ENGINEERING RESEARCH
JOURNAL
FACULTY OF ENG. SHOUBRA

مجلة
البحوث الهندسية
لكلية الهندسة بشبرا

بسم الله الرحمن الرحيم

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تحية طيبة وبعد .....

يسعدنا أبلاغ سيادتكم بأن البحث المقدم منكم لمجلة البحوث الهندسية – كلية الهندسة بشبرا
عنوانه :-

Smart Learning Spaces Moving Towards a Smart Campus.

قد تم تحكيمه وقبولة للنشر فى العدد القادم

رئيس التحرير

٢٠١٥/٤/١٤

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١٠٨ شارع شبرا – القاهرة Fax 2023336 ☎ 2050033 – 2050010

Smart Learning Spaces: Moving Towards a Smart Campus

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Abstract: Concept of traditional classrooms at campus has been changed nowadays to be 'smart' Learning spaces which correspond to the needs of our smart building era. Nowadays, students prefer to interact with information and receive near-instantaneous responses, so they need different learning environment which engages them in active learning and collaboration. Lately, learning process may be occurred in different physical environment whether classroom spaces as formal learning or by serendipitous interactions among individuals as informal learning. This paper discusses the new types of learning spaces, their classification and how these spaces are designed or reshaped in response to changing educational styles and to incorporate new information technology.

Keywords: Smart, Flexible, Technology, Learning space, Campus.

1. INTRODUCTION

Smart Technologies effect on student use of space as well as teaching and learning process, and the shape of learning space. [1] By virtue of technology learning became everywhere. New types of learning spaces not only incorporate technology, they also create new patterns of social and intellectual interaction. These trends suggest new strategies for overall campus design. In essence, the entire campus becomes an interactive learning device. Learning Spaces (physical or virtual), which represent more than 60% of all campus spaces, can have an impact on learning process. It can bring people together; it can encourage exploration, collaboration, and discussion. Or, space can carry an unspoken message of silence and disconnectedness. [2]

General learning spaces have been dominated in the last century to bring classrooms into the modern century, through tutor-focused, one-way facing and presentational, with seating arranged in either a U shape or in straight rows. Technologies have subsequently added interactive or conventional whiteboards mounted on the wall behind the instructor, ceiling-mounted projectors with cabling to a laptop, a wireless network or wired computers but these have rarely altered the dynamics of the design. All of these parameters convert classroom to be smart and effective learning space. Many new models of learning spaces have emerged over the last few years. Type of teaching and learning mode are

the two main factors which control space form and size, furniture, and the level of technology that should be used inside the space.[3]

2. SPECIFICATION OF SMART LEARNING SPACE

Learning space should be able to motivate students and promote learning as an activity, support collaborative as well as formal practice, and provide a personalized and inclusive environment, so it should have the following characteristics : [4]

- 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 energize and inspire learners and tutors.
- Supportive: to develop the potential of all learners.
- Enterprising: to make each space capable of supporting different purposes.

3. CLASSIFICATION OF SMART LEARNING SPACES AT SMART CAMPUS

Learning Spaces are mainly divided according to the type of teaching, space tasks, and the specific requirements needed for this task, i.e. physical environment needed for seminar rooms or classroom is completely different from the laboratories ones. So analysis for both the learning activity and the associated physical spatial needs should be described in design process. Therefore smart learning spaces have been classified into following major types [5]:

- Group teaching/learning
- Simulated environments
- Immersive environments
- Peer-to-peer and social learning
- Clusters
- External spaces.

The following attributes should be studied in each smart learning space major type during the design process to define a clear outline for each one: [6]

- Space type (dedicated versus flexible).
- Space form, proportions and size.
- Furniture type and layout through define grade of interaction (individual versus group).
- Category of technology used inside the space, such as display modes.

The previous smart learning spaces major types are also classified to sub types as shown in Fig. 1

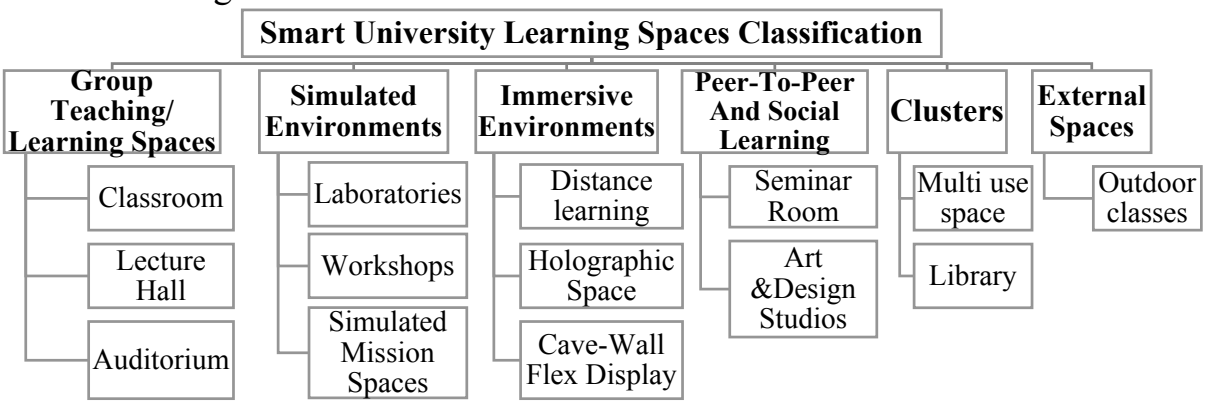

FIGURE 1. Smart University Learning Spaces Classification

3.1.Group Teaching/ Learning Spaces

Group Teaching/Learning spaces ,which are mainly consisted of classrooms and teaching halls , are considered the main spaces for formal learning process at the campus, it represent around 10-25% from total university space and more than 40% of learning spaces areas, so it'll be discussed minutely in the next part. [7] The new smart spaces are being transformed from traditional way which academic teachers is 'sage on the stage' to incorporate multiple learning modes that he is 'guide by the side', while the student is combining the role of quietly reflective absorber of ideas with that of active participants as shown respectively in Fig.2, Fig.3,and Fig.4.

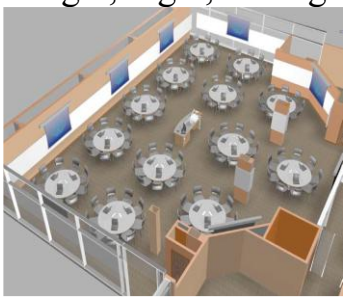

FIGURE 2. Classroom [8]

FIGURE 3. Lecture halls [9]

FIGURE 4. Auditorium [10]

The previous three figures illustrate how the concept of spaces layout had been changed to get the instructor more interact with the students by central layout

3.1.1. Size and form

Size of space depends mainly on students' capacity as shown in Table1.The preferred proportions for the Space is to be nearly square as shown in Fig. 5. This is because learning spaces which are too wide make it hard for instructors to maintain eye contact and typically have poor sightlines, and the deeper one makes it hard for students in rear rows to interact with instructors and other students. Therefore the preferable size learning spaces in a 2:3 or 3:4 width to

length ratio. [11] Spaces should have a shape based on "viewing angles" from projection screens to encourage interactive discussion while providing good sight lines, as shown in Fig.5.[12]

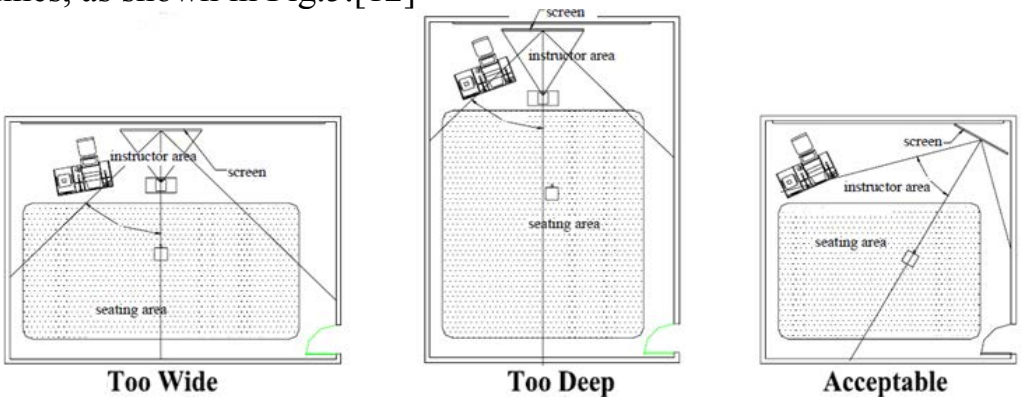

FIGURE 5 . Nearly square proportion with a good viewing angle towards the screen is more acceptable form than the deep or wide one at Group teaching spaces [13]

3.1.2. Furniture

Furniture Layout had been changed from lines of seats facing a single teacher, to center one, which allows learners to sit closer to the teacher and/or to view and learn from each other. This setting encourages small group conversations to aid learning Furniture size, mobility, stack ability, flexible and adjustability of different layout are defined according to space type and size as shown in Table 1. Figure 6 illustrates how furniture can be available in a variety of locations and different layout to encourage interaction between teacher and students. [14]

FIGURE 6 . Examples for various furniture layouts at the same classroom space, instructor can use movable furniture for different layouts according to type of teaching method in each class (discussion, presentation, etc.) [15]

3.1.3. Technology

Group Teaching/ Learning Spaces should be equipped with computer, projectors, projection screens, boards, and also may be with interactive white board and cameras in order to improve learning process. [16] Grade of technology and equipment used inside the space is defined according to space type capacity and size as shown in Table 1.

Technology can facilitate more active learning modes, such as personal response systems, students can vote on questions posed by presenters and everyone to see the results, also equipment and Infrastructure for wireless broadband or mobile telephony are installed for real-time transmission of information from elsewhere.

TABLE 1. Group Teaching /Learning Space Design Requirements for Each Type [17]

Group Teaching /Learning space Type			Students Capacity	Square meter	Clear Ceiling height (m)		Furnishings	Display modes
Learning space		Small learning space	20-25	45-50 m^2	3 m		• Movable tables & chairs • Instructor desk	1slide projector 1 screens 1 whiteboards
		General learning space	25-30	50-60 m^2	3 m		• Movable tables & chairs • Instructor desk	1slide projector 1 Overhead Projector or 1 Document camera 1 screens 2 whiteboards
		Oversize learning space	30-48	60-100 m^2	3.5 m		• Fixed writing surfaces & movable chairs • Instructor desk • Guest table for one speaker	1 projector-2 screens 1 Overhead Projectors or1 Document camera 2 whiteboards 1 voice amplification
Halls	Lecture Hall	Small lecture hall	48-70	Till 120m^2	Rear 2.5m	Front 3.6m	• Fixed writing surfaces & movable chairs • Instructor desk • Guest table for two speaker	1 projector-2 screens 1 Overhead Projectors or1 Document camera 3 whiteboards 1 voice amplification
		Large lecture hall	70-120	120-250m^2	2.5m	4.6m	• Fixed writing surfaces & movable chairs • Instructor desk • Guest table for three speaker	2 projectors 1 w/screen -2 s/screens 1 Overhead Projectors or1 Document camera 1 whiteboards 1 voice amplification
	Auditorium	Small Auditorium	120-300	300-450 m^2	2.5m	4.6m	• Fixed writing surfaces & movable chairs • Instructor desk • Guest table for three speaker	3 projectors 1 w/screen –2s/screens 1 Overhead Projectors or1 Document camera 1 whiteboards 1 voice amplification
		Medium Auditorium	300-400	400-500 m^2	2.5m	5.4m	• Fixed writing surfaces & movable chairs • Instructor desk • Guest table for three speaker	3 projectors 1 w/screen –2s/screens 1 Overhead Projectors or1 Document camera 1 whiteboards 1 voice amplification
		Large Auditorium	400-650	500-850 m^2	2.5m	5.4m	• Auditorium seats with tablet arms • Instructor desk • Guest table for three speaker	3 projectors 1 w/screen –2s/screens 1 Overhead Projectors or1 Document camera 1 voice amplification

3.2.Simulated Environments [18]

These are spaces where students can be taught safely and formerly learnt on the job through an apprenticeship system to be prepared for 'real world' environments. Figures 7, 8 and 9 represent examples for simulated environment spaces such as; Laboratories, workshops and simulated tasks like medical space.

FIGURE 7. Laboratories[19]

FIGURE 8 . Carpentry workshop[20]

FIGURE 9. Example for Simulated Health skills lab, University of Wolver Hampton [21]

3.2.1. Size and form

It is mainly dependent on the simulated mission. The designer should also try to get the best selection of sizes and proportions so that simulated rooms that are used infrequently can be redeployed for other purposes. Some rooms need to be oversized compared to their real world equivalents to accommodate a class of learners.

3.2.2. Furniture

Space should contain essential components for each simulated environment to achieve a highly degree of efficiency and productivity of the space. Mobile or stacking furniture is a great advantage in these spaces to allow multiple use of the room.

3.2.3. Technology

Space should be equipped with wireless broadband, data cabling, and smart equipment for different missions performed in the space. In some simulated environments, video cameras are required to record how students perform, so

they can be briefed on their level of competence .They also need a workstation and storage area for a media technician to control and manage films.

3.3.Immersive Environments

Spaces allow students to be taught by Virtual environment which make students into contact with complex information. The information may come in real time from another location, from prepared sources, or bringing famous characters to life again from the past, and they speak about themselves and/or explain something as an assistant teacher. It also can allow students to be taught by a "virtual teacher". [22] Figures10, 11 and 12 represent three examples for immersive environment spaces.

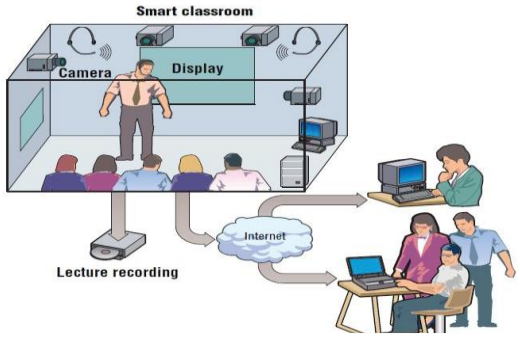

FIGURE 10 . Distance learning [23]
Student can see what happened in the classroom, if he was on another place

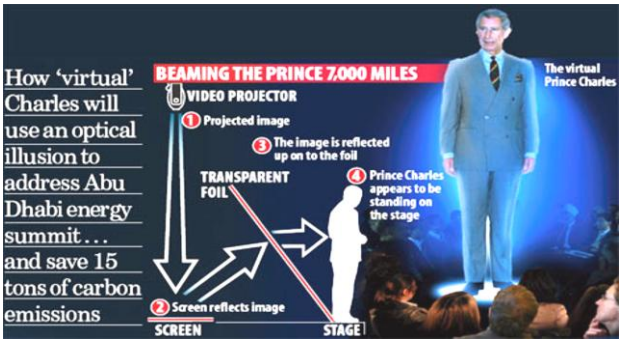

FIGURE 11 .3D Hologram in education [24]
Prince Charles appear in Abu Dhabi as hologram

FIGURE 12 . Cave-Wall Flex Display [25]
ASU Decision Theater which actively engages researchers and leaders to see around 360°

3.3.1. Size and form

Immersive environments in education are relatively small spaces for ten to twenty people, with several large, possibly curved, screens for projecting information so that occupants are literally surrounded by the data.

Cave spaces consist of: four screen (three for walls and one for floor with dimension 3m*3m), monitors and 3D glasses for users to make them interact with the environment, and these screens can be portable as flex system. [26]

3.3.2. Furniture

The common furniture layout for these spaces is rounded one with main table. The main factor of these spaces is screens types and its place to put sensors and monitors in the right places. [27]

3.3.3. Technology

Immersive spaces should be equipped with the following items: [28]

- Wireless broadband, Data cabling with computers cameras to transfer and receive data from different places and skilled computer with technician to control the data streams.
- Screens –projector -monitors –sensors – 3D glasses related to immersive environment type.

3.4..Peer-To-Peer and Social Learning [29]

Spaces facilitate interaction and face-to-face discussion among students and instructor in small classes, where they are being overtaken by more informal gathering places for social learning, a physical relaxation of the academic spaces. Figures 13 and 14 illustrate examples for two types of peer-to –peer space like seminar rooms and studios.

FIGURE 13 . Seminar Room [30]
Seminar rooms have traditionally contained the 'group conversation' form of learning. They are being overtaken by more informal gathering places for social learning.

FIGURE 14. Design Studios [31]
Studio learning for art and design courses, where learners work individually or in teams in an environment that encourages comment and discussion about each

3.4.1. Size and form

Seminar rooms are designed for at least 20 students and an instructor, with seats and tables arranged to let everyone can easily see each other as well as the screen.

Studio is being located in spaces near lecture theatres on main circulation routes. Its size depends on number for students and type of teaching i.e. space needed for engineering drawings is completely different from Art one.

3.4.2. Furniture

In Seminar furniture student seats should be within the viewing angle of the projection screen. [32]

Studios furniture and finishes are needed to withstand long hours of use, and unsafe substances or apparatuses.

3.4.3. Technology

Spaces should support audio-visual system with document camera and other audio-visual components on a movable cart located near the instructor to transfer and receive data anywhere. Also Wireless broadband, computers, and smart table for 3D drawings should be available in studio spaces.

3.5.Clusters [33]

Spaces designed for different learning modes. Space provide teaching several groups simultaneously using different learning modes accommodated in it as shown in Fig. 15.This type can change any previous type to be another teaching space .It actually incorporates interactive and group learning spaces, social learning spaces as well as more traditional lecture halls or classrooms, albeit with enhanced technology.

FIGURE 15. Clusters learning space transform the large area to small cooperative groups [34]

3.5.1. Size and form

Large single space, some areas have been created for multiple learning modes to be used in teaching several groups.

3.5.2. Furniture

Small area contains moveable partitions with fixed seating in tiers, and another area with grouped desks equipped with PCs for solo work.

3.5.3. Technology

Cluster spaces should be equipped with the following items:

- .Audio-visual facilities with Wireless broadband and Interactive whiteboards.
- Networked PCs used for ICT based learning activities for individuals or groups.

3.6.External Spaces [35]

Space between buildings, can play an important role in aiding learning. Fresh air helps in keeping people alert and therefore more able to learn, though the amount of time. Wireless broadband supplies information to these spaces in a manner that was formerly impossible.

3.6.1. Size and form

High level open plaza that is normally used for teaching sports, dance, music, natural drawings and can double as a gymnasium for the trainee teachers to use for their own health and wellbeing.

3.6.2. Furniture

Fixed outdoor seating units in shaded places and movable ones should be provided to be easy for transforming through any place. Natural seating can be designed by steps on plaza urban design to be used as learning space as shown in Fig.16. Blackboards should be located to create "think stops" for students brainstorming and sharing ideas.

FIGURE16 . Outdoor plaza is used as informal learning space **[**36]

3.6.3. Technology

Wireless broadband should be provided to supply information to these spaces in a manner that was formerly impossible. Smart information searching machines such as Google search appliance should be available .Infrastructure for wireless mobile telephony should be installed to allow individual access to the internet via personal computers or mobile devices.

4. CONCLUSION

The paper is a part of a research that aims to study the impact of using smart techniques for processing visual environment in smart learning spaces at university. This paper was mainly discussing the concept of smart learning space and how it can change the vision of campus to be effective and smart in order to accommodate students' needs. Different classifications of learning spaces had been illustrated with their significant requirements of size, furniture and also the type of technology that should be used in each one. According to

that Group Teaching/Learning spaces, which consist basically of classrooms and teaching halls, were founded to be the main spaces for formal learning process at the campus. It represents around 10-25% from total university space and more than 40% of learning spaces areas, so it had been chosen to study its visual environment requirements and investigate lighting performance on it according to different WWR and smart shading devices at the next part of the research.

ACKNOWLEDGMENTS

This paper is part of the current work of the author's MSc thesis at Department of Architecture -Faculty of Engineering - Ain Shams University (FEDA). The authors would like to express their gratitude to the department of architecture at Ain shams and Benha universities for providing the needed facilities and support to conduct this research.

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