Learning Spaces for Health Care Education: Best Practices in Design

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Introduction

> *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 can carry an unspoken message of silence and disconnectedness. More and more we see the power of* built pedagogy *(the ability of space to define how one teaches) in colleges and universities.*[1]

As health educators, we rarely have the opportunity to participate in the creation of new physical learning spaces, whether it is renovating an existing space or developing new building designs. However, when these opportunities do occur, we can create inspiring locations that foster and catalyze the unique teaching and learning strategies of health science education.

The rising use of standardized patients and patient simulators in health science education and the need to train more health professionals are both driving the design of new learning spaces on health science campuses. As the client for these design projects, educators are being asked to participate in the development and implementation of these new spaces, often without prior experience on a construction project. This requires that educators engage with other construction team members, including information and educational technologists, architects, building planners and learners to build their knowledge and assure a common understanding.

This collaboration is key to creating spaces that are easy for teachers and students to use, and maximize current and future learning aims. This is particularly challenging given the complexity of most learning spaces. In cases ranging from patient simulation to cadaver dissection to online microscopy exercises, educational goals will continue to require increasingly sophisticated facilities that can accommodate educators from a variety of disciplines.

At the November 2008 Annual Meeting of the Association of American Medical Colleges, colleagues from education, educational technology, information technology and facilities management came together to present a panel discussion to highlight their roles in the design of learning spaces for health science education. After a brief presentation by each panel member, the group created a map that graphically displayed the "current context" of learning spaces in health education.[2] This white paper grew out of that panel discussion and current context mapping exercise.

There are four unique perspectives presented in this white paper. Deborah Simpson, Ph.D., Associate Dean for Educational Support and Evaluation at the Medical College of Wisconsin, emphasizes that the educator's primary role is assuring that "space design decisions have learning outcomes as their touchstone." Jenn Stringer, Director of Education Technology at Stanford University School of Medicine, outlines the essential things that educational technologists can do to ensure that the technology supports teaching and learning. Vince Sheehan, Chief Information Officer and Associate Dean for Information Technology at Indiana University School of Medicine, describes four domains of technology that must be addressed in a building project: infrastructure, data management, support services and adaptability. Finally, Horace Bomar, Director of Facilities Management and Planning at the University of Michigan

Medical School, discusses the typical process for new construction and major renovations, pointing out the most critical phases for stakeholder participation.

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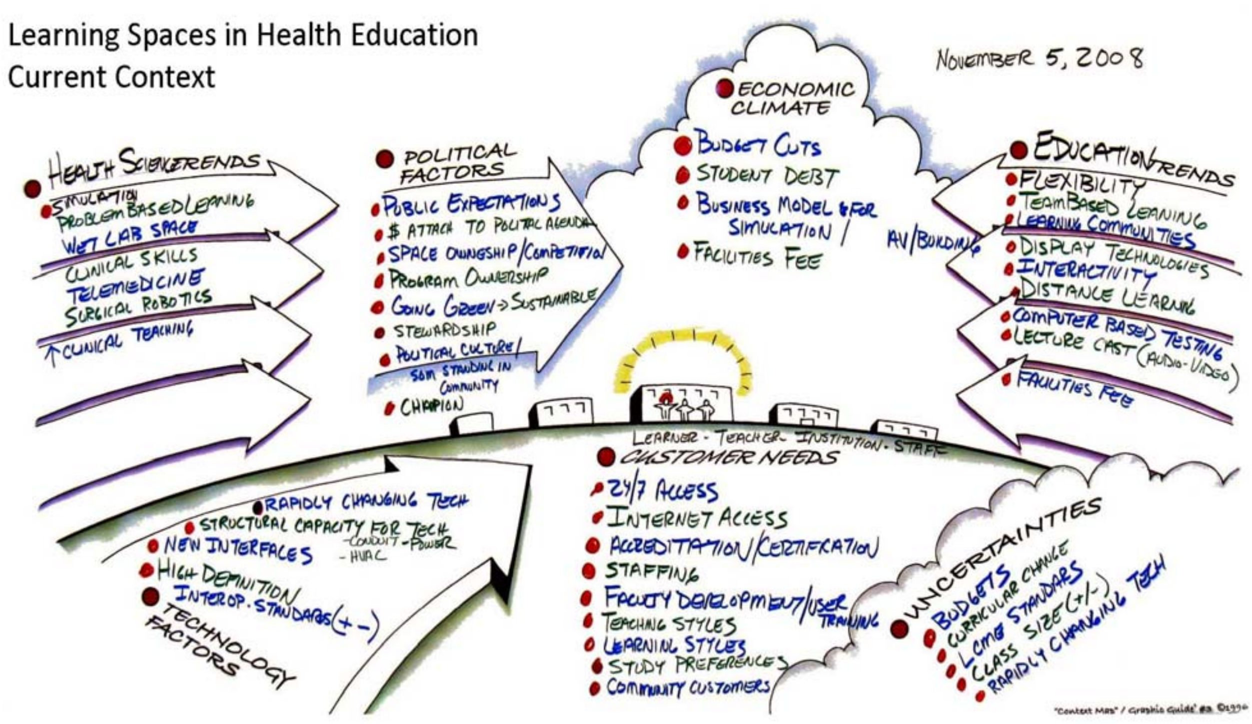
Current Context for Learning Spaces in Health Science Education

Context maps help individuals create a snapshot of their present environment. This process helps a group understand the factors at work in their environment and the unique web of relationships at play.[8] The map included here was developed by participants at a panel discussion on learning spaces held at the November 2008 Annual Meeting of the Association of American Medical Colleges in San Antonio, Texas.[2] It provides a framework for learning space stakeholders.. You can conduct a similar exercise with your stakeholders by having them brainstorm ideas and concepts around learning spaces that fall into these categories:

- Educational Trends versus Health Science Education Trends
- Economic Climate
- Political Factors
- Technology Factors
- Customer Needs
- Uncertainties or Unknowns

Figure 1: Learning Spaces in Health Sciences Education Current Context Map produced at 2008 Annual Meeting of AAMC by participants of group discussion on learning spaces.



The Role of Education

"Where are you going?" one medical student asks her classmate. Is the preferred response, as the classmate continues walking and his voice fades down the hall, *"To the STAR Center"*[3] [a learning space that houses human patient simulators and clinical exam rooms for standardized patients] or "*To work on my patient examination skills*"?

The first answer is a destination, a facility. The second answer reflects the learner's goal-directed focus; the destination is a learning environment that supports goal achievement.

For educators, facilities are the physical space in which learning and/or assessment of competency-based performance occurs congruent with specific educational goals. For example, a primary educational goal for simulation centers is to serve as a safe setting for deliberate practice, a setting where learners can obtain feedback relative to a set of defined benchmarks in situations that capture clinical variations and difficulty.[4]

The educator, as the end-user for the learning space, must be an integral member of the learning space design team. In discussions with the design team, the educator's task is to ensure that decisions are made that resulting in a physical environment aligned with current and future learning and/or assessment needs.

The *Learning Spaces in Health Education Current Context* map shown in the previous section emphasizes many of the key elements that the educator must effectively communicate to the design team, such as education trends (e.g., flexibility, interactivity, learning strategies like team-based learning), customer needs (e.g., 24/7 access, internet access, faculty development of users), and health super-trends (e.g., telemedicine, surgical robotics). At the Medical College of Wisconsin, existing space was redesigned to serve as a standardized patient, simulation and video conference center for learning and assessment. With a medical student enrollment of over 800 students per year and an almost equivalent number of residents and fellows, the approximately 8,000 square feet assigned to the center was designed to be responsive to the elements of the context map (e.g., internet access, flexibility, interactivity, future trends). For example, space flexibility allows the center to concurrently accommodate different users. Often, this space might simultaneously support:

- Emergency Medicine residents running a mock code on "Stan", a human patient simulator;
- Clinical clerkship students assessing "Harvey's" cardiac arrhythmias or performing an ultrasound on "Noelle";
- First year medical students entering a clinical room, washing their hands with running water and then practicing medical interviewing and/or H&Ps skills on standardized patients;
- Faculty observing trainees via monitors and providing feedback via phone or speakers, or watching the digital recording of a previous interaction.

Successfully designing physical space that serves current and future learning and assessment needs requires the expertise of a broad spectrum of individuals, many of whom come together for the first (and only) time for this specific project. Each expert brings a unique perspective and vision for the space and its purpose. For example, the desire to digitally record the activity in each of the facility's rooms and allow for playback of these recordings has unique implications for each design team member: IT staff need to enable streaming video, architects must design weight-bearing beams for the heavy servers, engineers will need air conditioning systems to keep those servers cool, and security teams will want to create access to the center via card readers or finger readers to keep these recordings safe.

The educator's role in these discussions is uniquely challenging. Design team meetings may be conducted using highly technical engineering shorthand that will be a foreign language to most educators; communications can likewise include references to unfamiliar regulation and compliance dictums. Unless the educator overcomes these barriers with active and informed participation in the decision-making, decisions will be made based on feasibility, cost, and style, with limited attention to the facility's chief education aims.

In summary, educators must be active members of the design team, focusing on learning outcomes, asking for clarification throughout the process, providing internal summaries, and verifying the capabilities of the space to ensure that space design decisions have learning outcomes as the touchstone.

The Role of Educational Technology

Advances in health science education require medical schools to install and support more diverse and complex technology in learning spaces than ever before. Medical education has moved beyond planning for lecture halls and small group spaces with tables, chairs, and whiteboards. New demands now exist for multiple computers and high-resolution displays for virtual microscopy and diagnostic imaging[5], as well as full-scale simulation centers with the requisite simulators, part-task trainers, and video capture and annotation systems. All of this means that the educational technologists are now a key part of the planning team for any learning space, and their role in designing learning spaces is becoming larger and more complex.

It is the educational technologist who understands best how technology is used in a particular space and can speak to the type of technology that should be selected, the physical placement of equipment in the space, and the user interfaces that need to be designed to make the technology easy to use. Because of their background and training in educational theory and pedagogy, they can often be a strong and consistent voice for teachers and learners to ensure that their needs are being considered throughout the process.

Educational technologists are the staff "on the ground" providing daily support to faculty members and students and working with faculty to integrate technology into their teaching. Therefore, they can serve as a reality check to ensure that the technology being considered will be both adopted by the users and supportable by the technology staff in charge of the spaces.

Before a space is designed and built, the educational technologist can do a number of things to ensure that the space is designed well and that the technology supports the teaching and learning process.

- **Observations and Interviews –** Educational technologists should go into current spaces and watch how technology is being used, misused, or not used at all. Although the design team often has a faculty member involved in the process, interviewing a variety of faculty members and students can provide a bigger picture. Below is an example of the kind of information gleaned from a faculty interview:

  Teaches mostly in Fleischmann Labs. Teaches a small seminar for residents and fellows in a pathology room or in S101 – he doesn't like that room – calls the back a peanut gallery.

  Loves the Fleischmann Labs; they are "nearly perfect." Likes the partitions in the room, the manual ones with the "door" between. Doesn't like the key operated ones.

  He is very intrigued with M112 (but never taught there…has had training sessions in there). He believes that within 3-5 years "virtual microscopy" will be good enough that students will not need to use microscopes much at all. At that point, he could see putting students in groups with large screens in a space similar to M112.

Interviewing support staff is also helpful, because they can identify the technology that is difficult to support currently and they often have key insights into technology placement and interfaces.

- **Photo Documentation** – In designing spaces, a picture is truly worth a thousand words.[6] Photos can give architects, furniture designers, and the rest of the team key insights to help design better spaces. Below are some examples:

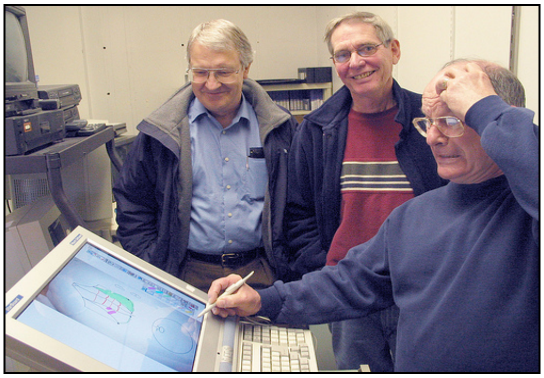
An instructor teaching students outside immediately after lecture. This photograph documents the need for informal spaces placed outside of classrooms so that teaching can continue beyond the lecture.

The same faculty member using a chalkboard and then using tablet monitor and annotation software to teach anatomy. This will inform lectern design, screen size, white board placement, etc.

Photos: EdTech 365/2009 http://www.flickr.com/groups/edtech365/. Used under permission of http://creativecommons.org/licenses/by-nc-nd/3.0/

- **Scenarios** – By documenting several scenarios that envision "a day in the life" of the space, taking into account different activities and times of year, educational technologists can see key design issues that transcend a particular teaching session. This is even more important when working on a set of spaces or an entire building, because of the increased complexity associated with larger projects.

- **Pilots** – Educational technologists should also pilot new technologies whenever possible. Most vendors are willing to loan equipment from their seed pools, will often install equipment temporarily, and can be called upon for training and support.[1] Below are some examples:



Faculty test a complete lectern mock-up with tablet monitor and annotation software. All of the equipment was on loan from the various vendors. "Try-out" sessions were held for teaching assistants, faculty, and support staff.

Photos: EdTech 365/2009 http://www.flickr.com/groups/edtech365/. Used under permission of http://creativecommons.org/licenses/by-nc-nd/3.0/

- **Site Visits** – Visits to other institutions that have similar types of spaces and talking with faculty members, support staff, and students is also helpful. Images from those spaces can be shown to the rest of the team when making decisions about tables, chairs, communication devices, control panels—the list goes on. There are also flickr™ sites that document learning spaces and an initiative to tag images related to learning spaces.[6]

- **Support and Sustainability** – It is important to have both support and sustainability models agreed too before making final technology purchasing decisions. This includes the commitment for additional staffing if needed, appropriate increases in the general supplies budget, as well as a dedicated "replacement cycle" budget for equipment. For example, in a five-year cycle, the simple act of adding dual high resolution projection to classrooms doubles the number of replacement lamps and project replacement costs. As well, purchases of a standardized patient with a simulator control and capture system can add very large software license and hardware maintenance fees into an ongoing budget.

The Role of Information Services

> *Medical educators increasingly use technology to supplement the delivery of learning resources. The advent of multimedia technology, the World Wide Web, and the ubiquitous nature of networked computers, have transformed educational technologies from esoteric legacy applications used by a few pioneering faculty to mainstream applications integral to the medical school educational enterprise.* [4]

These opening words from the Executive Summary of the "Effective Use of Educational Technology in Medical Education" highlight the dependence we all have on information technology. If all components are to work well together, it is imperative that information services colleagues be included in the process as early as possible.

Given this dependence, integrating the appropriate technology infrastructure will help determine the success of a learning space. Just as factory-installed equipment on your car fits better than after-market add-ons, technology that is integrated with the facility works better than technology bolted on as an afterthought.

With regard to IT, there can be a circular reference in a building project: technology decisions impact space design while space design impacts certain technology decisions. However, there are always several information technology domains that must be considered: IT infrastructure, data management, support services, and adaptability.

IT Infrastructure

IT Infrastructure involves much more than deciding where data jacks should be located. It includes network architecture, computer hardware, telephony, video, and integration with the mechanical plant.

- Will the space require its own data center or will smaller "machine rooms" be sufficient?
- Will standard server technology be used or will a High-Performance Computing environment require chilled water feeds and increased electrical and HVAC capacity?
- Does your voice network standard support IP phones? If not, a separate telephone infrastructure might be required.
- How will the general architectural design of the space impact the location of wiring closets?
- What is the right balance of wired and wireless access points?
- What type of Uninterruptible Power Supply (UPS) is needed? Should one UPS (or more) be dedicated to the education technology equipment or shared to support other equipment?

Data Management

Data Management decisions can also drive certain elements of space design. At a minimum, the determination of where and how data generated within the learning space will be captured and stored is critical in determining network architecture and space for data storage.

- What new data storage requirements are created by the use of computer-based tools in the learning space? Jerry York (CIO, University of Texas Health Sciences Center San Antonio) gave this advice after opening their new Clinical Skills Center: "Whatever you initially estimate for video storage capacity – triple it." He also recommends that "you ensure that Clinical Skills Centers are built with adequate storage space, particularly as various types of simulators required for teaching, multiply at an exponential rate."
- What other systems will faculty and students need to access while in the new space? Will they need connectivity to other school or university-based systems? Will they need access to systems outside your university (clinical partners, other universities, commodity internet)?
- What other systems will interact with the technology in the new space? Will you exchange data with existing Learning Management Systems (Blackboard, Sakai, or ANGEL), assessment systems, or E-portfolio systems?
- What level of security will be required for spaces where data are stored? In addition to Family Education Rights and Privacy Act (FERPA) regulations, are there any Health Insurance Portability and Accountability Act (HIPAA) implications, or if the facility is tied to federal facilities like a Veteran's Hospital, do Federal Information Security Management Act (FISMA) requirements apply?

Support Services

While determination of who supports what may not always dictate building or space design, it does have implications for the type of technology decisions made for the space.

- If technology support comes from the school or university IT staff, are they available early in the morning, in the evening and/or weekends? Will they only support offerings from an approved standards list (e.g., no support for Apple equipment)?
- Who is expected to support the specific educational technology deployed in the space and what are the staffing requirements? How much support will the vendor provide and for how long?
- What space is needed for operational controls of mannequins, for observation of clinical skills, or for de-briefing rooms, and what special technology needs must be met?
- Will technicians need a room for bench work or for staging equipment?

Adaptability

In a Tech Therapy podcast[7] from 2007, architect Mark Maves made the point that many buildings have a life of 100 years, mechanical systems in those buildings have a life of 35 years, and we expect furniture to last 20 years. Yet information technology often has a life cycle of only four to five years. Just as educational professionals must consider the diversity of pedagogies, facilities and information services professionals must consider how to make buildings adaptable to meet changing technology needs.

While there is no way to accurately predict what technology requirements will be ten years from now, having the information services expertise at the table with the architects and facilities professionals from the beginning gives everyone the best chance for flexible design. Maves recommends that the information services team members be included at the programming phase of any project.

This also provides an opportunity to learn what technology changes the information services team is planning in the near term. Remember that most building projects take several years to complete, so technology decisions should be made with an eye towards the future. Today's standards may be obsolete by the time the building opens.

These represent just a few of the many technology questions that must be answered in order to create the most effective learning spaces possible.

For example, Indiana University has been on a building boom for almost ten years. IT has been involved in opening nine new buildings in that time, with a tenth building opening soon. In addition, several of the buildings represent joint projects with other universities. The Indiana University's School of Medicine has eight Centers for Medical Education located throughout the state; five of those located on the campuses of other universities (Ball State, Indiana State, Notre Dame, Purdue, and University of Southern Indiana).

The medical school IT leverages university services as much as possible and depends on the university's core IT services provider, University Information Technology Services (UITS), to deliver networking, communications, and data center services.

The medical school does not own the hospitals where faculty and students teach, learn, and practice medicine. Therefore, the school is dependent on clinical partners to help deliver the right technology for the learning experience that is directly tied to patient care.

In this environment, cooperation and collaboration across all partners is essential. To keep in touch, a bi-monthly meeting is held that includes representatives from the medical school information services staff, the school's facilities department, and UITS. This is a standing meeting to discuss all projects and ensure that the lines of communication stay open. While this is in addition to project team meetings, it has helped build a collaborative environment so that everyone works as a coordinated team on any project.

We all know that once you've seen one medical school, you've seen one medical school. However, regardless of your organizational or cultural environment, having all stakeholders involved in learning space development projects as early as possible is always a good idea.

The Role of Facilities Management and Planning

Most medical schools either have planning and design professionals (architects, engineers, facility managers, etc.) on staff, or have access to them from their parent institution. These professionals have the background, experience and responsibility to assist in the development of learning spaces, and there are several reasons why they should be brought in early. They have the experience and expertise to inform programmatic need. They can serve as the overall shepherd of the project, as well as the steward for the facility in the future. Finally, facility planners and managers can often identify funding, space, or land for the project.

The process of developing learning spaces (or any capital project) should include the early identification of all stakeholders, the development of an overall project structure and approach, a consensus and understanding by all involved, and expectations that are realistic. Support and agreement from the highest possible leaders in the organization should be obtained early along with the identification of possible funding sources and supporters. The success of this early project stage will ultimately determine whether a project comes in on schedule, on budget, and meets everyone’s expectations.

Table 1 shows the typical steps in a capital project. The first four steps – need identification, programming, pre-design/concept design, and schematic designs (SD) – are the most critical. Each of these four steps should be as complete as possible and they must reflect key stakeholder consensus before moving on to the next step. Even if it means going back and re-doing portions or the entire prior step, consensus must be achieved. It is during these four steps that the gross order of magnitude of a project budget is developed and priorities are established as to what is “in or out” of the project.

At the end of each design phase – schematic design (SD), design development (DD), and construction documentation (CD) – there should be an updated project budget (not just a construction budget, but an overall total project budget) that becomes more and more accurate as the design detail emerges. There must also be agreement by all that there will be **no changes** as the project enters the subsequent design phase. Once in design, changes will cost money. Most important, however, is that no changes be allowed once the CD phase is started and certainly not during actual construction. When changes are made during these phases, major costs are incurred and the project schedule is impacted.

Table 1. Typical capital project process for new construction and major renovations.

				Central Campus Service Providers				External Service Providers					
	STAKEHOLDERS	Occupant / End User	Medical School Facilities Management and Planning Group	Planning and Project Management Group	Plant Maintenance and Operations Group	Other Service Providers eg. Public Safety, Environmental Health, Purchasing, etc.	Legal Counsel	Architectural and Engineering Consultants	Construction Management Consultants	Vendors	Contractors	Comments	Project Process Step Duration (months)
PROJECT PROCESS STEP													
Need Identification		3	3	1	0	0	0	0	0	0	0	End users working w/ their leadership w/assistance from Fac. Mgmt. staff	6 to 12
Programming		3	3	3	0	0	0	3	0	1	0		1 to 6
Pre-Design / Concept Design		3	3	3	1	1	0	3	0	1	0		3 to 9
Schematic Design (SD)		3	3	3	1	1	0	3	0	1	0		1 to 3
Design Development (DD)		2	3	3	1	1	0	3	0	2	0		3 to 6
Construction Documentation (CD)		1	2	2	1	1	1	3	1	2	0		6 to 12
Bidding / Award of Contracts		1	2	3	0	1	1	2	1	1	2		1 to 3
Construction		1	1	2	1	1	0	2	3	2	3		9 to 24
Commissioning		1	2	2	2	2	0	3	2	1	2	Should start during design and proceed through activation	3 to 6
Activation / Move-In		3	3	1	1	1	0	1	1	1	1		1 to 3

Level of involvement: High = 3 Low = 1

Notes:
Major issues that impact duration of project process steps, overall project schedule duration, and level of stakeholder involvement
Project type, size, timing will determine project process step durations
Decision making and approval processes will determine overal duration of project

Summary

> *If campuses exist to foster specific kinds of learning, they should inspire and foster this work physically as well as intellectually. Choosing chairs should receive the same kind of attention to learning as choosing textbooks; decisions on building layouts should be made with the same focus on learning as developing curricula. In short, a campus should proclaim that it is location-designed to support a community of scholars.*[1]

Recommendations for undertaking new learning spaces building projects:

- Identify the overall goals and stakeholders as early as possible;
- Obtain the support and agreement of the highest possible institutional leaders in your organization;
- Identify and develop all possible funding sources and supporters as early as possible;
- Consider that contemporary learning spaces are much more complex and energy intensive that ever before;
- Involve educators, who can ensure that design decisions have learning outcomes as their touchstone;
- Involve educational technologists, who can provide on-the-ground support to faculty members and learners and therefore serve as a "reality check" for existing and new technologies;
- Involve information technologists, who are essential to developing an appropriate IT infrastructure, data management plan, support services and adaptability to support the learning technologies designed for space;
- Bring your facility planning and project management team (which may include central university service providers) in to the process at the earliest stages so they can assist in the creation of a project structure and organization, task lists, conceptual schedules and project budget estimates, etc.;
- Recognize that the first four steps of a typical capital project process -- need identification, programming, pre-design/concept design, and schematic designs (SD) -- are the most critical and that changes during the design and construction phases will cost additional time and money;
- Go into current spaces and watch how the space and technology is used, misused or not used at all;
- Visit other institutions that have the types of spaces you are designing and talk to colleagues for best practices;
- Consider future trends, accreditation and licensure standards, emerging technologies early to prevent the space from being "out of date" before it opens;

- Use case scenarios to document "a day in the life" of how the spaces will be used by learners, teachers and staff;
- Pilot new learning strategies, assessment modalities and technologies being considered for the space to determine training needs and its ability to achieve the desired outcome;
- Develop models and budgets to both support and sustain the space and technologies over time.

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