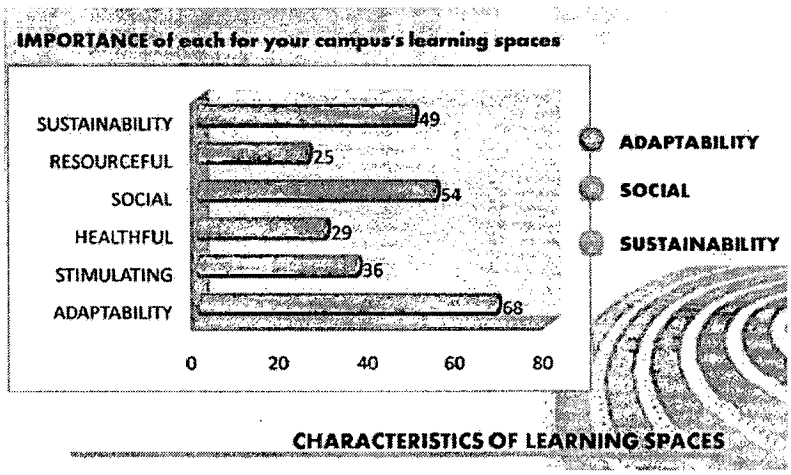


Figure 5.6 Graph showing the importance of various aspects from the survey

Learning studios and experimental labs were perceived as **most preferred** space for an effective learning/teaching activity. Case study rooms were also considered important while lecture halls and seminar rooms got moderate preference. It is to be noted that classrooms were perceived as the least preferred space in the campuses. Though the experimental spaces were most preferred, respondents indicated it as **unsatisfactory** in the campuses. The performance of seminar rooms and classrooms were judged fair and lecture halls and learning studios were graded good [Figure 5.7].

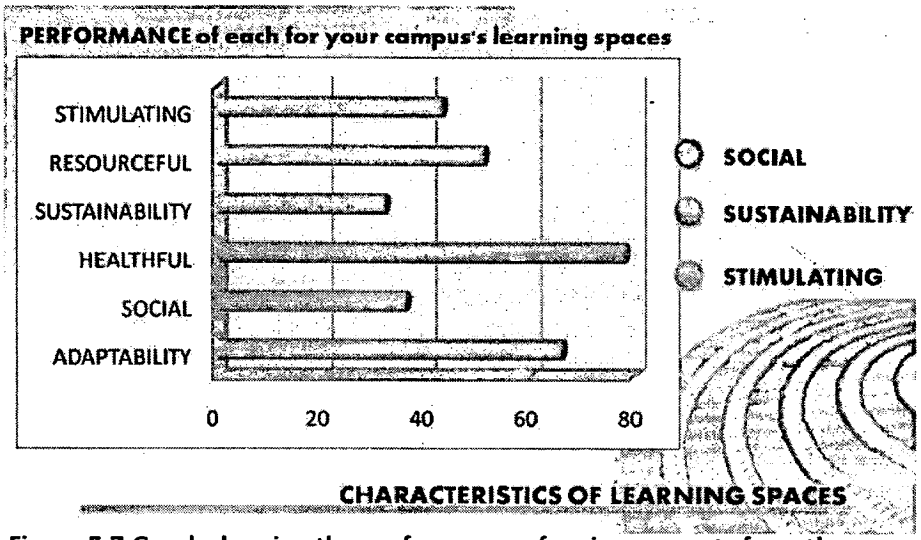


Figure 5.7 Graph showing the performance of various aspects from the survey

Most of the respondents were of the opinion that classrooms, learning studios and experimental rooms required improvements in design in terms of more interactive arrangement and add on spaces [Figure 5.8].

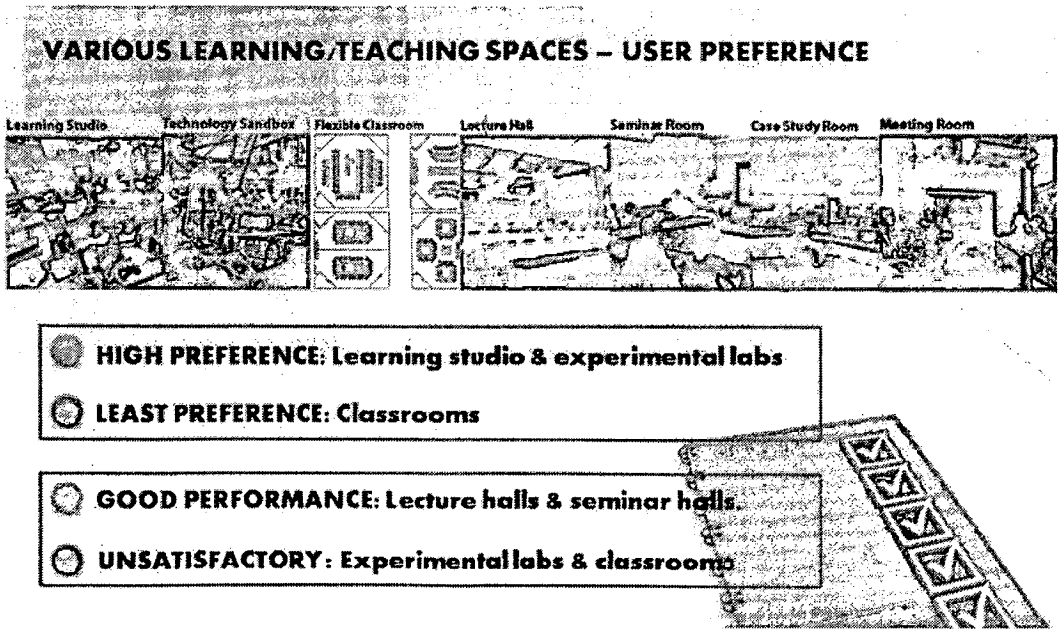


Figure 5.8 User preferences of various learning spaces

- **Essentials for Learning Space Design**

The **aesthetics and character** of spaces are graded crucial by most of the respondents. Learning spaces need to be well-maintained, offer access to natural light, be appropriately sized and proportioned, and has the furniture, finishes, and overall design. The survey findings [Figure 5.9] indicated that **thermal comfort** was most alarming issue unaddressed in most of the non a/c learning spaces. **Lighting** conditions were indicated poor in experimental rooms while naturally lighting was the majority preference for classrooms, case study rooms and case study rooms. **Acoustical issues** were marked majorly in classrooms and experimental labs by the participants. Noisy corridors outside of classrooms were the major problem, as they are distracting.

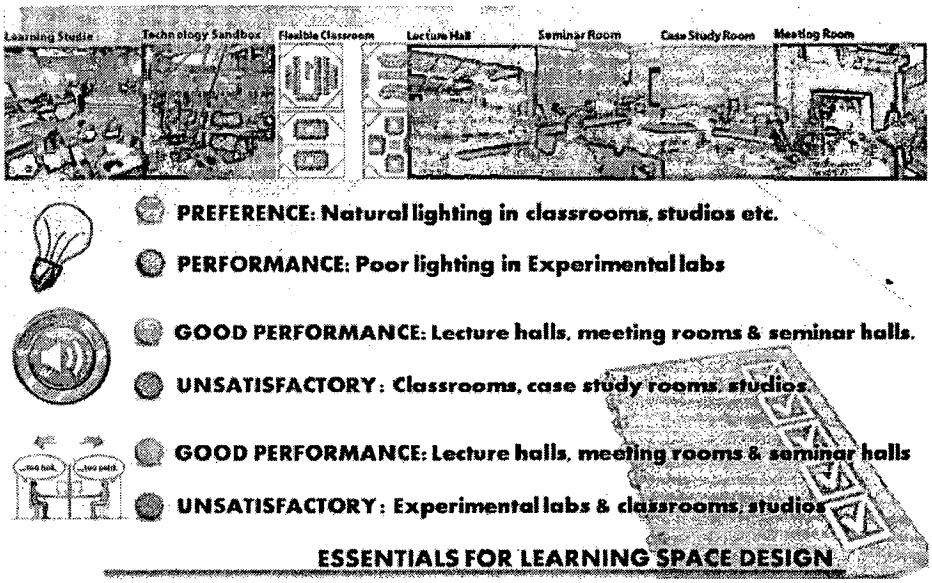


Figure 5.9 User preference and performance of aspects on learning space design

Participants pointed out **user devices** must be supported inside the learning spaces and out. This included the need for wireless access and power everywhere. Respondents indicated that **technology support** for projections or audio visual presentations etc is also needed in classrooms, learning studios and experimental labs to move toward new spaces and pedagogies. Other findings included that **more space** is needed per student within formal learning spaces in order to support student devices, allow students to spread out, enable group work, and because students themselves are larger.

- **Views on Learning Space Design in future**

Survey participants were asked a variety of questions on their views about what will drive learning space design in the future. The first question in this series asked respondents to select the biggest change they thought was driving new needs on campuses. **"Student expectations"** and **"technology"** were the items most selected in this question. Respondents see the need to support the variety of student learning styles as a factor increasingly driving their views on the design of learning spaces. Student and **pedagogical changes** are also likely reflected in the selection of **"interaction"** as the

second most important consideration. Respondents believe that in the future, the most valuable aspect of effective learning spaces will be **student and faculty engagement,**

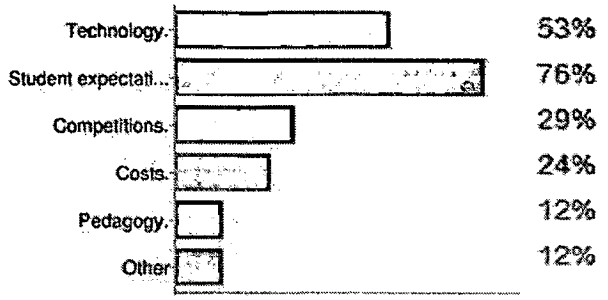


Figure 5.10 The biggest change driving new needs on campuses.

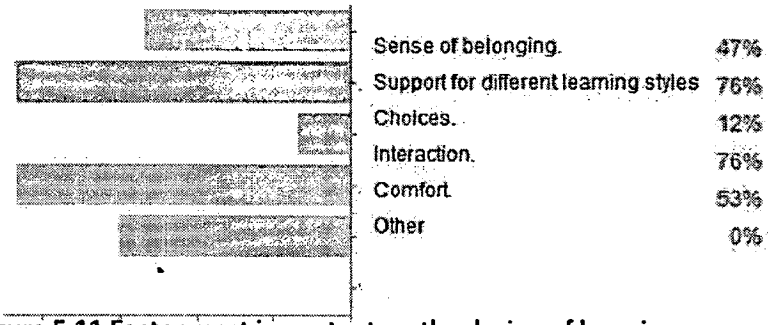


Figure 5.11 Factor most important on the design of learning spaces

peer collaboration and unique resources were the second ranking aspects. The final question in this sequence asked respondents their views on ideally what the most important measure of effective learning spaces will be in the future. Majority felt it would be the number of **hosted interactions, both physical and virtual** and student- faculty ratio. The second most selected measure was how well the space supported around the clock activities. [Refer Figures 5.10, 5.11, 5.12, 5.13]

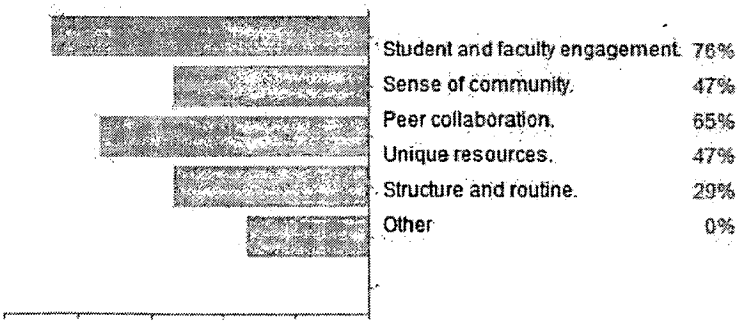


Figure 5.12 Most valuable aspect of effective learning spaces

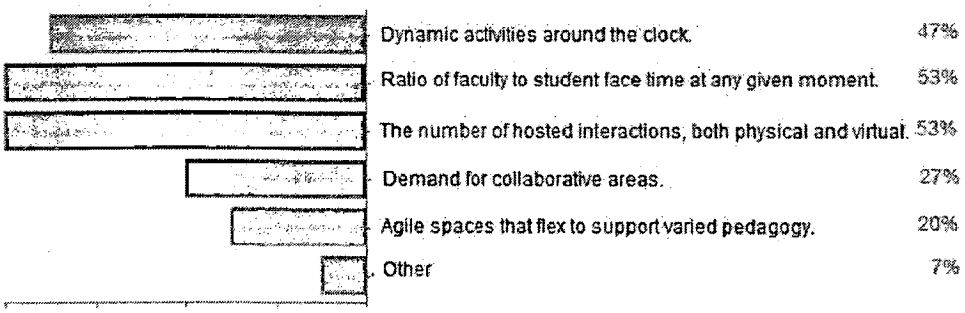


Figure 5.13 Important measure of effective learning spaces

- **Learning with Technology : Impact**

Students were asked to rate the level of agreement with several technology impact statements. There was overall agreement that to some extent technology benefits overall learning. They were unsure or disagreed however on whether technology has improved their writing skills. Students were positive about technology facilitating the completion of assignments, in particular creating multiple versions. There is a fairly even distribution of agreement vs. disagreement as to whether technology impacted the likelihood of missing classes. Students agreed that interaction with instructors, asking questions, getting feedback, and interaction frequency was enhanced by technology. They were less in agreement that technology demanded higher quality work or increased workload. Students agreed that technology made it easier to get help, collaborate with others, and gain access to library resources and services. Students agreed to a large extent that technology has enhanced their skills for future employment.

- **Effectiveness of technology resources**

Students indicated the extent to which several learning resources were useful to them. More than 60% of students who responded agreed that many technology resources were effective to some degree.

- Electronic journals and databases (95%)
- Wikipedia (86%)
- Google Scholar (72%)
- Google Books (66%)
- Digital video sharing sites (e.g. YouTube) (32%)

- **How students use technology and resources**

Thirty eight percent of the students reported spending 11 or more hours a day working on assignments or research in their living space at home or in a residence hall. The next amount of time spent with these activities is less than three hours. About half of the students spent this amount of time at a Library/Cybrary public workstation, departmental computer lab, public library, unoccupied classroom or lecture hall on campus, or at a Wi-Fi location. Of the student respondents, 40% relied on online resources (e.g., Google or other websites), with many reporting self reliance for their research work etc.

- **Teaching with Technology: Use and Encouragement**

Faculty encourage student use of instructional technologies in a variety of ways: primarily by suggesting use of online resources, followed by the faculty themselves incorporating technology in **lectures to encourage active learning**. Only 5 respondents indicated that they did NOT use any methods to encourage student use of technology. Faculty use a variety of resources to assist in the use of educational technologies. Respondents were asked to indicate where, or from whom, they seek help for technology

needs. **Departmental IT support** and **colleagues** were the sources most often cited when requesting help.

Attractions

Faculty were asked the degree to which they felt attracted to use various educational technologies. Those items which had a moderate to large degree of influence were:

- Increase students' access to course material
- Facilitate communication between instructor(s) and students
- Potential to make teaching more efficient

Barriers

Lack of access to technology classrooms was seen as a moderate to large barrier (40%). This was followed by lack of technology support in classrooms or labs (32%), inadequate support staff (to assist with or actually produce content) and lack of skills specific to the technology environment (26%). Difficulty keeping up with changes in technology (39%) and lack of "hands on" technology classroom spaces (43%) are appreciable barriers.

- **Need for Technology Enabled Learning spaces**

This survey makes clear the desire for increased technology enabled classrooms in general, and the addition of more "bells & whistles" to existing technology classrooms, as well as the need for **hands-on labs and small, technology-enabled collaborative spaces**. Faculty were asked to rate the importance of various features that should be included in the "perfect technology-enabled classroom." The most important feature was a **video projector**, the least important, considered "nice, but not critical" was a slide projector. The general themes that emerged from the detailed comments were a need for increased connectivity facilities including Wi-Fi, digital lecture recording of all types, secure testing methods (particularly where wireless is present), advanced annotation on multiple displays, videoconferencing, flexible seating for group work and simultaneous presentation of both video projection and chalkboards.

5.4 ANALYSIS MODEL OUTCOME

5.4.1 Identify the palette of formal learning spaces

Teaching and learning can take place in many different forms, from large lectures to intimate conversations. It is important to recognize the full spectrum of spaces that support these activities in order to recommend improvements. This palette of spaces is meant to spark ideas and ensure that learning space improvements are well-balanced across a broad range.

The identified formal learning spaces includes a) Lecture halls, b) Case study rooms, c) Learning studios, d) Classrooms, e) Seminar rooms, f) Meeting rooms, g) Experimental or technology rooms.

5.4.2 Identify the "strategies"

Each of the four elements, pedagogy, activity, capacity and technology, influence each other [Figure 5.14]. The arrangement of the shape and use of a space will influence the desired pedagogy. A learning space irrespective of its intended use will tend to shape what people do in it and hence the patterns of teaching and learning. Similarly a particular space places constraints (or presents opportunities) for the introduction of certain types of technology while a given technology can impact how a space is used by teachers and students. Thus while all three are interdependent in a cyclical manner, the question remains with which element do you start? Pedagogy seems to be the logical element to consider first, then activity, technology and finally capacity.

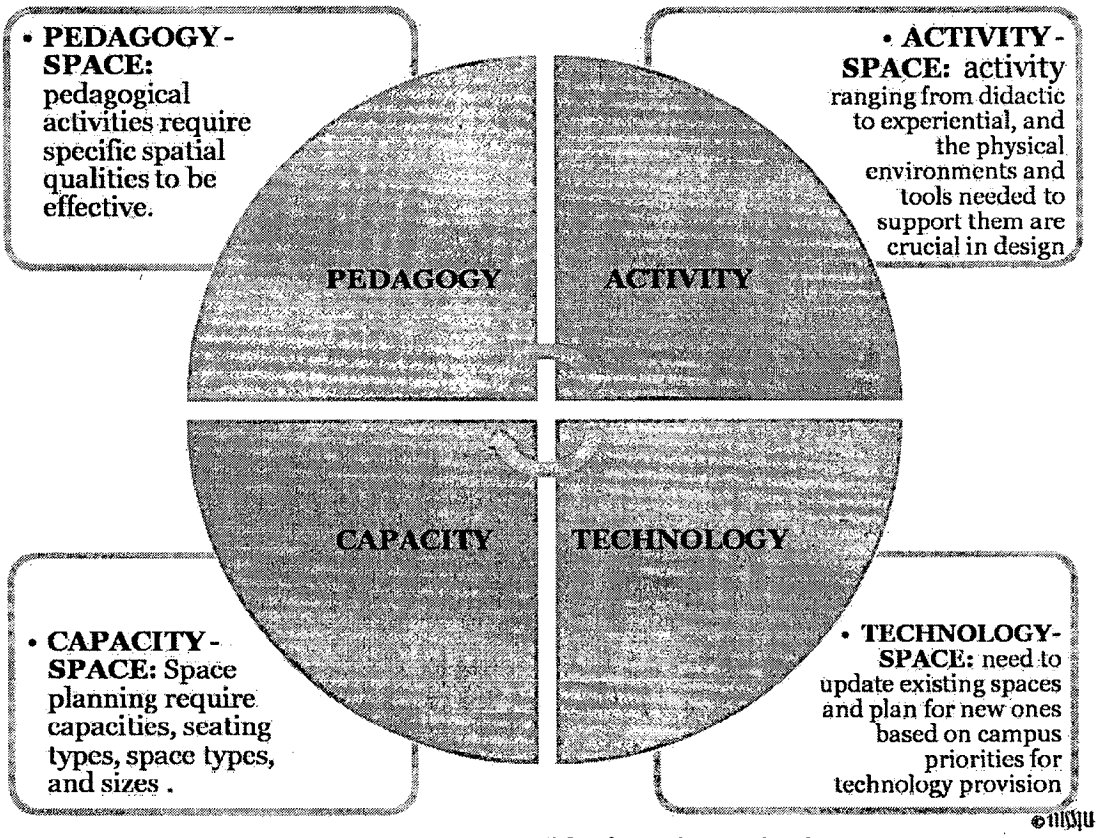
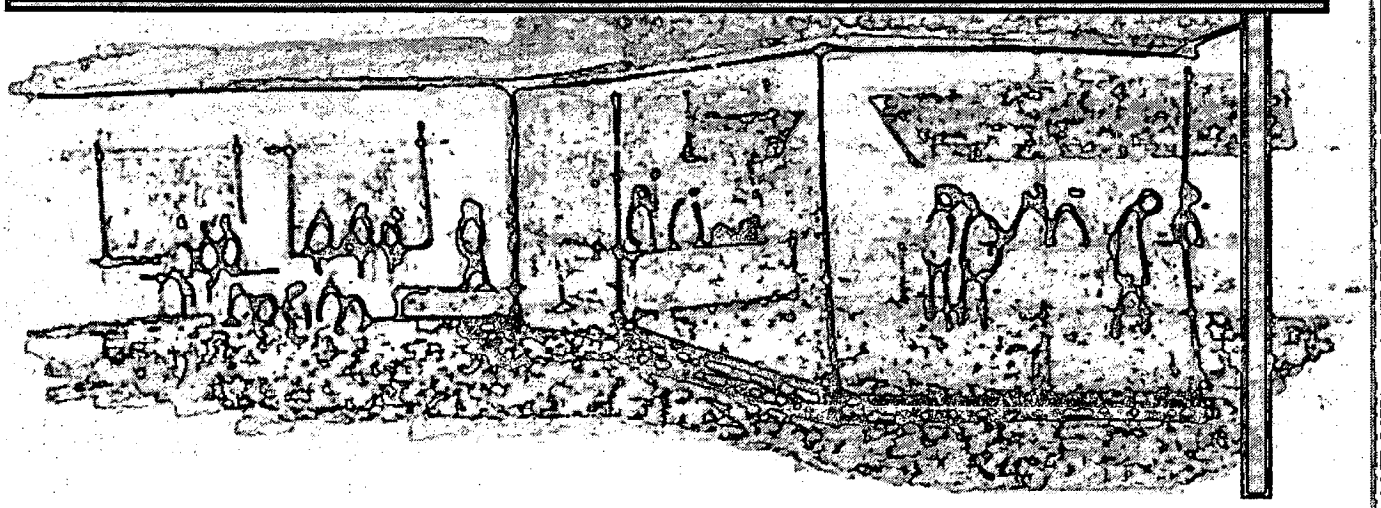


Figure 5.14 Identified "strategies" for formulating the design criteria

5.5 SUMMARY

The entire analysis model has been discussed and the strategies for developing the design criteria have been identified. The next chapter deals with the design guidelines for the learning spaces.

6.0 CHAPTER
DESIGN CRITERIA FOR FORMAL LEARNING SPACES



6.1 INTRODUCTION

The major outcome of the second phase of need assessment is the new design strategy based on the pedagogy-space-technology-capacity nexus. It has been developed through research and study and participatory process, and incorporated knowledge from the designers involved with learning spaces.

- Pedagogy
- Activity
- Technology
- Capacity

6.2 PEDAGOGY

Learning spaces are not always the appropriate size for class size. Taking into account furnishing and circulation needs, each learning space differs in its required minimum area per student for any given pedagogy. These range from instructor-directed to self-directed modes and also vary with different learning styles [Figure 6.1].
For example, the Law/Business schools would prefer teaching spaces that support interactive discussions in classes of less than 40 students, rather than the traditional big lecture halls that they have now, and there is need for more video practice rooms and observation rooms.

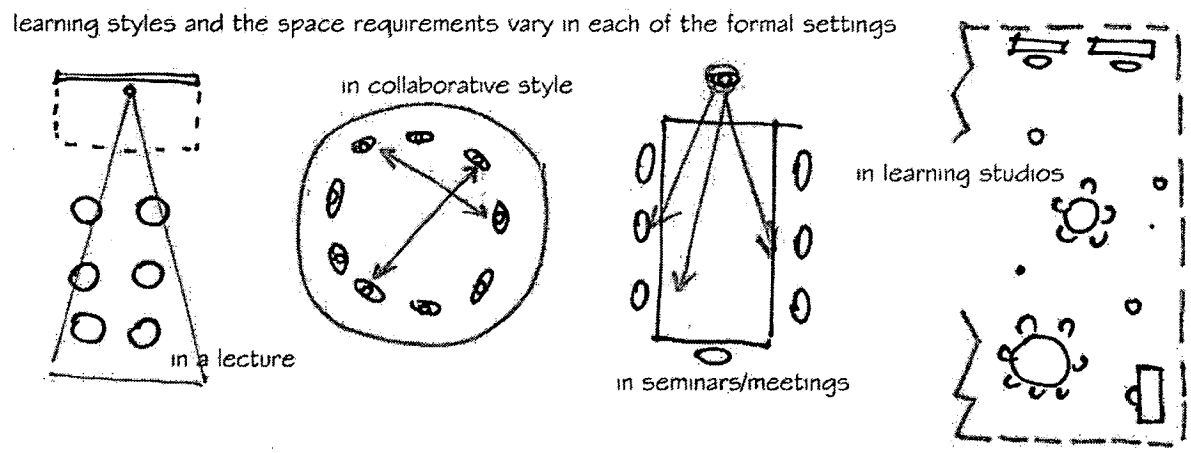


Figure 6.1 Pedagogical styles influence the design of learning spaces

Two types of settings for formal learning:

1. Group setting: Lecture halls, classrooms, learning studios, seminar & meeting rooms.
2. Hands-on setting: Case study rooms, experimental/technological labs.

Guideline 1

The multi-modal learning settings for various pedagogical modes and group sizes should be collocated and clustered to allow students to move around the various learning environments to suit the particular learning task.

a) ***Group setting: Types of spaces and spatial qualities must support groups as these are for small group collaborative [Figure 6.2] and cooperative learning activities and should have movable furniture so that the spatial organisation is learner-controlled.***

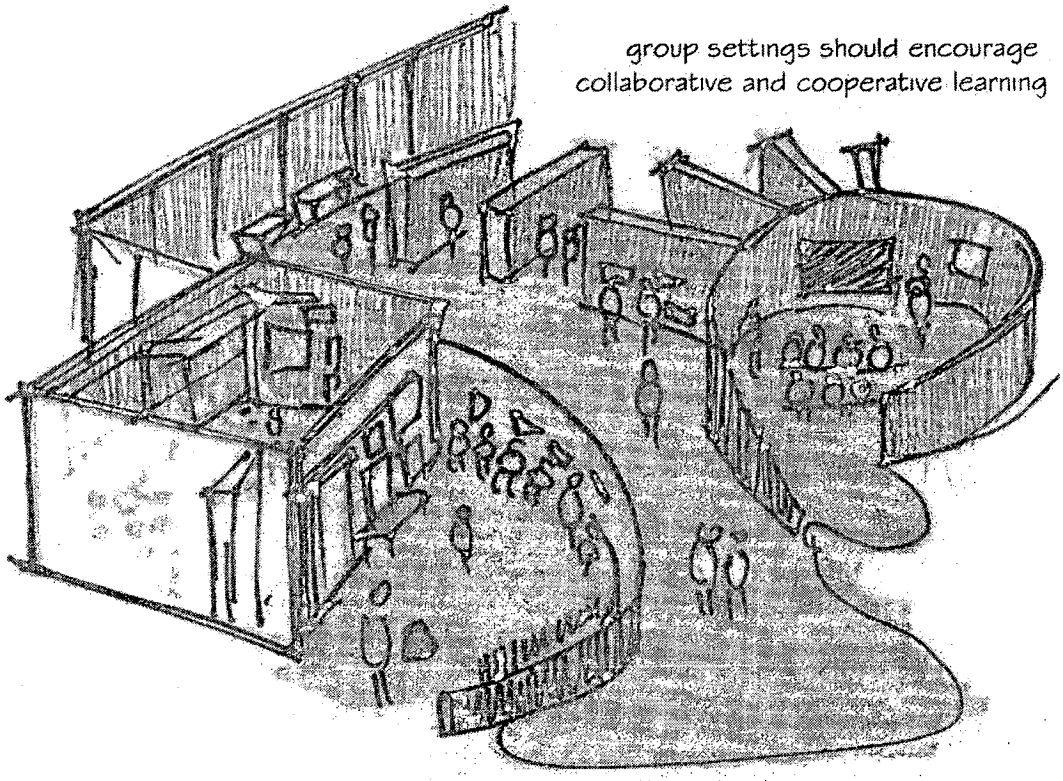


Figure 6.2 Group setting for collaborative activities and space should be learner controlled

- Converting to tables and chairs in the classrooms from tablet of bench furniture will in enable more flexibility within these spaces and allow for more active and collaborative work.

b) ***Hands-on setting: Types of spaces and spatial qualities must support activity as these spaces will be technologically enhanced and contain a range of services and other resources according to the space type [Figure 6.3].***

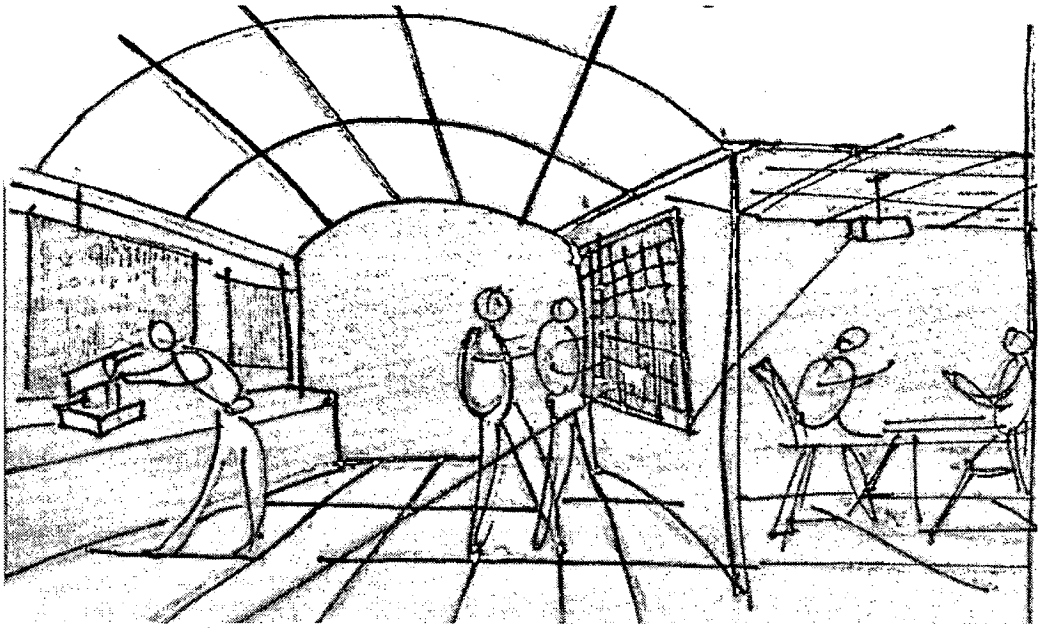


Figure 6.3 Hands-on setting spaces must be designed to support the activity and be technologically enhanced

Guideline 2

The learning spaces should be adaptable, being able to accommodate different learning styles, teaching styles and pedagogical modalities, providing diversity and flexibility in space types.

a) ***The classroom must be flexible [Figure 6.4] enough to support many learning styles—written, verbal, and interactive. Easily change the focal point of interaction between students and the teacher.***

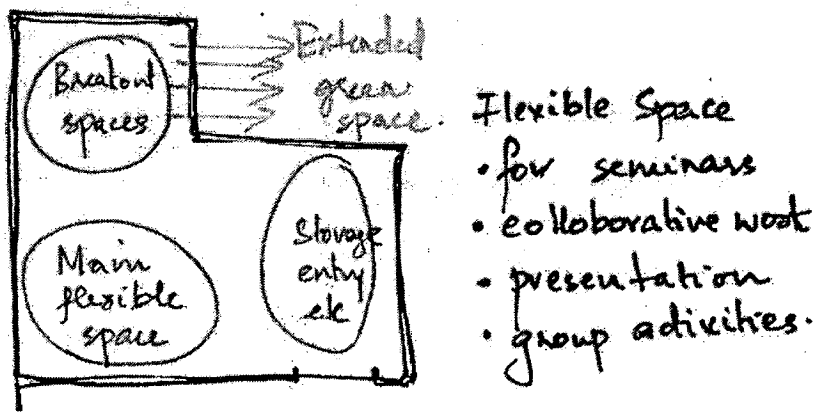


Figure 6.4 Flexibility and diversity in space types are crucial to support various learning styles

b) Specify classroom furnishings that can be easily moved by faculty and students to create different configurations within the space [Figure 6.5].

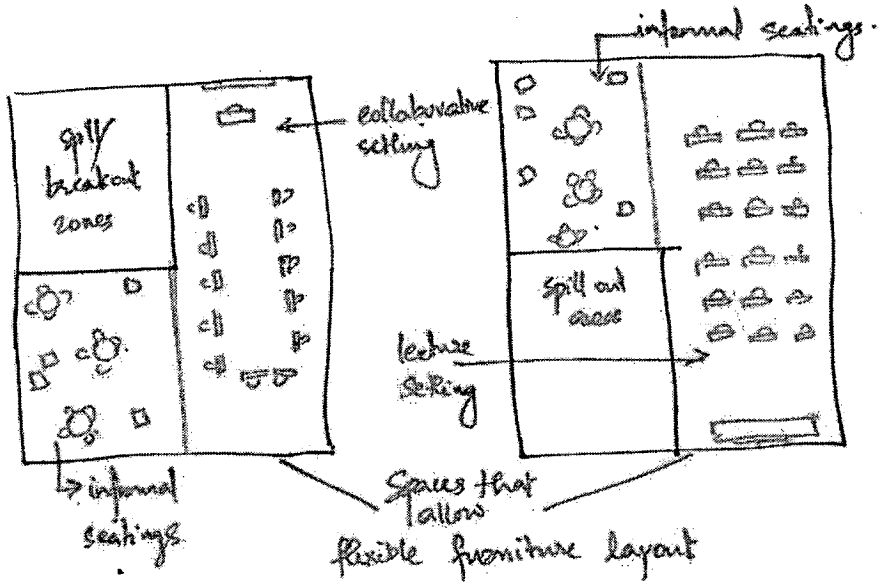


Figure 6.5 Ability to create various configurations within the same space.

c) Consider storage solutions that can also double as dividers of the space and can serve as movable boundaries between various types of ongoing activities within a classroom [Figure 6.6].

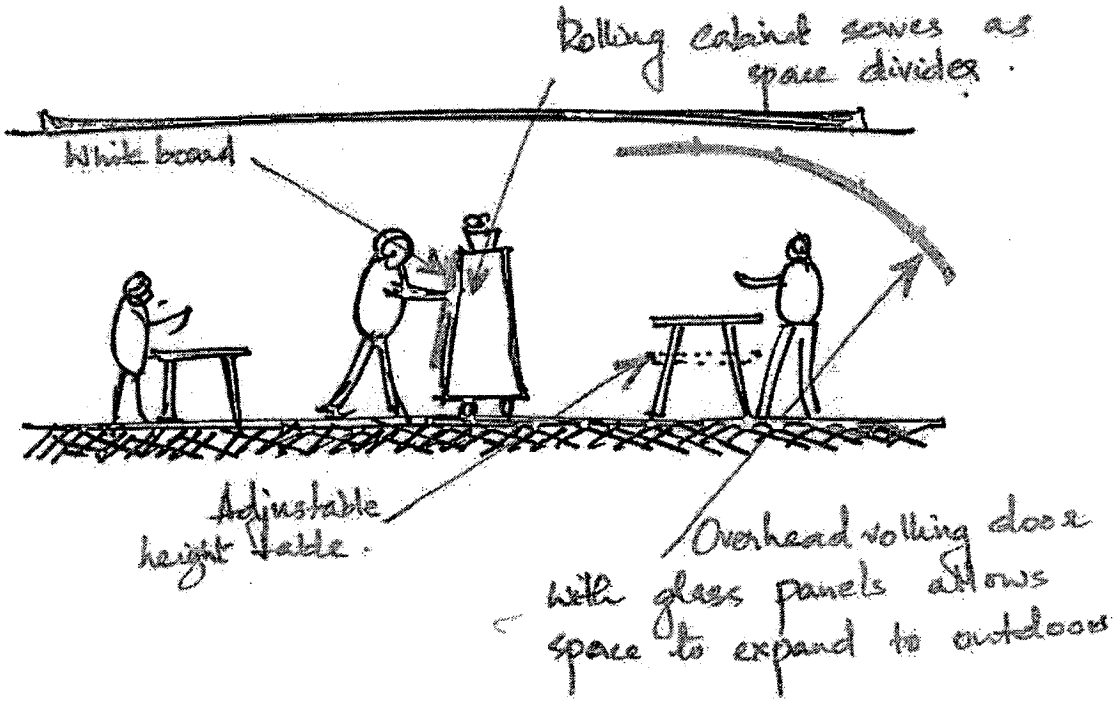


Figure 6.6 Movable furniture with storage solution for using space efficiently

d) Select multiple-use furnishings for use within classrooms: One Space, Many Uses. For example, meeting tables can serve multiple purposes; a single table can serve as a work surface for individual tasks, and can be linked to others for small team activities [Figure 6.7].

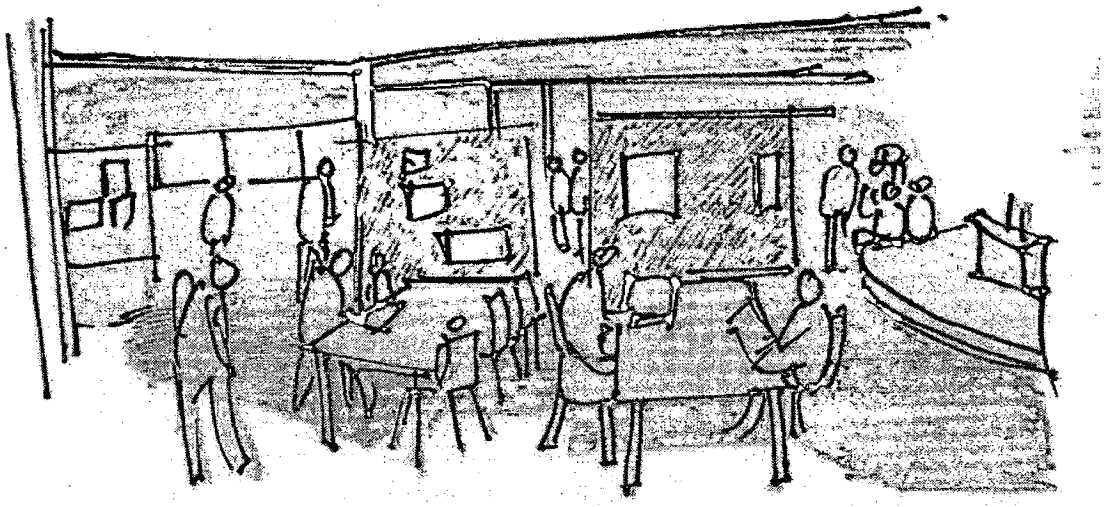


Figure 6.7 One space many use approach to design is important

6.3 ACTIVITY

Guideline 1

Design to optimize space for learning activities in each of the formal learning space and interspersing "specialized" spaces with "multipurpose" and "in-between" spaces.

a) Create small study nooks [Figure 6.8], breakout rooms [Figure 6.9] or larger spaces suited to formal and informal meetings, with the right furnishings and technology.

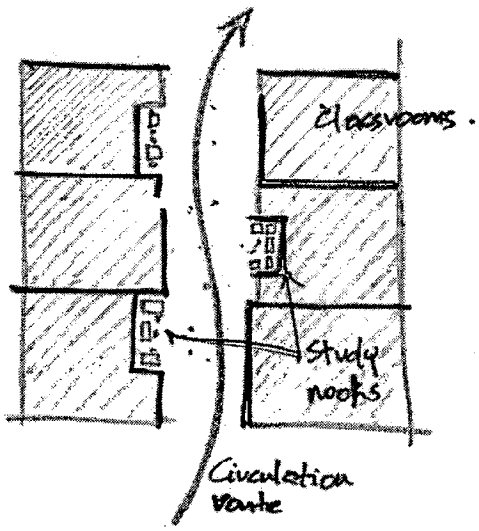


Figure 6.8 Study nooks along the spine

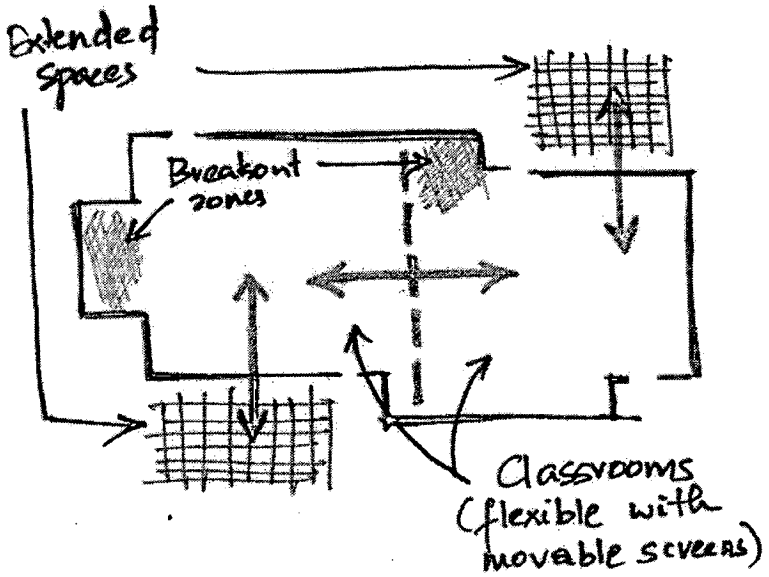


Figure 6.9 Breakout zones and extended outdoors for a better learning experience

b) Formal and informal learning spaces should be distributed and arranged strategically [Figure 6.10] to be mutually supportive so that classroom activities can 'spill' into other spaces and students and faculty can work wherever they are.

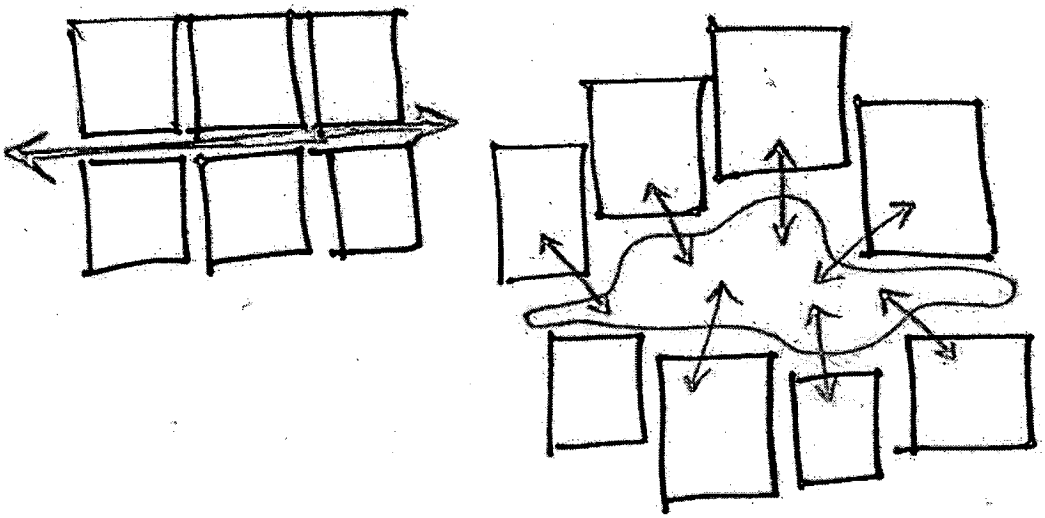


Figure 6.10 Design spaces such that they are arranged strategically and not monotonously

c) Allows easy flow into break-out areas or "front porch" spaces for connecting before classes or spill-over discussions after classes end [Figure 6.11].

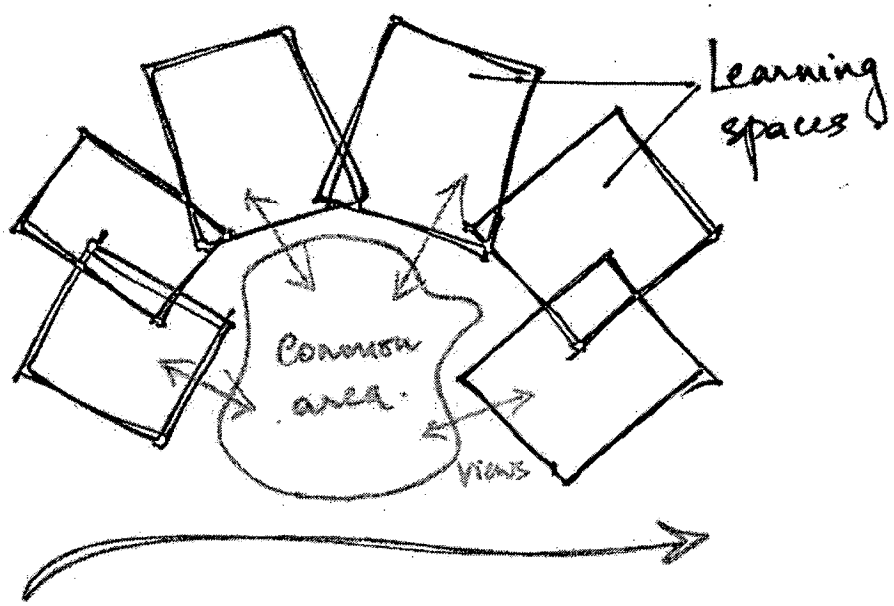


Figure 6.11 Easy movements into break out zones

Guideline 2

Design formal learning spaces considering the various activities in each and the associated physical space arrangement and tools to support them.

a) Lecture halls [Table 6.1]

LEARNING ACTIVITIES	ARRANGEMENTS	TOOLS & EQUIPMENT
Lecture	Rows of tables for laptop use or swivelling tablet chairs to allow small group discussions	Podium, 3-image screen as focus
Case Presentation/Discussion	Rows of tables in U-shaped case study type layout, or cluster tables	Movable podium or table, 3-image screen desirable
Briefing about procedures or activities about to experience in other spaces	Rows or other arrangements	Tools vary, video systems to connect with other locations (e.g. hospital, remote experts etc.)
Panel discussion	Rows of tables in U-shaped case study type layout, or cluster tables	Voice assist system, recording capability
Demonstration by faculty or students	In the round for better viewing, with movable demo station in center, projection to peripheral screens	Demo station with doc camera, other equipment

Table 6.1 Lecture hall activities and arrangement

b) Case study rooms [Table 6.2]

LEARNING ACTIVITIES	ARRANGEMENTS	TOOLS & EQUIPMENT
Lecture/ Presentation alternating with small group problem-solving	Seating to enable seamless transition from one activity to another, either flexible cluster tables or swivelling seats to allow two rows to work together	AV & lighting controls near instructor, audience response system
View and analyze real-time or taped scripted experience in another location (connected virtually)	One group all focused on same screen or several groups focused on separate screens	Multi-screen projection capability

Table 6.2 Case study room activities and arrangement

c) Learning studios & classrooms [Table 6.3]

LEARNING ACTIVITIES	ARRANGEMENTS	TOOLS & EQUIPMENT
Team-based learning activities: **Small group/team discussions and problem-solving**	Small tables, with faculty circulating. Team at each table works with its own shared screen	Shared screens at wall or at each table. Wall mounted and rolling whiteboards, pinup surfaces, poster rails. Writable table surfaces. Distributed power outlets, table type for power outlets at table surface
Group work developing products or creating presentations	Movable small tables & chairs	Rolling whiteboards, shared screens at tables for team focus
Report-back presentations by learner teams to full group	Table clusters	Collaborative software to enable easy sharing of team products

Table 6.3 Learning studios and classroom activities' and arrangement

d) Experimental & Technology rooms [Table 6.4]

LEARNING ACTIVITIES	ARRANGEMENTS	TOOLS & EQUIPMENT
View visual simulations as a group and discuss them	Groups around large visualization screens for immersive viewing or shared screens at tables for smaller groups	Display and software systems to support visualization of complex data, 3D stereoscopic viewing
Hands-on experiments (could provide spill over for added capacity from other spaces)	Small group tables with instruments or adjacent devices on rolling carts	Tabletop instruments or tools, distributed power outlets
Role playing exercises	Movable furnishings	Video recording devices to capture & playback for group reflection

Table 6.4 Experimental & technology room activities and arrangement

6.4 CAPACITY

Guideline 1

Design from the "inside out", not from the "outside in" to develop learning rooms with optimal space, good ergonomics, sight lines and efficient seating layouts.

a) ***Providing new and innovative learning spaces, deficiencies in terms of capacity and room standards in terms of quantity and specifications (room size, furnishings etc) must be considered [Table 6.5].***

- Room size & Furnishings
  - Learning spaces need to be large enough to comfortably accommodate the number of students planned for each type of room using the types and sizes of furnishings anticipated for instructors, students, and audio-visual components.
  - The following space standards and furnishings types shall be used to estimate the total usable floor area of learning rooms.
  - Furnishings layouts shall be developed during schematic design to insure that the room sizes and shapes proposed comfortably accommodate the number of students programmed for each room. The shape of the room, size and types of furnishings proposed, and other design features may increase or decrease the amount of space required per student.

SF PER STUDENT	CAPACITY	ROOM TYPE	FURNISHINGS
27	20	Seminar Rooms	Movable tables & chairs
22	32	Classrooms	Movable tables & chairs
20	40 or 48		Movable tables & chairs
21	60-99		Fixed writing surfaces & movable chairs
20	100-119		Fixed writing surfaces & movable chairs
19	120-199		Fixed writing surfaces & movable chairs
18	200-299	Auditoriums	Fixed writing surfaces & movable chairs
16	300-399		Fixed writing surfaces & movable chairs
14	400-650		Auditorium seats with tablet arms
40	25-40	Computer Instruction Labs	Computer stations/conventional monitors
35			Computer stations/thin-profile monitors
35-60	varies	Other Instruction Labs	Furnishings and space needs depend on function and discipline

Table 6.5 Square-feet area per student for different space types

b) Universal design approach in all the learning spaces is very important.

- Accessible wheel chair seating: Provide positions, distributed in each classroom or classroom/lab space, according to the following table 6.5:

CAPACITY OF SEATING IN ROOM	MINIMUM REQUIRED NUMBER OF WHEEL CHAIR SPACES
4 to 25	1
26 to 50	2
51 to 100	4
101 to 300	5
301 to 500	6
501 to 5,000	6 plus 1 for each 150

Table 6.6 Minimum wheel chair spaces in learning spaces

c) ***Formal learning spaces should enable faculty to circulate within the room for teaching and testing, incorporate more hands-on learning activities, and facilitate students working together in groups.***

- Seat spacing must provide adequate spatial comfort and allow students who arrive late to find seats easily with minimum disruption and ensures wheelchair users can reach their workstations and the front of the room.
  - Recommended seat spacing for classrooms/lecture halls is as follows:
    Movable seats spaced minimum 28" on center
  - Continuous work surfaces with movable chairs:
    36 inches apart - rows with up to 20 seats
    38 inches apart - rows with 21-24 seats
  - Lecture halls with tablet-arm seats:
    Seats spaced minimum 24 inches on center
    Minimum 21 inches clearance between tablet-arm supports
    Minimum 12 inches clearance between tablet-arms in use and seat backs (with seats fully reclined).
  - Access aisles:
    Minimum 36 inch-wide aisle leading to front of room.
    Minimum 28-inch-wide aisles in other locations

- The recommended spacing between workstations in computer instruction labs, science labs, and design studios varies because teaching methods and workstation designs vary widely. In these room types:
  - Minimum 36-inch-wide aisles in rooms where students work primarily in small groups or bulky equipment must be moved frequently from one workstation to another.
  - Minimum 28-inch-wide internal aisles in computer instruction and study labs where students usually work independently or with only one other student.

d) ***Space needed per student within formal learning spaces should be optimum in order to support student devices, allow students to spread out, enable group work, and because students themselves are larger [Table 6.7].***

SPACE	CAPACITY	AREA PER PERSON	PHYSICAL ATTRIBUTES
Lecture Hall	100 and up	20-30 sq ft (fixed tables), 15-18 sq ft with tablet chairs	• High ceiling height • Wide teaching wall to accommodate wide aspect ratio screens and 2 – 3 images • Continuous counters with power for laptop use • Alternative: deep tiers with chairs that swivel to support small group discussion.
Case study room	40-100	26-30 sq ft	• High ceiling height • Wide teaching wall to accommodate wide aspect ratio screens and 2 – 3 images. • Continuous counters with power for laptop use
Learning studio	40-84	27-35 sq ft	• High ceiling for sight lines • Plan accommodates efficient alternative layouts • Movable furnishings • Multiple screens • Sight lines to screens are important drivers • Group project work capture
Classroom	24-60	20-30 sq ft	• Movable tables and chairs • Distributed power outlets in floor • All walls enabled as white boards or projection surfaces • Collaborative software and systems to capture group products
Seminar room	16-24	25 sq ft	• Non-hierarchical table layouts • Room proportions more square than rectangular • Walls enabled for group work • Simultaneous writing and projection • Dual image projection • Group project work capture
Meeting room	8-12	25-30 sq ft	• All walls engaged in data display, multiple images • Ceiling grid for multiple projectors and devices in swappable locations • Capability to engage remote participants or network data, e.g. Access Grid • Additional space for supple mental devices
Experimental	15-25	Varies depending on function	• Flexible infrastructure with good power and data distribution • Supports introduction of advanced technologies • Movable furnishings to support multiple functions • Fit up tailored to local need and purpose

Table 6.7 Space type, capacity and attributes

e) ***Design room with appropriate proportions as they have a significant impact on seating capacity, sight lines, and the ability of instructors and students to interact with each other, even in small rooms.***

- Determine number of screens based on seating capacity, room type, and teaching goals. Determine the general location, size, and orientation of each screen and the seating area. Insure the instructor area meets the minimum dimensions in this guidance. Draw "viewing angles" from each screen and insure all seats are within them. Determine optimum width and depth of the seating area based on seat spacing guidance. Determine the location and size of access aisles. Then decide where the walls of the learning room should be located.

- The size of the instructor area in the front of the learning room is another important design consideration. This area should be:
  - Deep enough to accommodate a multi-media instructor workstation and a reference table and provide ample circulation space between the workstation and screens, marker boards, and the seating area.
  - Deep enough for carts used for portable media projectors to be located far enough from screens to project images without a keystone shape and large enough to be easily seen.
  - Wide enough for marker boards and at least one projection screen to be used at the same time spaced far enough apart so that light on the board does not spill over onto the screen.
  - High enough to give all students a clear view of projected images.

  These parameters suggest instructor areas in classrooms with up to 48 seats should be at least nine feet deep and 24 feet wide. Deeper instructor areas are typically needed in rooms with multiple screens, higher seating capacities, and portable projectors.

- To provide good sight lines to projection screens, ceilings in classrooms with flat floors should be at least 13 feet high in front of the screens. Ceilings in tiered floor classrooms also need to be at least 13 feet high in front of screens to insure that light from the projector will not be in the instructor's eyes. Lower ceilings may be considered in tiered floor rooms that have no screens located behind the instructor workstation.

Guideline 2

Design considers learning physiology and make spaces creative and comfortable to energise and inspire learners and tutors.

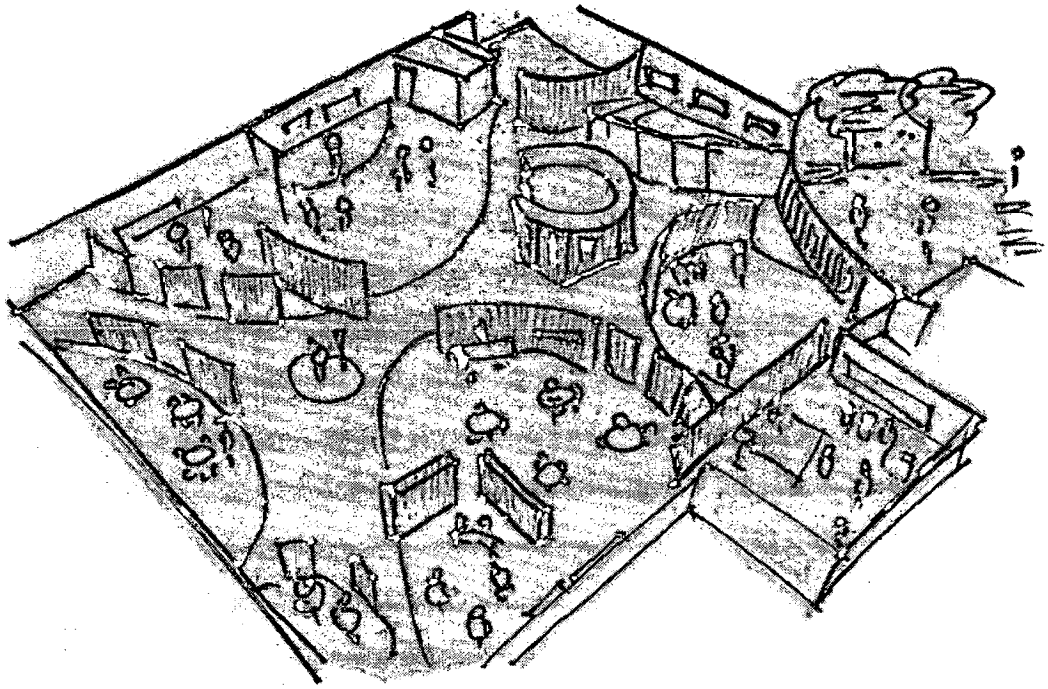


Figure 6.12 Creative and comfortable learning spaces

a) Welcoming, stimulating learning spaces with creative colours, textures, patterns [Figure 6.12].

- Soft flooring materials such as carpeting, however, should be avoided in most learning rooms even though they may improve acoustic performance. Soft flooring is usually more difficult and costly to keep clean than hard-surface finishes. Exceptions can be made in rooms where:
  - Food and drinks are not allowed, such as computer instruction labs.
  - Sound absorption is very important, such as distance-learning rooms.
  - Special use requires a softer, more luxurious floor finish than resilient flooring.
  - Raised floor systems are proposed to improve energy efficiency and reduce costs.

- Colours in the front of rooms behind marker boards and projection screens should be darker than in other areas to reduce light reflections when media projectors are in use.

- Colours for furnishings and audio-visual components shall be coordinated with finish colours used in the same building or on the same campus.
  - Neutral colours are preferred so these items can be moved from room to room.
  - Avoid use of "cool" colours in rooms with "warm" finishes, and vice-versa

- Low-maintenance finishes are strongly preferred. Typical solutions include:
  - Hard-surface or resilient flooring with durable surface coatings
  - Veneer plaster on gypsum wallboard with steel studs
  - Epoxy coatings or other durable materials on wall areas within reach of people
  - Sound-absorbing materials located beyond arm reach.

b) Architectural and design elements expand and open interior views with transparency [Figure 6.13].

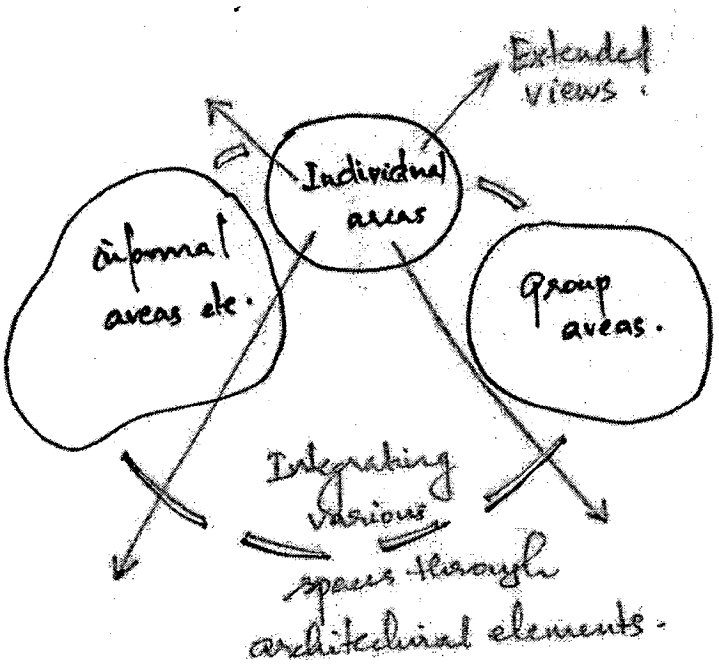


Figure 6.13 Open to exterior views

c) Range of formal and informal furniture and fittings to make spaces comfortable, imaginative and fun.

- Classrooms seating up to 48 students shall be designed with individual desks or tables and movable chairs for each student. This gives instructors the flexibility to break classes down into small groups and then quickly move furnishings back into a traditional layout that faces marker boards and screens.
- Classrooms seating more than 48 students and lecture halls with 200-399 seats shall be designed with continuous fixed work surfaces, tiered floors, and

upholstered movable chairs with adjustable-height seats and backs. Comfortable auditorium-style seats with tablet-arms can be used in larger auditoriums to reduce room depth and costs.

- Student desks, continuous work surfaces, seminar tables, and computer workstations shall be designed to accommodate right and left-handed students as well as students in wheelchairs. This requires careful consideration of work surface height and where they are located in the room. Provide unobstructed knee clearance space underneath work surfaces that is at least: 22 inches wide and 27 inches high.

  In large rooms with built-in seats (such as auditorium-style seats with tablet arms), provide 36-inch wide accessible workstations for students in wheelchairs as follows:
  - 4 workstations Rooms with 49 to 300 seats
  - 6 workstations Rooms with 301 to 500 seats
- In seminar rooms, classrooms and lecture halls with continuous work surfaces, and computer instruction labs, provide armless task chairs for students with adjustable cushioned and upholstered seats and backs, back tension that adjusts automatically to weight and casters (or steel glides). Select fabric that is easily cleaned and provides good abrasion resistance.

d) Designs should provide visual comfort by providing proper illumination levels and control, acoustic comfort [Figure 6.14] by addressing reverberation times, and year round thermal comfort by providing well monitored and controlled HVAC systems.

Acoustics

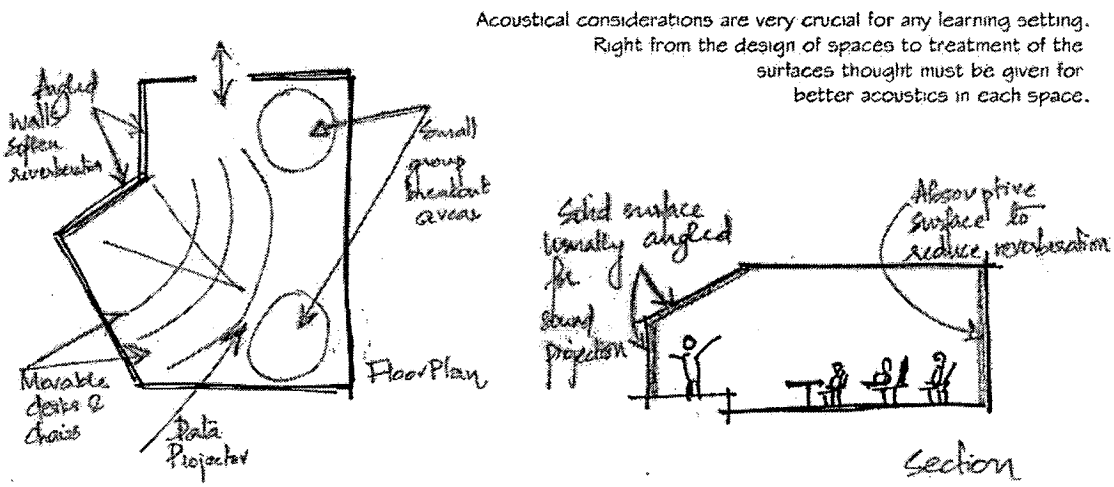


Figure 6.14 Acoustical treatment options in learning spaces

- Learning rooms shall be designed to provide adequate acoustical separation from all other interior and exterior noise sources. Meet or exceed the following requirements:
  - 50 STC Walls, ceilings, floors, movable or folding partitions

- 40 STC Doors and windows near high noise areas
- 28 STC Doors and windows near low noise areas

➢ The use of movable or folding interior partitions should be avoided because it adds significant cost to meet the 50 STC requirements.

➢ Wall, ceiling, and floor surfaces shall provide good acoustics. The design of large classrooms (over 50 seats), auditoriums, and distance-learning rooms requires special attention and the services of an acoustical engineer. Provide:

- High-reflectance materials near the instructor that project sound to the back of the room.
- Sound-absorbing materials on ceilings and on the upper levels of walls in the rear.
- Target 0.75 reverberation time (acceptable range, 0.6 to 1.2)

Lighting

➢ Lighting levels must give a comfortable learning experience in all the areas.
  - Minimum uniform light level at desk height is to be 540 lux, after bulb burn-in and after dirt accumulates, which means that 700 to 750 lux needs to be the minimal design level.
  - Use fluorescent fixtures with parabolic reflectors that reduce glare onto eyes and eye glasses.
  - Use of pendant direct/indirect fixtures between existing / new / future ceiling mounted projectors and screens

➢ To be sure that lighting zones are properly conceived and implemented, along with the necessary switching systems in the appropriate locations..
  - 750 lux over seating areas only, dimmable to 51 to 110 lux.
  - In rooms were very dark images such as x-rays are projected, provide lighting dimmable to 20 lux and full blackout capability
  - Avoid lights in front of projection screens
  - Lower light levels in corridors and instructor areas, and on ramps and tiered floors
  - Task light for instructor work stations that avoid light spill over to screens/monitors
  - Lights focused on marker boards that do not wash out screen images
  - Safety lights that remain on when other lights are off, but do not illuminate screens

➢ Place a dimming directional light fixture over the instructor table (when included) with no spill or wash on the screens. Individually switch from near instructional station. Position should be in ceiling system at 3' on student side of table.

- Avoid light that creates glare or reflections on computer screens:
  - Use indirect natural and artificial lighting in computer instruction and study labs
  - Use indirect or parabolic fluorescent lights in other learning rooms
  - Avoid placing lights behind instructor workstations

- Increase energy efficiency and the ability to see projected images by using:
  - Lighting controls that automatically turn off lights in vacant rooms
  - Energy-efficient dimmable lighting for seating areas
  - Light fixtures that don't block views of screens, marker boards, or instructors and light paths from projectors.

- HVAC systems shall be designed to provide a comfortable environment for learning without creating too much noise or wasting energy as per the criteria in National Building Code (NBC).

e) ***Designs must consider the importance of daylight and air quality in the promotion of good health. Sustainability and energy efficiency shall guide the design and selection of architectural materials, products etc for designing learning spaces.***

6.5 TECHNOLOGY

Guideline 1

Design should focus on creating integrated ICT rich learning spaces, with flexibility and control to provide connection for students and opportunities for collaboration and creation of work in various learning spaces [Figure 6.15].

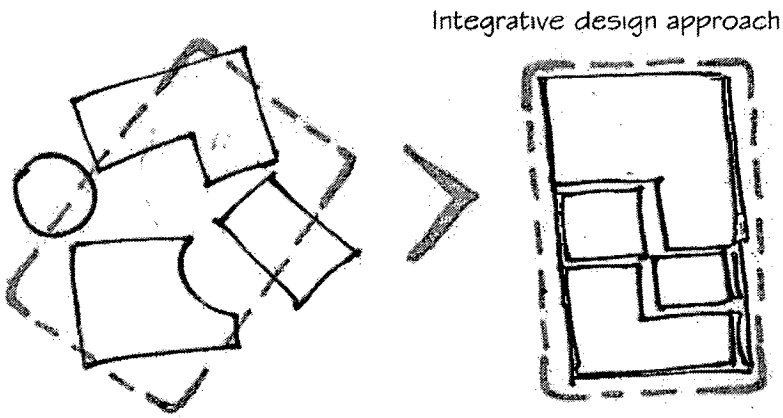


Figure 6.15 Integrative design approach

a) ***Every learning environment shall be designed for the accommodation of widespread lap-top, computer and internet use.***

- Audio-visual systems in learning environments shall be designed for the most commonly used conventional and electronic media, to include marker boards, display boards, transparencies, slides, videotapes, DVDs, compact disks, document cameras, and computer-generated media. Some rooms shall also be designed to project cable or satellite television images. The following sections provide applicable guidance for each of these media.
- Provide marker boards in learning spaces as [Table 6.8]

ROOM TYPE	ROOM DEPTH	FIXED-HEIGHT	ADJUSTABLE-HEIGHT
Seminar	Under 30 ft	Min 36 SF (3 x 12 ft)	None
Classroom, Computer Instruction	Under 50 ft	Min 36 SF (3 x 12 ft)	Min 24 SF (3 x 8 ft)
Larger rooms	Over 50 ft Any depth	Min 24 SF (3 x 8 ft) With electronic capability	None

Table 6.8 Marker board details in various room types

- Projection screens shall be designed for front projection in all learning rooms except large rooms used for distance learning. Screens shall be located and sized so students in all seats can easily see the entire projected image without discomfort or image distortion. Provide the following number of screens and projectors in each room as in Table 6.9:

ROOM TYPE	CAPACITY	SCREENS	CEILING MOUNTED DATA PROJECTORS	OVERHEAD PROJECTORS
Seminar	10 to 22	1	1	1
Classrooms	21 to 48	2	1 or 2	1
Classrooms	49 to 74	2	2	1
Classrooms	75-199	3	2 or 3	1
Lecture halls	200+	3	3	1

Table 6.9 Projection screen details for various room types

- Screen Size

  Minimum Height: 20% of distance to seat farthest away from screen

  Minimum Width: Determined by aspect ratio of projected images

  - 4:3 aspect ratio: Specify screen with nominal dimensions 7.5 ft high, 10 ft wide.
  - 16:9 aspect ratio: (HDTV) Specify screen with nominal dimensions 7.5 ft high, 13 feet wide.
  - HDTV "wide screen" images may reduce the number of screens that can comfortably fit in the instructor area and still allow enough space for marker boards.

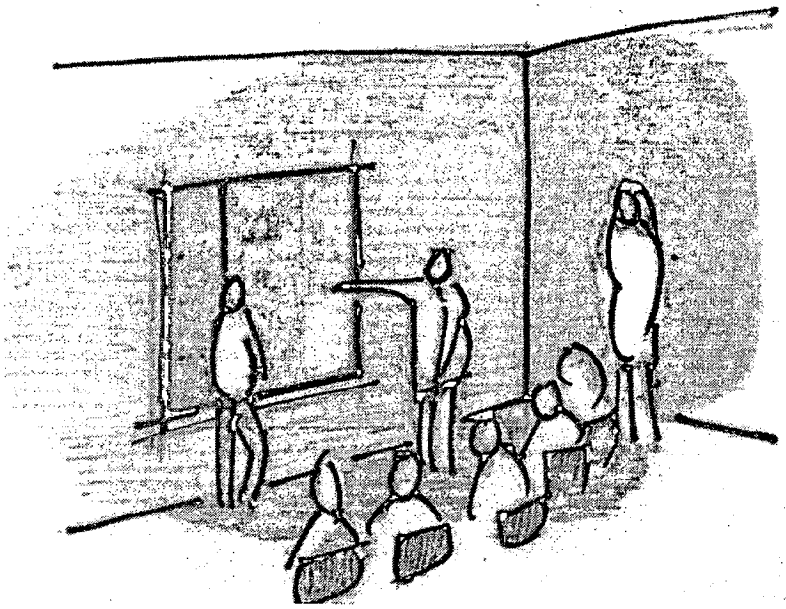


Figure 6.16 Screen positions are very crucial in all learning spaces

- Screens shall be oriented [Figure 6.16] towards the "center of gravity" of the seating area so students in all seats can easily see projected images and the adjustable-height marker board. In classrooms with only one screen, locate screen on right side of instructor area. Minimum distance between screen and closest seat:
  - Same as screen width: Rooms with 10-48 seats
  - 1.5 times screen width: Larger rooms

- All learning rooms accommodating at least 15 students shall have a personal computer at the instructor's workstation that is connected to the network, the room's projection system, and audio components.

b) Furniture suited to a range of technologies.

c) Ensure that technology devices and their input devices are specified and arranged to minimize awkward postures and support flow of teaching and learning tasks.

d) There should be appropriate control systems for the range of technologies in the learning spaces.

- Control systems for electronic components shall have the capability of controlling all of the technology components as well as projection screens, room lights, and shades operated by electric motors. Systems shall:
  - Be programmable and capable of being re-programmed
  - Interface properly with controls for screens, lights, and shades

- Have a touch panel on the instructor workstation with easy-to-read, simple menu choices

➢ Provide lighting and audio-visual system controls that are easy to use:

- Pre-set light levels on the audio-visual control system menu
- Wall-mounted switch for seating area lights near each entrance door
- Wall switches in one area near the instructor workstation, mounted 48" above the floor
- Dimmer switches that allow lights to be turned fully on, dimmed, or off.
- On-off switches for marker board lights.

Guideline 2

Design should outline a strategy to assess and update existing spaces and plan for new ones based on campus priorities for technology provision.

TECHNOLOGY & TOOL TYPE	LOW	MEDIUM	HIGH
Flexible lighting	On/off or full room dimming	Dimming plus filtering (shading) /blocking	Zoned lighting with flexible spot control for capture
Furniture / Room Configuration	Fixed seating and room configuration	Adjustable seating, but fixed room configuration fully configurable seats, tables and dividers (tables/benches/ dividers)	Fully configurable seats, tables and dividers
Teaching station	None	Fixed and configurable	"Moveable and configurable"
Sound	No resident infrastructure	Single presenter, wireless microphone delivered	Multi-presenter, multi-participant microphone/capture access (fixed system, resident access)
Room Acoustics	No special treatment, dampening, or HVAC isolation	Special treatment, some dampening & HVAC isolation or balancing	Acoustically treated and balanced, no refraction & highly isolated from external sound
Chalk / White boards	Single fixed	Multiple boards (on slides	Multiple movable boards
Network Access	Single wire port, Internet only	Wired ports with Internet & LAN access, marginal wireless neighbourhood	Dedicated wireless access or fully wired classroom with Internet and LAN access
Data Access	By Optical drive or disk	Access to campus resources	Highly personalized institutional repository at enterprise & departmental access level
Printing	None	Printer restricted to specific lab or learning space	Distributed to "on demand" pick-up

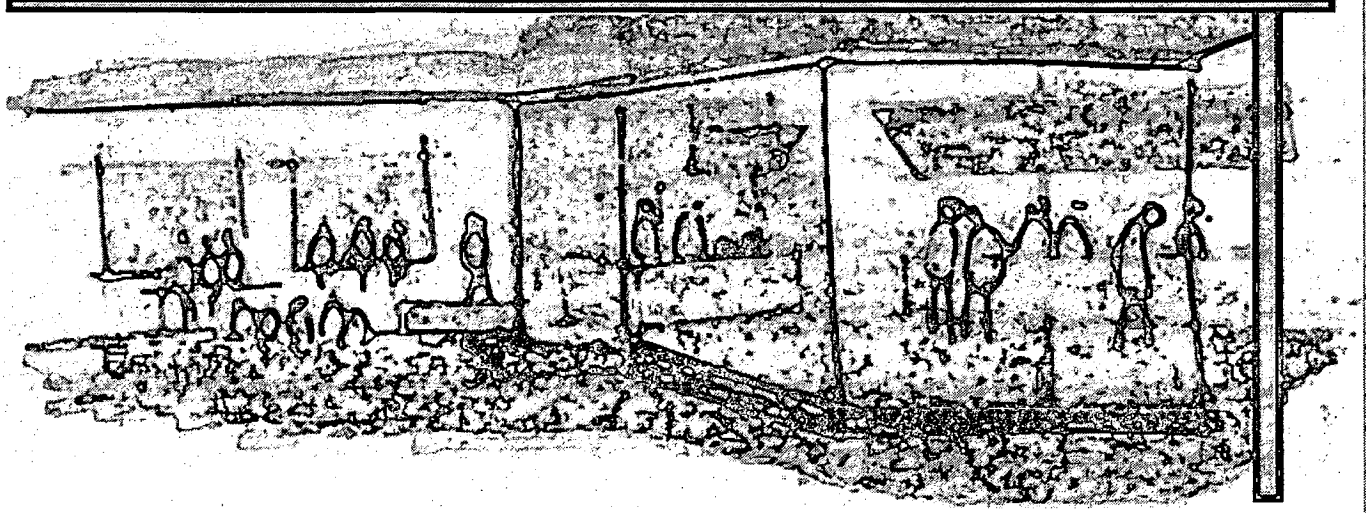
Table 6.10 Technology update strategy for learning spaces

"High" level interventions offer the latest teaching and learning technologies and should be positioned strategically. "Medium" and "Low" levels of interventions should be considered in relation to [Table 6.10] both departmental and centrally located spaces across the campuses. Rooms performing at "low" levels should be upgraded to the "medium" baseline over time.

6.6 SUMMARY

Well-crafted educational frameworks require learning environments that support curiosity as well as literacy and numeracy. Learners must be curious, self-directed, and able to work across platforms to succeed in tomorrow's global context. Likewise, campuses must integrate a new understanding of learning for the 21st century that extends beyond traditional building solutions. Given this understanding, the four strategies of design criteria are essential to the creation and maintenance of innovative educational facilities. The chapter discussed on each of the strategies in detail. The next chapter will be on the design application at IIT Gandhinagar campus.

7.0 CHAPTER
DESIGN IMPLEMENTATION
IIT Gandhinagar



7.1 INTRODUCTION

The chapter discusses the design scheme at zoning and blocking for the academic core level and basic building planning for two blocks to show the various learning spaces that can be included in a department complex and its arrangement and flow of spaces. The design level does not intend to detail out the entire academic zone. Only a learning block has been designed as a model which can be replicated in the major departmental zone and a science department with their spaces is also the scope of the design work.

7.2 KEY PLANNING FOR THE IIT-GN CAMPUS

- Flexible, permeable and open learning spaces of varying scales, both within built forms and the external environment.
- Design of building envelope provides direct visual connections to the 'learning precinct',
- Exposed architecture, using the building as a teaching tool to demonstrate how architects work with materials and the environment.
- Promote sensory elements of identity and community through unique building form.
- Adaptive learning spaces for unique learning experiences, within clusters for student learning, common workspaces and flexible use rooms.
- Students should be able to move about, with the development of a central location; 'everyone's group, everyone's house'.
-

7.3 PLANNING AND ZONING

The major campus zones have been planned around the left section of the site with the area above the Palaj village acts as a buffer recreational zone. The academic core forms the central zone with the administrative zone beneath it. The entry is defined by two axes which encloses the administrative to lead to nodes of academic core. The housing zones are on either sides of the academic core with the conservation and research zone within minimum intervention on the rich land right to Palaj village. The river edge can be designed for informal spaces. [Refer Sheet 7.1 & 7.2]

7.4 OBJECTIVES FOR THE ACADEMIC CORE PRECINCT

- To strengthen the role and function of the Core as the heart of the Campus;
- To accommodate an increase in student population through the consolidation and remodelling of the Core;

- To protect and enhance the passive open space and environmental qualities of the northern portion of the Core; and
- To enhance the amenity within the core for students and academic staff.
- Upgrade and visually strengthen the arrival and entry points to the precinct with landscaping and signage.
- Activate pedestrian zones within the Core with ground floor activities, cafes and shops where appropriate.

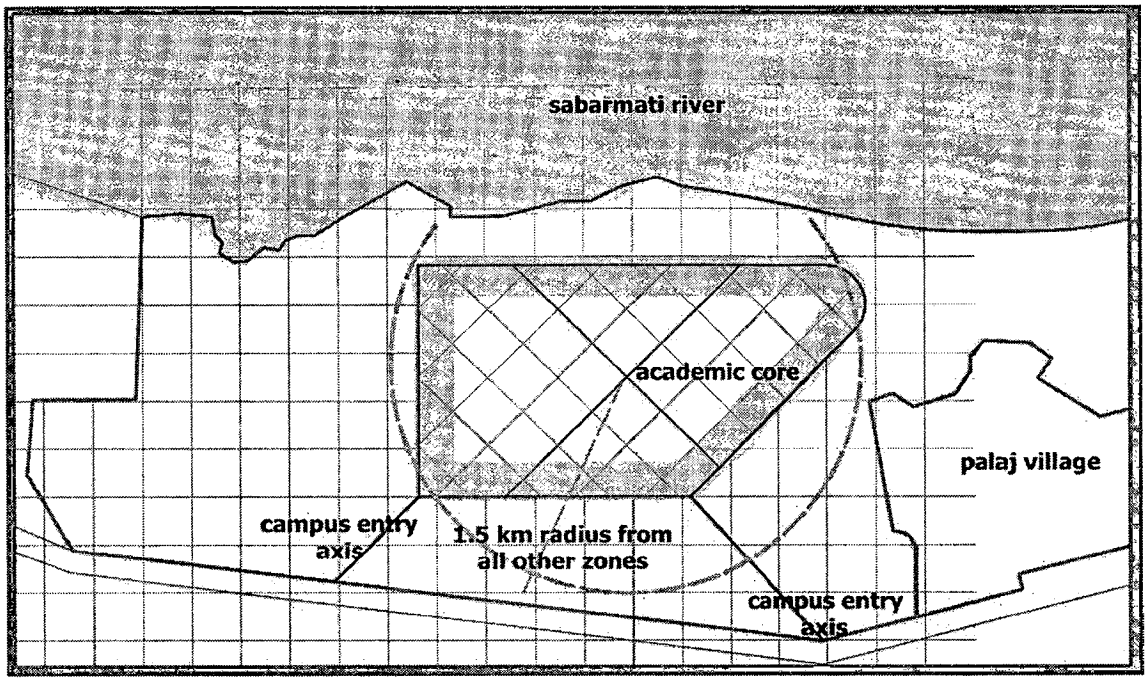


Figure 7.1 Academic core planning

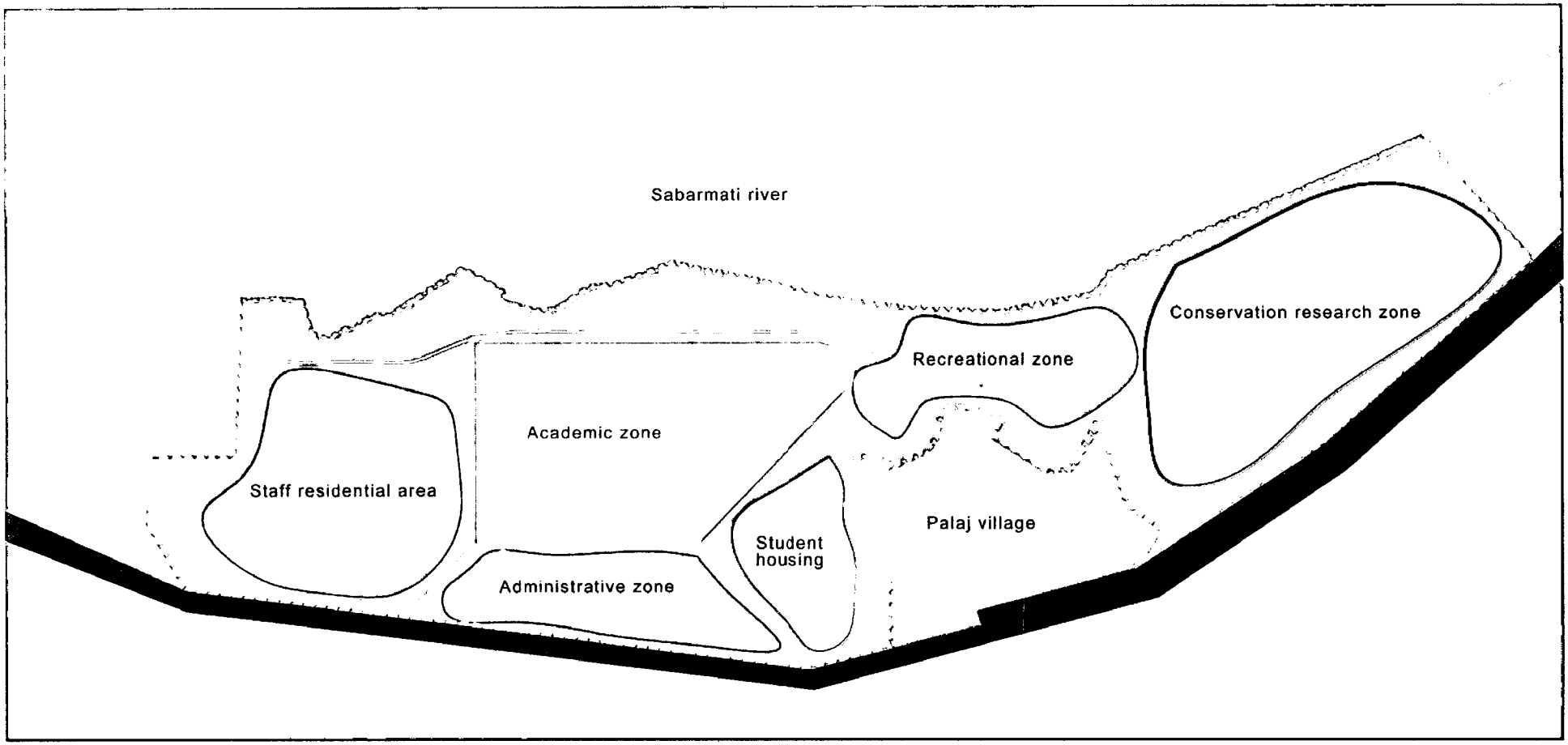
7.5 URBAN STRUCTURE – IIT GN

The key structural organising element for the Campus is the 100m north-south orientated square. This grid has been used to locate the pedestrian, road and services networks as well as provide a site for individual buildings. This grid reflected the philosophy of freestanding buildings set in a landscaped setting albeit in a concentrated form. The rationale for this approach is that streets should become more activated, pedestrian friendly and provide passive surveillance.

The relationship of the two grids, which are approximately at 45 degrees to each other, is considered as a positive way of distinguishing the Academic Core from the surrounding non-academic buildings. This is important so as to retain the identity of the Institute as a relatively tight cluster of buildings surrounded by non-academic buildings which should still be read as part of the Campus. The relationship between the north-south/east-west street and pedestrian grid of the Academic Core and the entry point at 45 degrees makes for interesting vistas, quite distinct from an overall orthogonal grid. The

CONCEPT

Zoning on the functional relationships with grid planning for the academic core. The This grid reflected the philosophy of freestanding buildings set in a landscaped setting albeit in a concentrated form. The rationale for this approach is that streets should become more activated, pedestrian friendly and provide passive surveillance.Design of buildingblock provides direct visual connections to the 'learning precinct' - academic core. Flexible, permeable and open learning spaces of varying scales, both within built forms and the external environment.



ZONING

The major campus zones have been planned around the left section of the site with the area above the Palaj village acts as a buffer recreational zone. The academic core forms the central zone with the administrative zone beneath it. The entry is defined by two axis which encloses the administrative to lead to nodes of academic core. The housing zones are on either sides of the academic core with the conservation and research zone within minimum intervention on the rich land right to Palaj village.

Zoning plan : I I T Gandhinagar N

Sciences department complex

differnt block for the sciences departments with new learning spaces. the space design concepts have been applied for flexibilty and collaborative spaces.

Expansion sector

academic block expansion zone for future buildings. the sector will be very much an integral part of the core.

Academic plaza

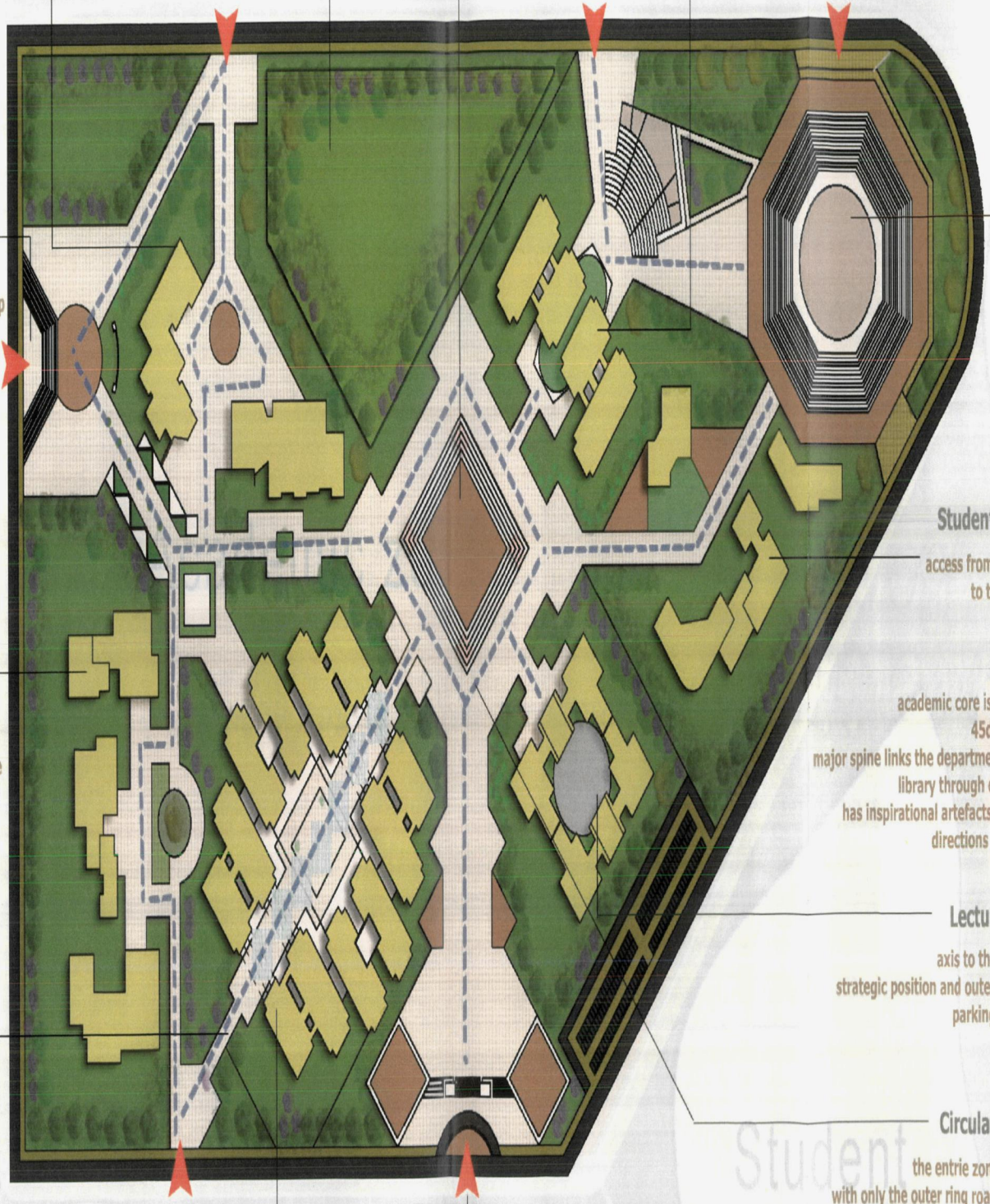
hub of social activity bringing together people in an outdoor environment contextual pathways places the plaza at the nexus of pedestrain traffic.

Library

along the major academic axis strategic location informal seating for outdoor learning along the riverside

Open air theatre

recreation zone at this edge of the academic zone with adjoining students cemter and cafe



Secondary entry

from the outer loop second entry into the academic core. links to the department complex through a focal plaza.

Students center & cafe

access from the loop and close to the recreation zone.

Workshops & laboratory

the experimental spaces have been planned close to the department complex with outdoor breakout zones and connecting focus.

Academic core

academic core is planned along the 45deg N_S 100m grid. major spine links the departmentcomplex and the library through central plaza which has inspirational artefacts to lead to the four directions to seek knowledge.

Lecture hall complex

axis to the main plaza with a strategic position and outer ring entry directly parking faculites provided

Circulation & planning

the entrie zone is pedestrianozed with only the outer ring road for vehicular way. entries into the core from this ring road is from two main nodes. two major axis formed thebasis for the entire blocking of the approx: 23,600sqm area of academic zone

Academic spine

The interaction spine with breakout area and study nooks for new learning experience

Department complex

learning & teaching hub approx: 13700sqm of area, with spaces exploiting the riverside views

Main entry into the academic complex

primary axis to the central plaza- interaction hub of the academic core

Academic core plan : I I T Gandhinagar

Sheet 7.2 N

opportunity has been taken in this Concept Plan to reconcile and celebrate the interface of the two grids and take full advantage of the urban design

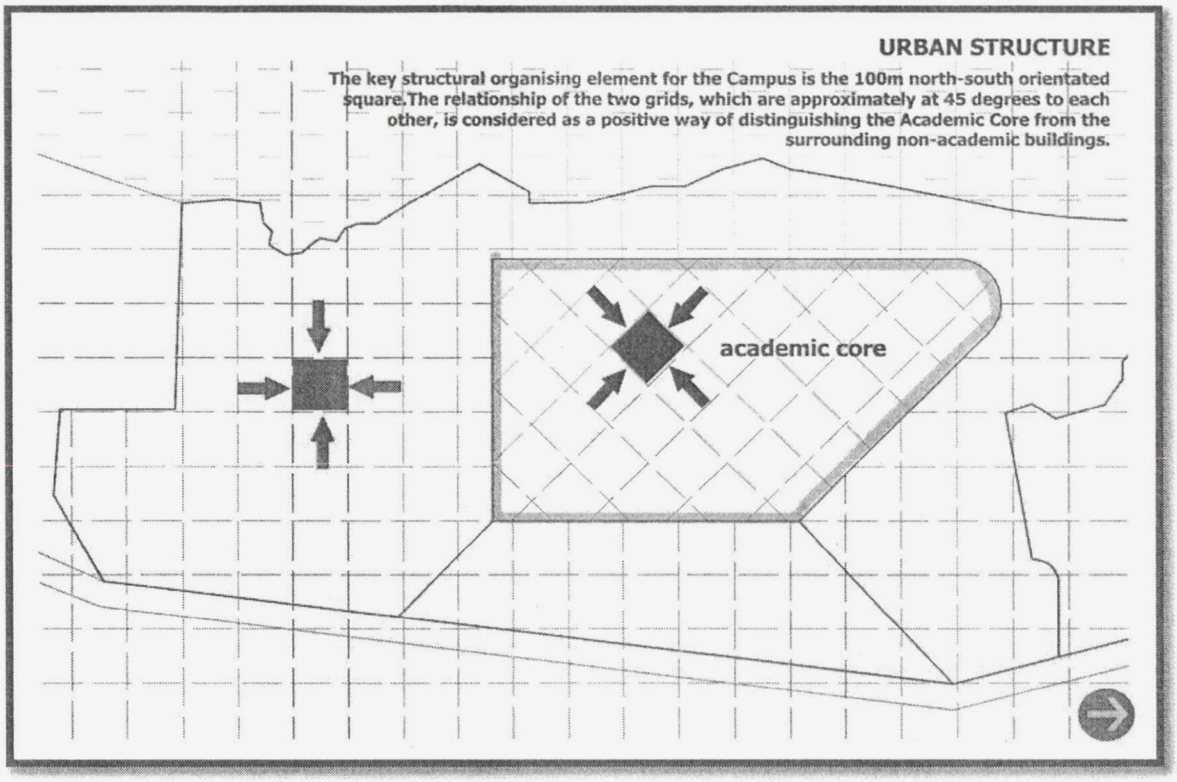


Figure 7.2 Urban structure of the academic core

7.6 BUILDING LEVEL DESIGN SCHEMES

7.6.1 Department learning block design

More variety and types of classrooms are a much-needed resource for the new institute as it pioneers new ways of teaching and learning. Be it breakout zones or study rooms for 6 to 10 students, a seminar room for 15, 25, or 40 people, or a tiered classroom that holds 66-80 students, each room has been designed providing more space per person than usual classrooms to better enable dialogue and collaboration.

Flat classrooms accommodate various group sizes through the use of flexible table configurations, making the room's dimensions appropriate to the number of people using it. Each classroom contains sophisticated technology, which may include dual and/or triple projection, touch panel-based systems for audiovisual devices, flat-panel displays, and cameras for capturing video of sessions. Embracing the Gandhinagar climate, each classroom has natural light permeating the space. [Sheet 7.3]

7.6.2 Science Department design

The floor plan for this quad allows choosing an active, collaborative learning environment or a more solitary, quiet one for research and learning processes/ Flexibility was the key to the design of the spaces in this department. [Sheet 7.4]

7.6.3 A learning studio design module

The intent is to show how to have a learning studio (1), collaborative classroom (10,16), tech lab (11) and also storage and other utilities for them and the faculty hubs required for the department space. The highlighted area is the connection corridors which link these blocks to other designed blocks of the academic core. The position and location for various technology requirements have been detailed out with area for display too.

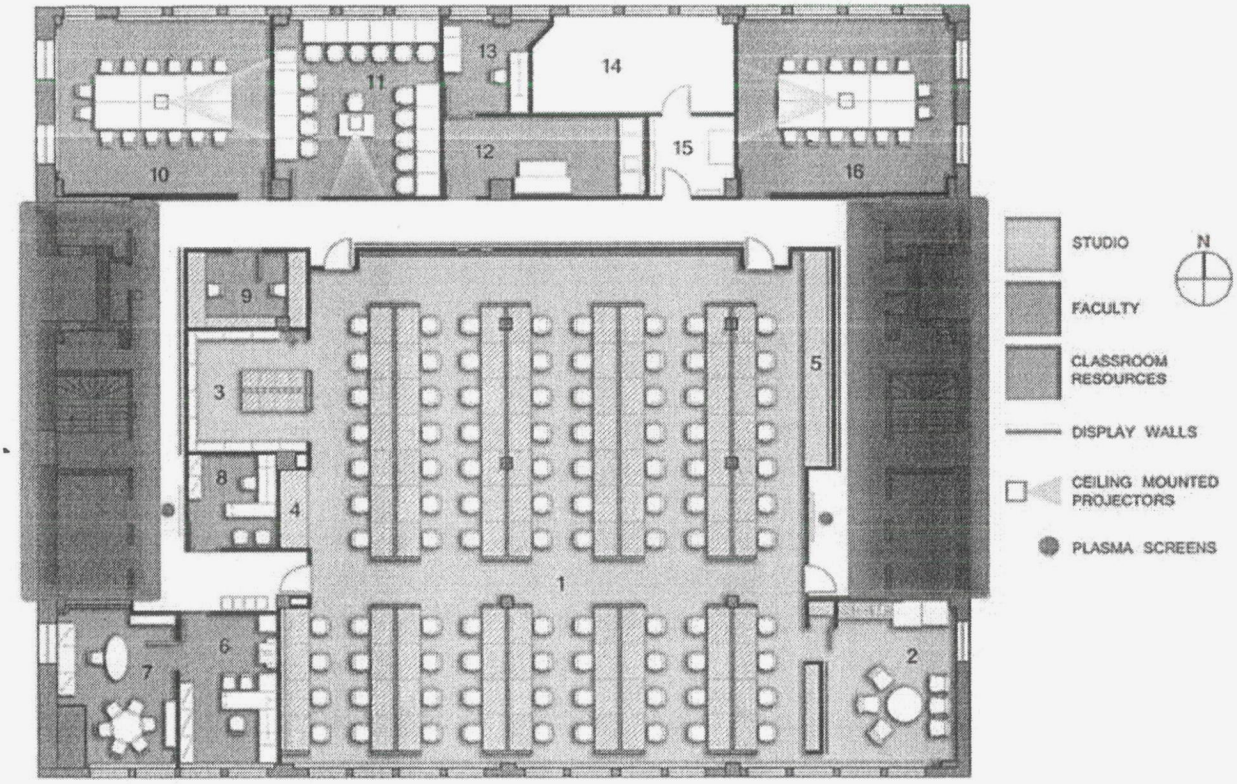
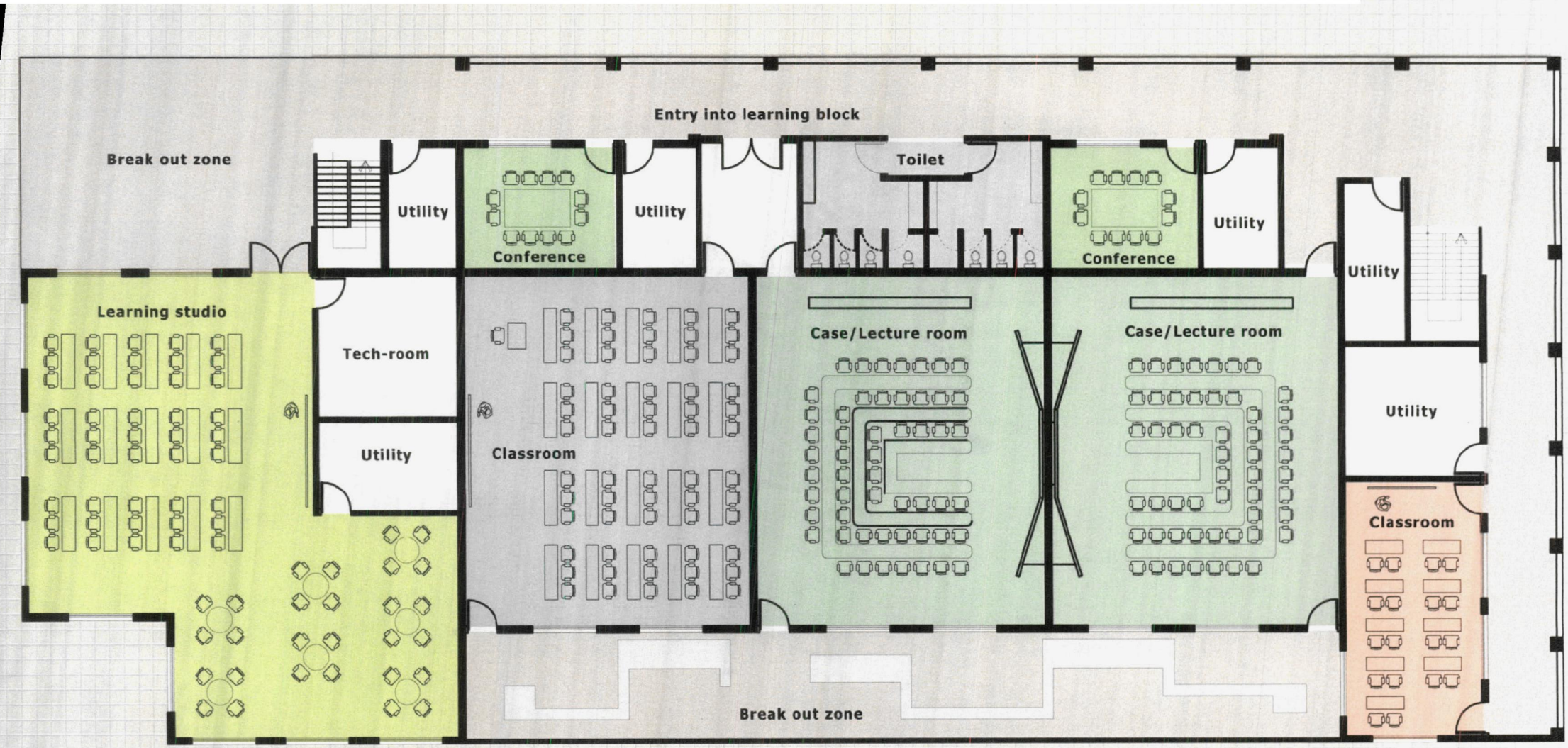


Figure 7.3 Learning studio module for a department

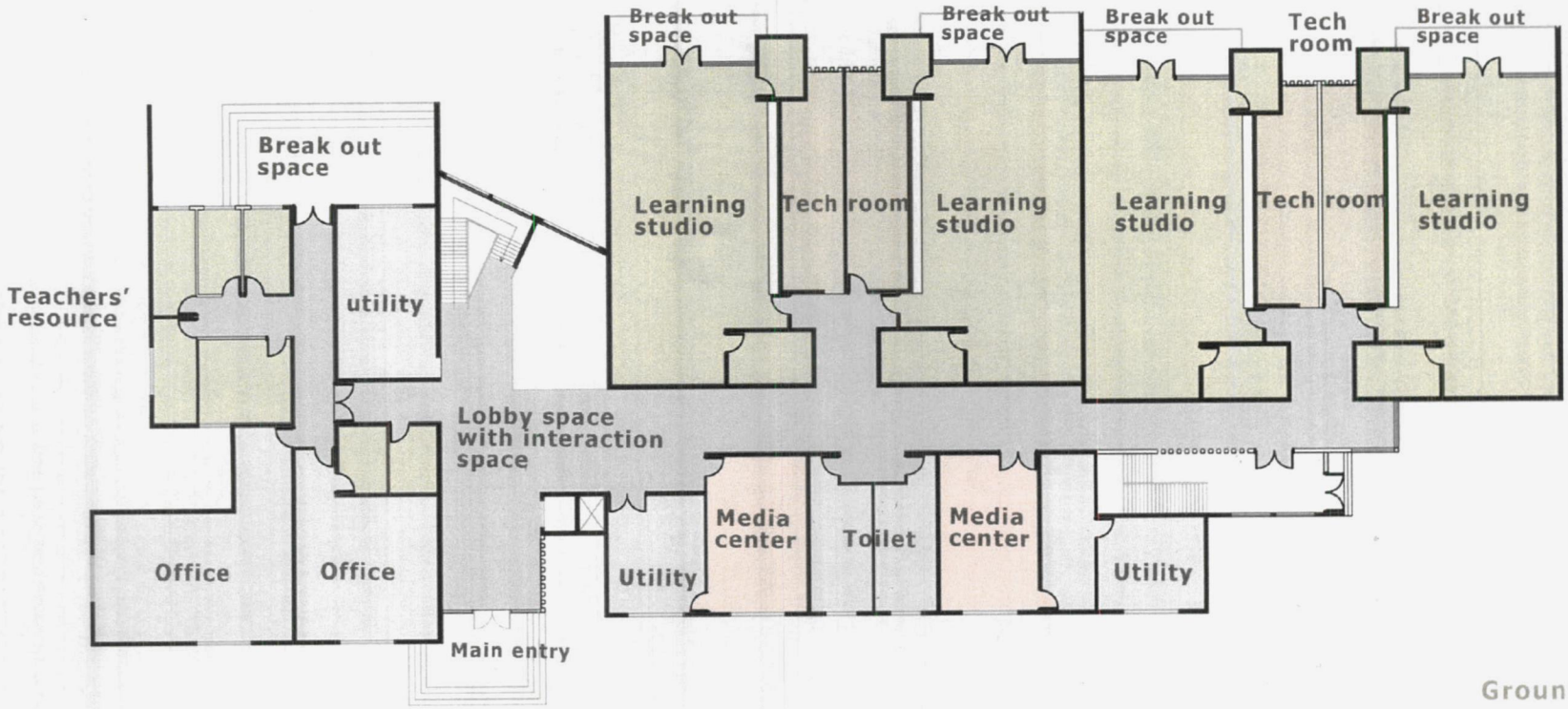
7.7 SUMMARY

The design scheme has been discussed in this chapter and the next is the concluding chapter with views on future research and recommendations.

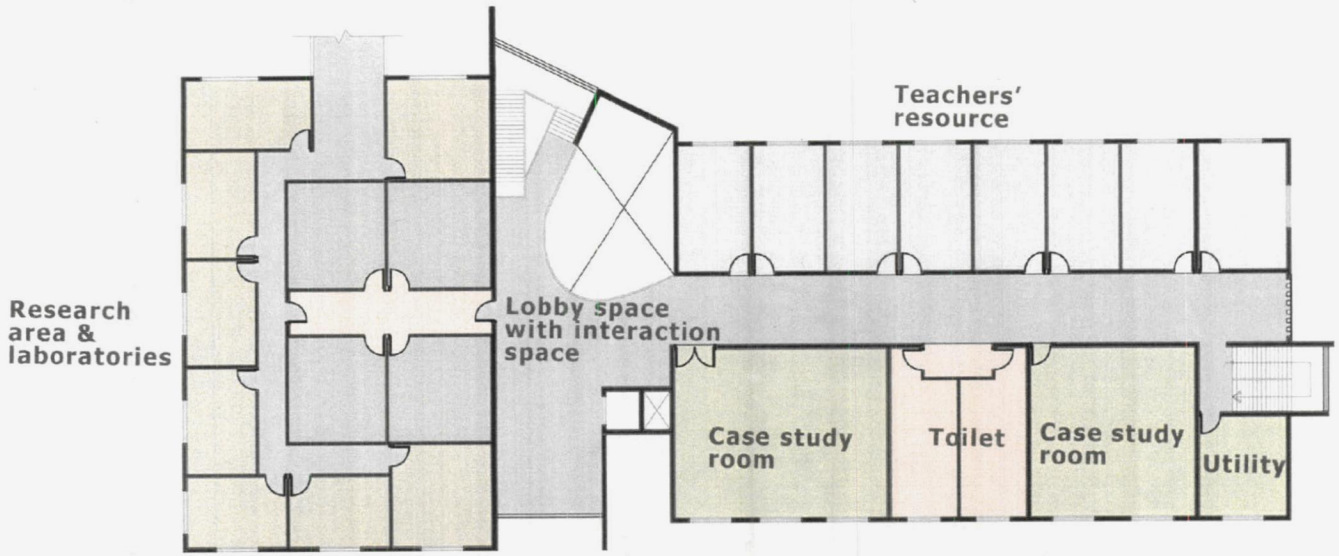


TYPICAL FLOOR PLAN OF LEARNING BLOCK: I I T Gandhinagar

Sheet 7.3



Ground floor plan

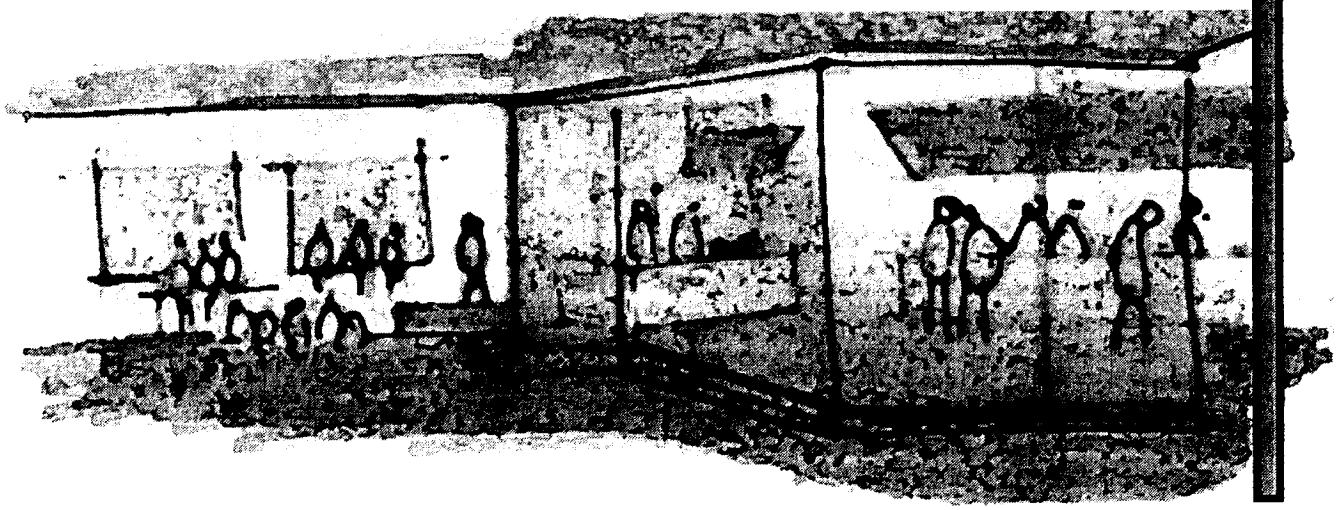


First floor plan

FLOOR PLAN OF SCIENCE DEPARTMENT: I I T Gandhinagar

Sheet 7.4

8.0 CHAPTER
CONCLUSION & RECOMMENDATION



8.1 FUTURE RESEARCH

The key to getting a space that works for a campus is being absolutely crystal clear about the pedagogical aspects one want to design for. The need is to consciously design for the learning that happens in there. In fact the new space must be stimulating to take the pedagogy further. The future for the research work is to embed the learning space design principles in the procedures and protocols of the campuses who have been engaged with the research, and to take learning spaces in higher education to other campuses across the sector. This work has already begun, through a series of conference presentations and workshops. However the further need is to assess student performance on the basis of the new models developed for design of such spaces. There is need that that students and teachers should equally develop their spatial literacy and spatial vocabularies so that the learning environments they spend so much time in can become more relevant to the events occurring within. Identifying the right pedagogical style to achieve the desired learning outcome is also an area for future research where focus should also be on what learning environments suit the style and thus develop a pilot program as mentioned earlier to evaluate them. There should be a committee when a campus planning starts to develop evaluation metrics on the use of new space and develops a number of cutting edge experimental formal and informal learning spaces that can be used as a crucible for future developments of learning spaces. Its recommended that sustainability principles are also deployed in the design and building of learning spaces, and that Information Technology services give consideration to environmental sustainability when deploying infrastructure solutions.

8.2 SUMMARY AND CONCLUSION

Based on the research in the project, a series of tools is developed to further facilitate innovation and experimentation in the design of learning spaces. The design principle for these tools has been to create a common language by which academics, and designers and architects can articulate their professional expertise across academic subject areas and occupational proficiencies. The concept which links these different proficiencies is the notion of value, providing the basis for a connection between different professional discourses.

The campus needs renovation and creation of learning spaces, f or which a coordinated approach to the design of these spaces as per the analytical model is required. This approach must articulates with campus vision, which includes environmental sustainability and the hubs and spokes model, and also responds to practical issues such as larger cohort sizes. Increasing cohort sizes means that spaces need to be larger, especially when considering collaborative work; if this is not possible technology needs to be deployed that connects groups of students. However there cannot be the expectation that students and faculty and staff will instinctively know how to use educational technology. Professional and Educational Development strategies need to be developed and deployed that enables them to use new spaces effectively. Above all a campus must

evaluate and experiment with these learning spaces, to create the next generation of spaces that foster student-lead learning.

A 'pedagogy-first' approach which focuses on students identifying their pedagogical aims and selecting and sequencing tools based upon a concrete understanding of the capacities of those tools provides a flexible yet situated approach to teaching learning design. It is hoped that the process proposed herein may be utilized for educational gain in other learning design teaching settings as well as provide an impetus for future research.

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APPENDIX (A-D)

Need Assessment for learning spaces in higher education.

Changes in the design of learning spaces are being seen on more and more in campuses. This survey is intended to understand how pervasive the trend toward learning-centered space design is on campuses today.

* Required

Name of the Institute. *

Please indicate your role at the campus. *

- Faculty
- Student
- Staff
- Other:

No: of years in the campus.

Approximately, what is the institution's most recent Full Time Equivalent (FTE), Student Headcount?

- Less than 1,499
- 1,500 to 2,499
- 2,500 to 4,999
- 5,000 to 9,999
- 10,000 to 14,999
- 15,000 to 25,000
- Over 25,000
- Don't know

Please rank in order the following six characteristics in terms of the IMPORTANCE of each for your campus's learning spaces. The characteristic that is most important for your learning spaces would receive a one (1), the characteristic that is least important would receive a six (6), with the other characteristics assigned ranks accordingly.
(If any other characteristics seems to be included please specify below)

(i) ADAPTABILITY: Spaces that support people, activities and change, while keeping pace with a multitude of learning and teaching styles (including people, technology, and furnishings).

1	2	3	4	5	6
○	○	○	○	○	○

(ii) SOCIAL: Spaces that support collaboration, interaction, and engagement.

1	2	3	4	5	6
○	○	○	○	○	○

(iii) HEALTHFUL: Spaces that promote the safety and physical well-being of students, faculty, and staff.

1	2	3	4	5	6
○	○	○	○	○	○

(iv) SUSTAINABILITY: Spaces that are environmentally responsible.

1	2	3	4	5	6
○	○	○	○	○	○

(v) RESOURCEFUL: Space that support long-term efficiency and use of assets.

1	2	3	4	5	6
○	○	○	○	○	○

(vi) STIMULATING: Spaces that attract people and spark creative thinking.

1	2	3	4	5	6
○	○	○	○	○	○

Please rate how well your campus is PERFORMING on the following six characteristics of learning/ teaching spaces.

	Best	Average	Neutral	Poor	Poorest
(i) ADAPTABILITY: Spaces that support people, activities and change while keeping pace with a multitude of learning and teaching styles (including people, technology and furnishings).	○	○	○	○	○
(ii) SOCIAL: Spaces that support collaboration, interaction and engagement.	○	○	○	○	○
(iii) HEALTHFUL: Spaces that promote the safety and physical well-being of students faculty and employees.	○	○	○	○	○

(iv) SUSTAINABILITY: Spaces that are environmentally responsible.	○	○	○	○	○
(v) RESOURCEFUL: Spaces that support long-term efficiency and use of assets.	○	○	○	○	○
(vi) STIMULATING: Spaces that attract people and spark creative thinking.	○	○	○	○	○

Choose your preference for these spaces in your campus for an effective learning/teaching activity.

	High preference	Moderate preference	Neutral	Less preference	Least preference
Lecture halls	○	○	○	○	○
Case study rooms	○	○	○	○	○
Learning studios	○	○	○	○	○
Classrooms	○	○	○	○	○
Seminar rooms	○	○	○	○	○
Meeting rooms	○	○	○	○	○
Experimental/ Technology labs	○	○	○	○	○

How do you assess each of the following learning/teaching spaces in your campus?

	Excellent	Very good	Good	Fair	Unsatisfactory
Lecture halls	○	○	○	○	○
Case study rooms	○	○	○	○	○
Learning studios	○	○	○	○	○
Classrooms	○	○	○	○	○
Seminar rooms	○	○	○	○	○
Meeting rooms	○	○	○	○	○
Experimental/ Technology labs	○	○	○	○	○

Do you as think that you have enough space to use the following spaces in ways that suit your learning/ teaching needs and activities?

	Yes it has.	Needs an add on space.	Need a joining of two rooms.	Needs a different arrangement.	Needs more storage/utility space.
Lecture halls	○	○	○	○	○

Case study rooms	○	○	○	○	○
Learning studios	○	○	○	○	○
Classrooms	○	○	○	○	○
Seminar rooms	○	○	○	○	○
Meeting rooms	○	○	○	○	○
Experimental/ Technology labs	○	○	○	○	○

Do you think the following learning/teaching spaces in your campus looks:

	Dull	Fairly interesting	Stimulating	Fantastic	Overdone
Lecture halls	○	○	○	○	○
Case study rooms	○	○	○	○	○
Learning studios	○	○	○	○	○
Classrooms	○	○	○	○	○
Seminar rooms	○	○	○	○	○
Meeting rooms	○	○	○	○	○
Experimental/ Technology labs	○	○	○	○	○

If you chose 'Dull' and 'Fairly interesting' in the above question,how do you think improvements could be made with in these learning spaces.

	Colour	More light	Better displays	More interactive arrangement	Other
Lecture halls	○	○	○	○	○
Case study rooms	○	○	○	○	○
Learning studios	○	○	○	○	○
Classrooms	○	○	○	○	○
Seminar rooms	○	○	○	○	○
Meeting rooms	○	○	○	○	○
Experimental/ Technology labs	○	○	○	○	○

Can students with special education needs use these learning/teaching spaces without difficulty?

	Yes	No
Lecture halls	○	○

Case study rooms	○	○
Learning studios	○	○
Classrooms	○	○
Seminar rooms	○	○
Meeting rooms	○	○
Experimental/ Technology labs	○	○

Does outside noise interfere with learning/teaching activity in these spaces.

	Yes	No	Sometimes
Lecture halls	○	○	○
Case study rooms	○	○	○
Learning studios	○	○	○
Classrooms	○	○	○
Seminar rooms	○	○	○
Meeting rooms	○	○	○
Experimental/ Technology labs	○	○	○

As a student can you hear and understand the lectures from all parts of these spaces? OR As a teacher can you hear and understand the students in these spaces?

	Yes	No
Lecture halls	○	○
Case study rooms	○	○
Learning studios	○	○
Classrooms	○	○
Seminar rooms	○	○
Meeting rooms	○	○
Experimental/ Technology labs	○	○

These learning/teaching spaces in your campus are:

	Naturally well lit	Artificially well lit	Poorly lit	Overlit
Lecture halls	○	○	○	○
Case study rooms	○	○	○	○
Learning studios	○	○	○	○

Classrooms	○	○	○	○
Seminar rooms	○	○	○	○
Meeting rooms	○	○	○	○
Experimental/ Technology labs	○	○	○	○

Are these learning/teaching spaces suitable for projection, data shows or other activities that require control of the levels of natural light?

	Yes	No
Lecture halls	○	○
Case study rooms	○	○
Learning studios	○	○
Classrooms	○	○
Seminar rooms	○	○
Meeting rooms	○	○
Experimental/ Technology labs	○	○

Do you suffer from unusual colds, allergic reactions, unspecified illnesses or headaches after being in these learning/teaching spaces for a longer time?

	Yes	No
Lecture halls	○	○
Case study rooms	○	○
Learning studios	○	○
Classrooms	○	○
Seminar rooms	○	○
Meeting rooms	○	○
Experimental/ Technology labs	○	○

These learning/teaching spaces in your campus are:

	Air conditoned	Naturally ventilated
Lecture halls	○	○
Case study rooms	○	○
Learning studios	○	○
Classrooms	○	○
Seminar rooms	○	○

Meeting rooms	○	○
Experimental/ Technology labs	○	○

These learning/ teaching spaces in the campus are thermally comfortable throughout the year.

	Yes	No
Lecture halls	○	○
Case study rooms	○	○
Learning studios	○	○
Classrooms	○	○
Seminar rooms	○	○
Meeting rooms	○	○
Experimental/ Technology labs	○	○

If your answer was No to the previous question please specify at that time of the year you feel uncomfortable and the reason for the same.

Do u feel problems of direct sunlight glare or overheating in your learning/teaching spaces?

- ○ Yes
- ○ No

These learning spaces in the campus encourage interaction between students and faculty.

	Yes	No
Lecture halls	○	○
Case study rooms	○	○
Learning studios	○	○
Classrooms	○	○
Seminar rooms	○	○
Meeting rooms	○	○

Experimental/ Technology labs ○ ○

If you answered "NO" why do you think this interaction is lacking in these spaces of your campus.

Do you think that students can adopt a good working posture at their desk or computer workstation in the learning spaces?

- ○ Yes
- ○ No

Do you have complaints about smells and mustiness in learning/ teaching spaces?

- ○ Yes
- ○ No

If you answered yes in the previous question chose from the following,the reason for the same.

- ☐ mould and dampness on walls or in carpets
- ☐ nearby toilets or septic tanks
- ☐ badly placed exhausts from labs etc.
- ☐ students perspiring and exhalation.
- ☐ new furniture.

According to you the biggest change driving new needs on campus is:

- ☐ Technology.
- ☐ Student expectations.
- ☐ Competitions.
- ☐ Costs.
- ☐ Pedagogy.
- ☐ Other:

According to you for students in the future, the most important consideration in the physical learning spaces will be:

- ☐ Sense of belonging.
- ☐ Support for different learning styles.

- [ ] Choices.
- [ ] Interaction.
- [ ] Comfort.
- [ ] Other:

If learning can happen anywhere, the most valuable aspect of effective learning spaces will be:

- [ ] Student and faculty engagement.
- [ ] Sense of community.
- [ ] Peer collaboration.
- [ ] Unique resources.
- [ ] Structure and routine.
- [ ] Other:

In an ideal future, the most important measure of effective learning spaces will be:

- [ ] Dynamic activities around the clock.
- [ ] Ratio of faculty to student face time at any given moment.
- [ ] The number of hosted interactions, both physical and virtual.
- [ ] Demand for collaborative areas.
- [ ] Agile spaces that flex to support varied pedagogy.
- [ ] Other:

Given five minutes with the Head of your institution to talk about learning spaces on campus, what would you make sure you said?

This section is intended to know more about those physical qualities that make learning/teaching spaces most effective.

Please think about two very different learning spaces on your campus. One learning space should have the qualities that you see as creating a desirable learning space; one that enables effective learning and enhances opportunities for learning. This is Learning Space Optimal. The second learning space should be one that does not help facilitate effective learning or enhance the opportunities to learn. It's physical characteristics would be such that students would prefer not to use it. This would be Learning Space Minimal.

Please write a brief narrative describing Learning Space Optimal and the features that made you select it as one of your campus' effective and desireable learning spaces.

Please write a brief narrative describing Learning Space Minimal and the features that made you select it as one that least exemplifies an effective learning space.

Submit

Need Assessment -"Learning with Technology" : Students survey.

This survey in intended to do a gap analysis between student and faculty recommendations for resource priorities relating to technology in learning spaces in their campus.

* Required

Name of the Institution *

Please indicate how many hours per week you do homework or research from the following locations.

	Less than 3 hrs/wk	4-6 hrs/wk	7-10 hrs/wk	11 hrs/wk or more	Don't know
Departmental computer lab on campus.	○	○	○	○	○
Home/residence hall.	○	○	○	○	○
Unoccupied classrooms or lecture halls on campus.	○	○	○	○	○
Library.	○	○	○	○	○
Other WiFi locations.	○	○	○	○	○

How many total hours per week do you work?

- ○ Less than 10 hours per week
- ○ 11-20 hours per week
- ○ 21-30 hours per week
- ○ 31-40 hours per week
- ○ more than 40 hours per week

Please indicate the extent to which you agree each of the following is a useful learning resource:

	Strongly agree	Somewhat agree	Agree	Disagree	Strongly disagree
Electronic journals and academic databases.	○	○	○	○	○
Wikipedia.	○	○	○	○	○
Google Books.	○	○	○	○	○
Web-based threaded discussion tools.	○	○	○	○	○
Course websites.	○	○	○	○	○

Chat tools.	○	○	○	○	○
Digital video sharing sites (e.g. YouTube).	○	○	○	○	○

Please rate your level of agreement with the following statement, "In general, using technology tools at my Institute...."

	Strongly agree	Agree	Neutral	Strongly disagree	Don't know
Has helped my learning.	○	○	○	○	○
Increases interaction with instructors.	○	○	○	○	○
Facilitates faster feedback from instructors.	○	○	○	○	○
Makes it easier to ask instructors questions.	○	○	○	○	○
Facilitates collaboration with other students.	○	○	○	○	○
Enhances skills for future employement.	○	○	○	○	○
Allows creation of multiple versions of an assignment/project.	○	○	○	○	○
Facilitates successful completion of assignments.	○	○	○	○	○
Allows me to study more efficiently.	○	○	○	○	○
Increases my interest in coursework.	○	○	○	○	○
Provides greater control over my learning.	○	○	○	○	○
Causes instructors to demand more workload.	○	○	○	○	○
Makes it difficult for instructors to provide more in-class instruction on how to use IT.	○	○	○	○	○
Causes instructors to demand higher quality work.	○	○	○	○	○
Provides greater access to online library resources and services.	○	○	○	○	○
Has improved my writing skills.	○	○	○	○	○
Makes it more likely that I'll miss classes.	○	○	○	○	○
Makes it easier to obtain help with research.	○	○	○	○	○

Listed below are several aspects which focus more effort and resources on modern learning spaces. Please indicate your level of priority for each

	High priority	Moderate priority	Neutral	Low priority	Don't know
More public computing labs/spaces.	○	○	○	○	○
More technology classrooms.	○	○	○	○	○
Expanded technology classroom tools (e.g., video course capture, smartboards, annotation tablets).	○	○	○	○	○
Library facilities/services.	○	○	○	○	○
Digital content storage system/repository.	○	○	○	○	○
Facilities to use technology tools (scanners, A/V editing, multimedia).	○	○	○	○	○
Facilities for students to learn how to use technology tools (e.g., scanners, A/V editing, multimedia incorporation).	○	○	○	○	○
Emerging technologies (e.g., blogs, wikis, podcasting).	○	○	○	○	○
Improving discipline-specific software.	○	○	○	○	○
More "hands-on" technology-enabled classrooms/labs.	○	○	○	○	○
Small, technology-enabled work group spaces.	○	○	○	○	○

Submit

Need Assessment- "Teaching with Technology" faculty survey.

The broad purpose of the survey is to explore how faculty use technology as a teaching tool, and to what extent faculty encourages student use of technology primarily through online resources and incorporation of images and/or multimedia as part of lectures or formal presentations.

1. Name of the Institute.

2. Please select the department in which you do the majority of your teaching.

- Engineering.
- Arts & Sciences.
- Management
- Architecture & Planning.
- Other:

3. Please indicate your instructional role at the Institute.

- Professor.
- Associate Professor.
- Assistant Professor.
- Graduate/Teaching Assistant.
- Other:

4. When teaching with technology and preparing course materials, do you generally consider yourself:

- Expert, use multiple technologies with ease.
- Very comfortable, require little assistance with material preparation or technology classrooms.
- Comfortable, but require some consultation and occasional troubleshooting assistance.
- Uncomfortable, require a moderate amount of consultation and support.
- I avoid the use of technology in teaching.
- Other:

5. How do you encourage students to use instructional technologies? (Check all that apply.)

- [ ] Suggest use of online resources.
- [ ] Suggest use of presentation software for individual/group projects.
- [ ] Suggest "creative use" of multimedia for papers/presentations.
- [ ] Suggest inclusion of digital images in presentations/papers.

- [ ] By incorporating use of technology in lectures to encourage "active learning".
- [ ] By offering a course through a non-traditional delivery format (e.g., video or online access).
- [ ] I do not encourage students to use instructional or multimedia technologies.
- [ ] Other:

6. Please indicate your sources of help when working with the following technologies.

	Department IT Support	Library services	Colleagues	Online sources	Students
In preparing course materials.	○	○	○	○	○
For incorporating multimedia.	○	○	○	○	○
In learning new technologies.	○	○	○	○	○
In learning or using discipline-specific software.	○	○	○	○	○
Test-scoring devices	○	○	○	○	○
If office-computer "not working".	○	○	○	○	○

7. To what degree does each of the following attract you to teaching with technology?

	Not at all	Small degree	Moderate degree	Large degree	Don't know
Ability to address different student learning styles.	○	○	○	○	○
Desire to facilitate communication between instructor(s) and students.	○	○	○	○	○
Desire to facilitate communication among students.	○	○	○	○	○
Desire to increase students' access to course materials.	○	○	○	○	○
Ability to use games & simulations to teach certain topics.	○	○	○	○	○
Potential to make teaching more efficient (time saving).	○	○	○	○	○
Ability to expect higher quality work from students.	○	○	○	○	○
Student demand for use of technology.	○	○	○	○	○
Personal enjoyment of working with technology.	○	○	○	○	○
Desire to improve					

access to educational materials to students.	○	○	○	○	○
Desire to reduce cost of education to students.	○	○	○	○	○
Desire to provide access to non-traditional or off-campus students.	○	○	○	○	○

8. To what degree do each of the following serve as a technical barrier to teaching with technology?

	Not a barrier at all	Small degree	Moderate degree	Large degree	Don't know
Network / Internet connection problems.	○	○	○	○	○
Lack of current hardware and/or software.	○	○	○	○	○
Lack of access to a technology-enabled classroom.	○	○	○	○	○
Lack of technology support in classrooms or labs.	○	○	○	○	○
Inadequate technical staff support in general.	○	○	○	○	○
Lack of necessary technical skills.	○	○	○	○	○
Lack of teaching skills specific to the technology-enhanced environment.	○	○	○	○	○
Disciplinary content unsuited to delivery via technology.	○	○	○	○	○

9. To what degree do each of the following serve as an administrative or training barrier to teaching with technology?

	Not a barrier at all	Small degree	Moderate degree	Large degree	Don't know
Amount of time required to learn about technology tools.	○	○	○	○	○
Amount of time required to use technology in class.	○	○	○	○	○
Inadequate student access to technologies.	○	○	○	○	○
Doubts about the usefulness of teaching with technology.	○	○	○	○	○
Lack of "hands on" technology classroom space(s).	○	○	○	○	○
Difficulty keeping up with changes in	○	○	○	○	○

technology.					
Lack of formal recognition (e.g., promotion/tenure) for educational technology use.	○	○	○	○	○

10. Below are several issues on which focussed efforts and resources are required for future needs for a range of learning/teaching spaces. Please indicate your level of priority for each.

	High priority	Moderate priority	Neutral	Low priority	Don't know
More public computing labs/spaces.	○	○	○	○	○
More technology classrooms.	○	○	○	○	○
Expanded technology classroom tools (e.g., video course capture, smartboards, annotation tablets).	○	○	○	○	○
Library facilities / services.	○	○	○	○	○
Improving student/faculty IT literacy skills.	○	○	○	○	○
Seminars about improving pedagogy through use of instructional technologies.	○	○	○	○	○
Facilities to use technology tools (scanners, A/V editing, multimedia).	○	○	○	○	○
Facilities for students to learn how to use technology tools (e.g., scanners, A/V editing, multimedia incorporation).	○	○	○	○	○
Improving discipline-specific software.	○	○	○	○	○
More "hands-on" technology-enabled classrooms.	○	○	○	○	○
Small, technology-enabled work group spaces.	○	○	○	○	○
Emerging technologies (e.g., blogs, wikis, podcasting).	○	○	○	○	○

11. In thinking about "the perfect technology-enabled classroom" how would you rate the importance of the following features?

Moderate

	High priority	priority	Neutral	Low priority	Don't know
Chalkboard (traditional)	○	○	○	○	○
Whiteboard	○	○	○	○	○
" Smartboard " (interactive whiteboard)	○	○	○	○	○
Variable lighting control	○	○	○	○	○
Video projector	○	○	○	○	○
Acoustically treated rooms (so students can better hear instructor / each other)	○	○	○	○	○
Digital lecture recording	○	○	○	○	○
Projection display of selected student's workstation or laptop	○	○	○	○	○
Audience Response System ("clickers")	○	○	○	○	○
Wireless Internet Access	○	○	○	○	○

12. Is there anything else that you would like to share about teaching with technology at the Institute?

Please click "Submit" to submit your responses. Thank you for your feedback :-)

Submit

Assessment of Campus Culture and Values.

Efforts to shape and strengthen campus culture and value should be informed by and consciously directed toward any Institute's larger mission and values. That is, the campus environment should reflect the Institute's core mission and values, and should foster attitudes, relationships, and actions that directly or indirectly promote those values. These values are a part of the design of campuses and its spaces especially the learning/teaching spaces and hence through this survey I intend to assess how members of the Institute community contribute to that mission with regard to campus culture.

Please indicate your role at the campus.

- ○ Faculty
- ○ Student
- ○ Other:

Differences of opinion and viewpoint are respected at your campus.

	1	2	3	4	5	6	7	
Strongly Agree	○	○	○	○	○	○	○	Strongly Disagree

I feel safe when I am in the campus.

	1	2	3	4	5	6	7	
Strongly Agree	○	○	○	○	○	○	○	Strongly Disagree

The Institute recognizes and rewards excellence.

	1	2	3	4	5	6	7	
Strongly Agree	○	○	○	○	○	○	○	Strongly Disagree

There is social and learning interaction in the campus.

	1	2	3	4	5	6	7	
Strongly Agree	○	○	○	○	○	○	○	Strongly Disagree

The campus is attractive in appearance.

	1	2	3	4	5	6	7	
Strongly Agree	○	○	○	○	○	○	○	Strongly Disagree

People at the campus are generally friendly and helpful.

	1	2	3	4	5	6	7	
Strongly Agree	○	○	○	○	○	○	○	Strongly Disagree

I am happy to be in this Institute

	1	2	3	4	5	6	7	
Strongly Agree	○	○	○	○	○	○	○	Strongly Disagree

I feel that the campus spaces foster healthy relationships and strengthen attitudes.

	1	2	3	4	5	6	7	
Strongly Agree	○	○	○	○	○	○	○	Strongly Disagree

I feel that the campus design is sensitive to the environment and related issues.

	1	2	3	4	5	6	7	
Strongly Agree	○	○	○	○	○	○	○	Strongly Disagree

Racial and cultural differences are honoured at the campus.

	1	2	3	4	5	6	7	
Strongly Agree	○	○	○	○	○	○	○	Strongly Disagree

If I express my opinions clearly, I know that they will be heard and considered by the Institute administration.

	1	2	3	4	5	6	7	
Strongly Agree	○	○	○	○	○	○	○	Strongly Disagree

If I had it to do over again, I would choose to be at this same Institute.

	1	2	3	4	5	6	7	
Strongly Agree	○	○	○	○	○	○	○	Strongly Disagree

I would recommend the Institute to other people.

	1	2	3	4	5	6	7	
Strongly Agree	○	○	○	○	○	○	○	Strongly Disagree

I feel respected and supported by students, faculty and staff in the campus.

	1	2	3	4	5	6	7	
Strongly Agree	○	○	○	○	○	○	○	Strongly Disagree

Submit