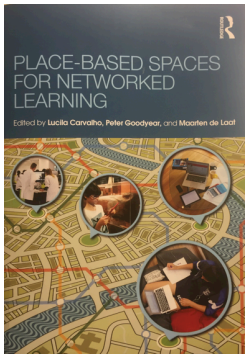

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Translating translational research on space design from the health sector to higher education – lessons learnt and challenges revealed for place-based spaces of network learning

Robert A. Ellis, Kenn Fisher

1.0 Introduction

This chapter reviews lessons and challenges arising from healthcare space development in the health sector over the last decade that may offer insights for learning space planning and development in the higher education sector.

The first part of the chapter discusses the experience of the health sector over the last decade and its translational research agenda of linking the practice of evidence-based (EB) medicine to EB healthcare space design. In the health sector's approach, the practice and experience of understanding how health practice works successfully is used as a basis of evidence for the design of healthcare spaces intended to support different health outcomes. In the second part of the chapter, a series of observations, insights, and lessons learnt from the health sector's experience is considered for their relevance for the higher education sector's current challenges of university learning space and its design. In that part, we draw on some of the ideas of research into learning networks (Carvahlo and Goodyear, 2014) to frame the observations made, many of which lie behind the motivation for this book and its collection of chapters.

The issues considered in this chapter are generally made at the level of the sector. In most cases, exceptions to the generalised observations can be found in both sectors. However, for the purposes of translating lessons learnt from one area to another, the observations draw on evidence of trends at the sector-level to discern issues and descriptions of the current status. In discussing both sectors, common examples of hospitals and universities are used to conceptualise key elements of space design in both sectors.

The 'networked' element of the health sector can generally be referred to as telemedicine (Ekeland, Bowes and Flottorp, 2012). In the design and build process of health spaces, it has started to become a systematic aspect of the design process for buildings themselves (Li, Wilson, Stapleton and Cregan, 2006). Current standards and practice in the health sector would find it unlikely that the designing and planning process for hospital precincts and

buildings would not have a large portion of the activity using evidence from healthcare practice to inform the procurement and post-occupancy evaluation of the space.

In this chapter, the 'networked' element in the higher education sector is conceptualised as virtual learning space or the online environment. These can be understood as being enabled through ICT networks, hardware and software, and providing non-material spaces which are an extension to the physical or place-based spaces used for learning in universities. While the integration of virtual learning space and online learning is increasingly ubiquitous throughout the higher education sector, it is yet to culminate in sector-level awareness of EB planning and design and how to most effectively integrate it into campus and precinct planning. This is one of the themes we pursue in the chapter.

It is worth noting that the shape of the first part of the chapter has been determined by how place-based spaces have gradually introduced technology into the design process in the health sector. Identifying evidence to inform *physical* healthspace design occupied most of the early efforts into space design activity (Zimring et. al., 2008). While telemedicine has been around for some decades, its greatest influence on the health sector space design has been in the last decade as caregiving by healthcare professionals has been increasingly mediated by technology (Ekeland, Bowes and Flottrop, 2012). The design process for healthcare institutional space such as hospitals has mirrored this relationship. Gradually telemedicine considerations are being integrated into physical healthcare space design, typically starting with the policy-driven, health care model, the subsequent purpose of the healthcare space development idea, and then integrating physical design with technological considerations in relation to the healthcare activity driving the design. The perspective drawn on throughout this chapter follows this trajectory, considering the lessons learnt from an end-to-end process of the design and development of institutional healthcare space, and within this, considering how telemedicine research has informed the design of physical healthcare space to improve the learning and experience of stakeholders in that space.

1.1 Perspectives on placed-based health spaces

In a translational research agenda aimed at providing an evidence-base of user experiences to inform healthcare space design, design teams are comprised of at least a quadrumvirate of knowledge-holders and perspectives;

- clients or users of the space: in healthcare it is the doctors/nurses/health professionals/patients; in higher education it is the students/teachers/program convenors/educational leaders;
- architects who are looking for a decision-making framework in which to apply their previous experience and knowledge to the new design,
- technology providers: those charged with designing the information and communication technologies that are part of the networked physical space design
- academic researchers who are framing questions and investigating the key questions designed to move the field forward in developing knowledge of what works and why

in terms of networked space design which will build an evidence-based body of knowledge and community of practice

While this is a potentially fruitful grouping of collaborators and perspectives with which to achieve outcomes, it has a number of potential disconnects that require some reflection and is the motivation for this chapter. In a sense, a successful translational research approach to learning space design can be thought of as enabling the best understanding of these (often siloed) perspectives to intertwine without hindrance in a united purpose. If this is a legitimate goal, then a key challenge is translating the most insightful observations of the users of the space into research questions, and the outcomes of researchers into designed solutions for users that make sense to architects and technology providers who can then provide designs that meet the real needs of users.

2.0 Stages in healthcare space design and development

In healthcare space design, there is rarely a fixed design template which can be implemented from project to project. This is because the outcomes of healthcare space projects need to address the needs of different combinations of stakeholders who are involved in the different projects. Clearly there will be some transferability in design solutions, but in terms of the detailed design required to meet the requirements of users, the variation reported in the literature is considerable. Furthermore, advances in technology and the opportunities to implement these in design occur more often than new physical developments such as buildings, due in part to their contrasting life expectancies. Consequently, every healthcare space project, completely new or refurbishment projects, should consider the application of new and emerging technologies which may not necessarily been used and tested previously.

For this reason, the method underpinning the *process of design* for healthcare space has proven to be just as important if not more so, than the design outcomes from healthcare space projects. This primacy of design process has motivated the structure of this chapter.

To structure a review of research into healthcare space design, the first part of this chapter has arranged the ideas based on stages in the development of healthcare space design programming. A review of the relevant studies will show that healthcare space design processes is a dynamic process within a fixed time-period in which to make design decisions; that the design process is focused on a purpose, best informed by strategic healthcare activity, in which the activity of healthcare professionals is influenced by the physical and technological environments and the people around them.

The following stages have been derived from a summary of the research studies that follows. In practice, there are many more stages involved, however for the purposes of describing key parts of the sector's approach, the following structure serves to link the outcomes of the different studies;

a) Purpose of healthcare space development– The purpose of healthcare space development is intrinsic to its design. Before any healthcare space development project is considered, there needs to be a purpose expressed in terms of the outcomes

required. These outcomes, typically informed by a policy-informed, health care delivery model of the particular institution, can be expressed at different levels of a health institution and from different perspectives of legitimate stakeholders.

   a. Patient experience – improvements to the experience of the patient receiving care in the healthcare space
   b. Professional caregiver – improvements to the quality and efficacy of the process and experience of providing professional care to the patient(s), including technology-mediated processes which improve the health experience of both the patient and caregiver
   c. Health management – strategic and operational improvements to institutional-level health service provision, where strategic considerations may include being able to service a wider variety of patients because of the improvements to the healthcare space and operational considerations may include serving a greater number of people in the same category of care provision because of improved efficiencies and scale of processes.
   d. Health leadership – improvements to the ability of health leaders to guard health standards and advocate for health improvements in the sector. Substantial healthcare space developments can achieve this. For example **a** recent development is the Charles Perkins Centre 'Hub' at the University of Sydney, aiming to achieve new approaches to problem solving health issues through the combined efforts of specialists across the medical sciences, arts and social sciences, architecture, business studies, education and social work, engineering and information technology, and the physical, life and environmental sciences. These types of developments can create and foster an inter-disciplinary culture of specialists who are by their very nature committed to - and more focussed on - their own discipline epistemology, but by working together in teams, progress our understanding of a shared societal problem through collaboration.

b) Preparatory research by the healthcare space design team – each member of a health design team has their own cycle of professional research into healthcare space issues. This research considers such issues as; known theories of space design and the hypotheses they generate for effective design briefs; the challenges of capturing user requirements at project initiation stage, detailed design and post occupancy; variation in concepts amongst the researchers, architects, technology providers and users; principles for aligning space to purpose and the design approaches to improve the likelihood that the projects realise the desired outcomes. This research draws on the body of evidence-based knowledge established over the past two decades or so.
c) Requirements specification – this happens throughout the life of healthcare space development projects, but particularly at projects feasibility stage, procurement and detailed design stages. The challenges of articulating comprehensive requirements from all legitimate stakeholders is a significant issue for successful healthcare space design and development processes and is required in the following stages;
   a. At the feasibility stage, brainstorming, evaluating and identifying possible solutions are captured with users

b. At the procurement stage, these solutions are detailed sufficiently to ensure the builders, architects and technology providers can indicate costs of meeting the design briefs
c. At the detailed design stage, the solutions are provided in visual and written forms in sufficient detail for the builders and technology providers to realise the final outcomes expected by the stakeholders.

d) Quality assurance after the design and construct period, involving testing, commissioning and getting healthcare spaces ready for users
e) Post occupancy evaluation of healthcare spaces – investigating space performance and the performances of processes in the new space designs. This is an essential part of evidence-based design.

3.0 Purpose of healthcare space development

It is widely acknowledged in healthcare space research over the last decade, that well-designed healthcare space with a clear purpose can enable institutional goals and improve the daily enterprise of healthcare professionals to achieve desired ends (Becker & Parson, 2007; Cesario, 2009; Dijkstra, Pieterse & Pruyn, 2006; Elf & Malmqvist, 2009; Henriksen, Isaacson, Sadler & Zimring, 2007; Joseph, 2006; Hignett & Lu, 2010; Pati & Pati, 2013; Sadatsafavi & Walewski, 2013; Vischer, 2008; Zimring et. al., 2008). One of the difficulties in health institutions agreeing on the purpose of healthcare space development is the tension that can occur in the different level of outcomes sought, such as the health leadership aspirations of executives in comparison to the daily sustainable activities of healthcare staff. Without careful consideration of how a high level goal, for example, of assisting a wider section of the community with their health concerns, will impact on the daily practice of the healthcare workforce and the ensuring quality of care to patients, the purpose of healthcare space development can create unresolvable tensions in the design solution. In this particular example, if the high level goal is not mediated with the reality of daily professional practice of staff, the workloads involved may be unsustainable.

One design strategy to address tensions in the purpose of healthcare space planning is to divide the physical space design into functional zones of healthcare activity which can then be aligned to different stakeholder interests (Al Zarooni, Abdou, Lewis, 2011). For example, dividing hospital projects into nursing zones for patient care, clinical zones for diagnosis and treatment areas, support zones to provide support to these two areas of activity and administrative zones that provide the administration services necessary for management oversight of the healthcare activities (Dickerman, 1992; Zilm and Sprecklemeyer, 1995). This type of classification then offers design criteria for the different zones, criteria which should align to the high level aspirations of management and the healthcare activity realised in each of the spaces. Using the previous example as context, if the vision of management is to treat a larger section of the society through a redevelopment of the space and services offered by a hospital, then the workload and throughput of activities in the different zones need to be mapped to ensure that the hospital will be able to offer the range of support services necessary to sustain the increase in healthcare service provision.

Sometimes socio-management goals of an institution may inform institutional healthcare space developments, such as workforce planning which in turn may see the new facility being used as a stimulus for transformation and change management. Some healthcare space research has looked at the relationship between the quality of the built environment, organisational management practice such as Human Relations (HR) management and performance outcomes of healthcare workers (Sadatsafavi & Walewski, 2013). Derived from the theoretical work of Wicker (1992) who argued small-scale social systems are the product of both people and physical objects, the purpose inherent in this type of healthcare space development is the associations between the quality of the built environment and positive experiences of the management of staff. In their study, Sadatsafavi & Walewski identified links between the perception of the quality of the built environment by healthcare workers and their job satisfaction. They found that the two were related to the organisational commitment of staff and outcomes such as patient safety, patient outcomes and organisational efficiency. Such models are setting up the research agenda for healthcare space design for the next decade as they are still in their early stages of hypothesis testing and model development.

4.0 The challenges of evidence-based research and design-brief development for healthcare space projects

One of the main themes in healthcare space design research over the last decade is the role and use of evidence during the planning process. There has been much discussion about the meaning of 'evidence-based planning' (EBP) and it remains a contested area amongst members of design teams and within the sector. Nevertheless, it has been a galvanizing force across the sector to raise the importance of linking healthcare practice to space design. The discussion around evidence in design-planning is largely fuelled by the different perspectives the team members bring to the design table.

One of the challenges for evidence-based planning is agreeing on what counts as evidence. When you have architects, technology providers, researchers and clients on design teams, the different values and perspectives they bring can make it very hard to agree on what constitutes reasonable evidence (Hamilton, 2013). To overcome this, a number of studies have recommended post-positivist research approaches, which embrace an epistemology acknowledging that there is more than one truth or perspective on key issues and that together, they offer a more complete understanding of the phenomenon under consideration than accepting only the latest view on what counts as useful evidence. This observation is consistent with recent research into learning networks which recognises that new paradigms often displace all aspects of old paradigms rather than building on them into a more holistic understanding (Carvalho and Goodyear, 2014, p27). This angle on evidence gathering encourages a combination of qualitative and quantitative data and a range of investigative methods to provide evidence to inform key design issues.

Another challenge for an evidence-based planning approach to space design is when and how to draw on evidence in the design process. Our review of the research has suggested that the

integration of evidence effectively into the design process is not necessarily linear or ordered, but rather creative and spontaneous, shaped by the issues raised and ideas offered by design team members in relation to different aspects of space development. This perspective suggests that it is the combination of the innovative idea, any emerging evidence of its appropriateness for the space development under consideration, and how well it is understood by the stakeholders which shapes at what stage of the design process it should be considered. For example, evidence coming from the environmental sciences is best considered when the design process is dealing with the engineering detail of the environmental design aspects of areas as well as during the detailed design stage involving considerations such as ergonomics, lighting and noise and their links with the recuperation time of patients (Zimring et. al., 2008). Similarly evidence from social sciences on the links between social factors such as stress and anxiety and physical space design (Joseph, 2006, Hignett and Lu, 2010) plays a part in design decisions when overlaying the healthcare activity on the emerging physical space floorplans.

With the introduction of telemedicine solutions into hospital design processes, part of the difficulty in evidence-based planning is that the evidence for what works well may not have been captured prior to the project. This occurs in part because the innovation with technology in the healthcare sector usually outstrips the evaluation of that activity. Consequently, effective healthcare space design processes involving telemedicine need to incorporate processes within each project for identifying how technology-enabled health practice can inform the design of physical healthcare space. (See Ekeland, Bowes, & Flottorp, 2012; Fitzpatrick & Ellingsen, 2013 for useful overviews of telemedicine). Here we review three examples of how telemedicine enabled healthcare processes have elaborated the physical, social and technological dimensions of space design;

- how the telemedicine activity shapes the design considerations internally within a hospital;

- how the telemedicine activity has shaped the design considerations between two hospitals

- how the telemedicine activity has shaped the design considerations amongst a group of hospitals

4.1 Telemedicine practice shaping networked space within a health institution

One of the areas that telemedicine has influenced within a hospital space design is within Intensive Care Units (ICUs). Changes in the model of care delivery in ICUs brought about by technology are changing their physical and functional design of the units. Technology-enabled workflow (observation, diagnosis, treatment, documentation), patient confidentiality and safety (identifying patients, medication and blood product administration), monitoring and communication for both emergency and non-emergency reasons (automatically monitoring patients' vital signs, paging doctors) are just some of the requirements enabled by technology which is shaping the layout of the ICU design (Thompson, Hamilton, Cadenhead, and Swoboda, 2012). This can be as involved as improving bandwidth, capture and display technologies for the transfer of large chunks of medical diagnostic data between departments

or as simple as integrating emergency monitoring signals with paging and communication systems.

4.2 Telemedicine practice shaping networked space between two health institutions

Some approaches to telemedicine design involve creating two-way, diagnostic and communication facilities amongst doctors and patients across two hospitals. In this type of approach, the design for the telemedicine function needs to suit a number of disciplinary requirements and is often provided through a stand-alone type of medical video-conferencing room in which there are facilities for observation of patients and the transmission of images (Major, 2005). Design considerations that take account of the healthcare activity in the room can be quite detailed and involve both material and non-material considerations. Materially, for example, the diagnosis of skin-related issues for patients over video-conferencing solutions determines the of paint colour on the walls of the video conferencing room: light blue preferred over yellow- orange tones which distorts skin colour and makes diagnoses difficult to make. Non-materially, research on patient experiences in such facilities has found that the background image being projected to the patient from the specialist at a distance through the video-conferencing image should not have doors in the line of sight of the patient. Patients have reported feeling that their privacy may be compromised during the observation stage of treatment over the video-conferencing connection because they felt the unlocked door represented the potential for someone to walk in uninvited. This distraction in the communication between the doctor and patient at a distance reduced the quality of the diagnostic process.

4.3 Telemedicine practice shaping a 'hub and spoke' networked space amongst health institutions

Some approaches to telemedicine design in hospitals are determined more precisely by the nature of the medical activities being provided in the healthcare space. When a medical speciality is in short supply in a region of a country, a hub and spoke design can be used to manage the medical activity and risks involved in patient care. One example of this approach is in the field of stroke prevention. The 'hub' hospital is funded to provide stroke prevention specialists who work with non-specialist doctors and patients at a number of 'spoke' hospitals. The medical activity across the rooms in the hub and spoke hospitals needs to take account of the following type of design considerations;

- patients presenting with possible strokes at the spoke hospital are required to undergo a number of medical procedures. Results need to be captured and transferred to the specialist doctor at the hub hospital (for example blood samples, CAT scan images). The specialist doctor (a neurologist in this example) requires high definition live images of the patient from cameras in the room at the spoke hospital and high definition monitors in the room at the hub hospital

- The room at the spoke hospital needs to be able to cater for video-communication between the patient, family-members, the doctor, with the neurologist at the hub hospital.

- The emergency department at the spoke hospital needs to be included in the video communication to help the neurologist at the hub hospital with the examination and laboratory results

- The neurologist requires real time observation of instruments attached to the patient in the room at the spoke hospital and zooms in on the cardiac monitor during the video consultation

Once the purpose of the healthcare space development project has been articulated, and the team has completed sufficient background research into issues related to the purpose of the project, the next challenge in the design process is the development of healthcare space design briefs.

5.0 Developing healthcare space design briefs

In the healthcare space design process, the articulation of user requirements to inform the design brief that will shape the final outcome is one of the most important stages in the whole design process. It is at this stage that the greatest influence on the likely outcomes of the process can be affected through careful attention (Kelly & Hunter, 2005; Lindahl & Ryd, 2007; Hansen & Vanegas, 2003).

One of the traps in gathering user requirements for healthcare space is a tendency by the design team to focus on functional designs first, without deeply understanding the purpose of healthcare space development. The gap between real needs to be met in a design solution and the final outcome can be magnified if significant documentation of all stakeholder requirements is not captured in the first stages of requirements specification (Becker & Parson, 2007; Ryd & Fristedt, 2007). Consequently in the early stages of the briefing process, alignment between the purpose of the project, the strategic goals of the institution and the context for feedback from patients and professional staff needs to be clarified to avoid misalignment (Kelly, Hunter, Shen & Yu, 2005; Ryd & Fristedt, 2007).

Given that most healthcare space development projects are meant to improve patient outcomes as one their key goals, it is infelicitous that healthcare space research has identified little evidence of patient feedback in healthcare space design briefs, in contrast to relatively significant feedback from healthcare professionals in design briefs (Elf & Malmqvist, 2009). This is part of a broader concern about the quality for design briefs in the healthcare sector which has identified a lack of sufficient details and structure in design briefs**.** The 2009 study investigated the content and quality of design briefs for multiple healthcare space projects and found little direct feedback from patients, despite most of the projects claiming to seek improvements to patient experience of healthcare. This is the type of oversight that can lead to misalignment in the briefing process between the purpose of the project and the final outcome (Cesario, 2009; Vischer, 2008)

To avoid gaps in the briefing stage of the design process, some recommended strategies are;

- Providing sufficient room in the project to engage in collecting evidence of medical activities which will occur in the space, such as the telemedicine examples of the previous section (Li, Wilson, Stapleton and Cregan, 2006; Thompson, Hamilton, Cadenhead, and Swoboda, 2012)

- adopting standardised instruments for collecting user feedback as a key part of documentation processes (Barrett & Baldery, 2009). Even so, care needs to be taken

with the use of such instruments as some dimensions necessary for the development of holistic design briefs can be overlooked when the same instrument is transferred between projects (Fristedt & Ryd, 2004).

- ensuring that perspectives of all legitimate stakeholders are included (patients, professional caregivers, management, leadership(Elf, Engström & Wijk, 2012).

The challenge of documenting user requirements in the design and development process for healthcare space research remains an ongoing challenge.

6.0 Testing, commissioning and healthcare space readiness

Towards the end of the healthcare space development, a key stage of the design process is the testing and commissioning of the space in terms of the extent to which it supports the medical activities destined to operate there. While this stage occurs towards the end of the build process, the integration of the principles of testing and commissioning begins well before, at least at the outset of healthcare space project specification, described above in section 2. It is at this stage that those members of the design and development team who will oversee the testing and commissioning phase agree upon and establish the best available measurable project performance requirements (Henriksen, et. al., 2007). Apart from ensuring that compliance and operational processes aimed at improving efficiency have been achieved and that those responsible for their operations have been trained, the less measurable and intangible aspects of the project outcomes need some consideration at this stage. This can be achieved by having the healthcare workers who will work in the space once commissioned, engage in trials of the healthcare space facilities as part of the commissioning process in order to provide advice on the usability of the healthcare space. Their feedback can provide essential advice necessary to correct often simple but fundamental aspects of the outcomes of the build process.

A noticeable change in commissioning practice over the last decade in healthcare space development has arisen because of a greater use of technology to achieve health outcomes. With the increase of technology-mediated healthcare practice shaping the design of physical healthcare space, there is a greater imperative in the healthcare space commissioning phase to test the appropriateness of the design solutions for the healthcare professionals and patients. This has meant that the evaluative criteria for commissioning technology-mediated medical activity has moved from questions such as ‘does it work?’ to ‘to what extent does the design of the technology-mediated activity achieve the medical purpose for which it has been designed?’ This shift in the emphasis of commissioning technology in healthcare space design has meant a greater attention to input from healthcare professionals at this stage of the design process than in comparison with the past (Li, Wilson, Stapleton and Cregan, 2006).

7.0 Post occupancy evaluation of healthcare spaces

Post-occupancy evaluations which focus on holistic assessment of healthcare activity, are not only an essential part of recognising if the healthcare space project has met its goals, but can also be used as input into similar projects as one source of evidence. However, when

considering their potential contribution to design decision for subsequent builds, care is needed (Pati & Pati, 2013). One of the common mistakes in claiming post-occupancy evaluations as evidence for ensuing design processes is that all such evaluations are not equal. They are typically designed for specific audiences. Consequently, if the purpose of the evaluation does not relate meaningfully to the design issue under consideration, then it is unlikely to be of help in the decision-making framework.

One reason that post-occupancy evaluations may not be suitable for subsequent builds lies in the difference between physical and functional evaluations. The former focuses on the technical performance of the tangible and observable built environment. The latter focuses on the workplace processes which are enabled by the physical. In general, reviews of post-occupancy evaluations have found that very few focus on both the physical and functional, and consequently often only offer half a picture on the contribution of the design to the outcomes sought by stakeholders (Zimring, 2001).

Functional evaluations of healthcare space are where the benefits of designs informed by telemedicine are likely to come to light. The methodology of post-occupancy evaluation in the health sector has become sufficiently developed to consider how effective the use of technology is in the practice of healthcare in new space developments (Chiu et.al., 2014). Adopting a socio-technical approach, renewed post-occupancy evaluation methodologies can include measuring the interaction and adoption by healthcare workers of technology-enabled processes to yield insights into both the effectiveness of the technology for the outcomes sought, as well as raising any ongoing issues for management and/or policy implications. Such approaches tend to measure the digital footprint left by healthcare workers on the space, and then use the context of the healthcare activity to judge to what extent the design of the process is meeting outcomes.

8.0 Lessons learnt - considering health sector space planning practice in relation to the higher education sector

The overview of health sector planning and design practice in the first part of this chapter has described how an evidence-informed approach has shaped space development at the level of the sector. In the following, we observe that a sector-level approach to evidenced-based planning is not similarly extant in the higher education sector and offer some explanations as to why we make this claim. In doing so, we discuss a number disciplinary and socio-cultural factors which may contribute to current approaches in both sectors by drawing on previous closely related research which investigated the activity of participants in networked learning space (Carvahlo and Goodyear, 2014).

In this section of the chapter we use three questions as a reflective framework in which to consider the issues;

- why does sector-level planning for space design seem to be more developed in the health sector in comparison to the higher education sector?

- why has the systematic integration of technology in health space planning in the health sector not been reflected in the campus planning in the higher education sector?
- what lessons from healthcare space design in the health sector can meaningfully inform the approach to learning space design in the higher educaiton?

Before addressing these questions, reviewing some of the key concepts from previous research will help to frame how the observations are made. In order to understand how networked learning occurs when considered in the healthcare space in which it is placed, the ideas of 'set design', 'social design' and 'epistemic design' are useful to understand and draw on.

Set design for healthcare space: The description of how new physical designs and telemedicine are being integrated into healthcare building design in the health sector can be understood as a type of 'set design', or preparing of the space in which healthcare activity is to take place. From a stakeholders point of view, the modern design of a hospital can be viewed as the bringing together, or assemblage, of the very latest thinking in how to arrange specialist facilities, fixtures, fittings, technologies in the most opportune way to promote healthcare across physical and virtual space. From the description in the first part of this paper, if the design process is to be effective and well-informed, it should be orientated around, and depart from, a socially orientated interpretation of the space which has at its heart, the needs of patients, healthcare workers and healthcare leaders.
Social design of healthcare space: Putting the needs of stakeholders at the centre of healthcare space design, can be understood as privileging the 'social design' of the space where 'social' refers to the interaction of healthcare workers and leaders engaged in healthcare activity aimed at particular outcomes.
Epistemic design of healthcare space: The purpose of healthcare space development is to enable healthcare tasks and activities and is best informed if the design team understands the 'epistemic design' requirements of the space, how it shapes the sequence of activities and situates the participants within those sequences.

The following is not an exhaustive application of these ideas to space development in the health sector as there is insufficient rooms to give it due justice. Rather it is an opening of the discussion, framing developments in space design which may be applicable to more than one sector.

8.1 Why does sector-level planning for space design seem to be more developed in the health sector in comparison to the higher education sector?

The higher education sector as a whole does not seem to display the evidence-based movement that has informed space planning in the way that the first half of this chapter has described its realisation in the health sector (see Rycroft-Malone and Bucknall, 2013 for a wide range of outcomes from the health sector in evidence-based practice). Some of the reasons why the health sector seems to be in advance of the higher education sector in space design may be related to differences in the interplay of epistemic and social relations in the

sectors (Maton, 2013). In the health sector, relatively greater sector-level advances in space development may be due to reasons such as;

- the measurability and agreement on what constitutes outcomes in the health sector is relatively less ambiguous in the health sector than in the higher education sector
- the stakes of getting the set design wrong in the health sector, a hospital for example, can be more serious than getting the set design in the higher education sector such as a university.
- the epistemic design of healthcare activity is more fixed and procedural than learning activity because the outcomes are more relatively concrete and measurable in the former than the latter

8.1.1 Learning outcomes and healthcare outcomes

In higher education, learning outcomes are notoriously difficult to measure, and often difficult to define. They can be quite specific and involve the full awareness of the student (Marton and Booth, 1997; Prosser and Trigwell, 1999) and they can also be realized from the incidental by-products of study activities and absorbed by students (Goodyear and Carvalho, 2014). What constitutes evidence of learning outcomes in the higher education sector is often relatively more contested than what constitutes health outcomes in the health sector. For example, measuring improvements in diagnosis, treatment and cure is intrinsically a less abstract exercise than measuring who learns what and how much they learn. In relational terms, the difference in evidence-based outcomes across the two sectors could be described as a difference between a 'knowledge code' of what constitutes health outcomes, and a 'knower code' of what constitutes learning outcomes (Maton, 2013). In this comparison, an emphasis on states of knowledge and expectations that count as health outcomes is relatively clearer and more explicit, than the states of knowledge and expectations required to achieve learning outcomes.

8.1.2. Lack of systematic evaluation of learning space at the level of the higher edcaiton sector

With a relatively greater contestability of what counts as legitimate outcomes in the higher education sector compared with the health sector, it is perhaps not surprising that there are significant differences in sector-level evaluation systems.

Internationally in the health sector, advocacy work for the development of evidence and evlautioin for healthcare space is coordinated by EDAC - Evidence-based Design Accreditation and Certification[1] - and its accompanying journal HERD - Health Environments Research and Design[2].

In the higher education sector, apart from SCUP - the Society for College and University Planning[3] - and CEFPI - the Council of Educational Facility Planners International[4] - there is

[1] http://www.healthdesign.org/edac/about
[2] https://www.herdjournal.com/
[3] http://www.scup.org/page/index

no equivalent and those organisations are yet to have the same penetration as the EDAC nor an established community of practice in EBD.

This is not to say that there has not been significant effort at the level of the higher education sector for learning space research. Internationally, two bodies which have a prime focus on the use of technology in learning - Educause in the United States of America and the Joint Information Services Committee in the United Kingdom - have considered learning space in part (see for example Oblinger 2006; JISC, 2006), but those projects have now been largely discontinued with the exception of an attempt at codifying what constitutes a 'good' learning environment through the just released beta version of a 'learning space rating system' (Felix and Brown, 2011). Nationally, the Australian Office for Learning and Teaching has has funded some studies into the phenomenon of learning space (see for example Radcliffe et. al., 2008; Mitchell et. al., 2010; Lee et al., 2011; de la Harpe et. al., 2014). These have been very valuable in raising the issue at the national level, but the complexity of understanding how integrated learning space is related to learning outcomes has meant that these studies have only just scratched the surface.

In the higher education sector in Australia, an emphasis on research over education tends to reduce the impetus for systematic learning space research. There has been traditionally relatively less funding for learning and teaching development activity in universities than research development activity. For example, the Australian Research council 2013-2015 actual and projected grant funding available for research development activity is something over $800 million dollars a year (ARC, 2013). This is in comparison to the Australian Office for Teaching and Learning with a budget of something over $20 million each year. This has been in part because research has typically been priveledged over teaching and learning as the service provided to society by universities and is well illustrated by the world university ranking tables discussed below.

To bring about a sector-wide change in evaluation of learning space in Australia, the development of a case for evidence-based learning space planning should be brought to key governing bodies in the Higher Education sector, bodies such as Universities Australia and the related organisations - the Group of Eight, the Australian Technology Network and the Innovative Research Universities group. Such a case informed by some of the ideas of evidence-based space planning and design in the health sector may be able to address the gap in the higher education sector. Any such strategy should include ways of helping the links between learning outcomes and space design to move increasingly towards a ‘knolwedge code’ in order to increase its chances of establishing sector-level awareness of the issues and complexities.

8.2 Why has the systematic integration of technology in health space planning to enable health outcomes not been reflected in campus planning in the higher education sector?

Technology planning for learning is often best guided by departing from the learning outcomes sought from the experience. By seeking an alignment from learning outcomes to

[4] http://www.cefpi.org/i4a/pages/index.cfm?pageid=3277

assessment to learning activities to technologies chosen to enable the activities, the likelihood of the technologies supporting the achievement of outcomes is increased (Biggs and Tang, 2007; Laurillard, 2002)

If we accept that health outcomes are relatively clearer and more explicit than learning outcomes at the level of the sectors because of the different forms of knowledge across the two sectors, then it is perhaps not surprising that the predominate focus of research how technology is related to learning is at the level of tasks, courses within a degree program and even at the level of a department. Little of it is at the level of building and campus design, particularly with the idea of a university campus as a place of learning. There are few studies which discuss and provide evidence of the design of a building aligns to the teaching and learning model of a university and the teaching and learning model underpinning its campus.

The stages in the development of healthcare space design programming that structured the first part of this chapter clarified how technology planning is being systematically integrated into healthcare space design processes. In healthcare space design, the building is conceived of as a specialist 'space' in the procurement process. Each building, including the physical and virtual environment it provides, can holistically be construed as an artefact to enable health outcomes (Gregory, Hopwood, & Boud, 2014). Yet in the higher education sector, the integraton of technology to enable learning in physical spaces and to integrate these with virtual spaces is yet to be part of a systematic approach to learning space design programming for buildings and university campuses.

Tensions within social design factors, created by putting the needs of multiple stakeholders in the centre of learning space design, can impede an integrated concept of technology in building and campus planning in the higher education sector. For example, the design of learning and teaching space at a university may be driven by the university curriculum in order to emphasise the alignment of the envrionment with the learning needs of students and teaching staff. In such cases, the social design concept of 'learning' drives the design. Campus planning processes, however, often can priveldge other concerns such as brand or business model benefits which do not have teaching and learning at the centre of it. For example, University Rankings and league tables are constructed on indicators mostly influenced by research and are relatively detached from indicators that reflect teaching activity and student outcomes (Bowman and Bastedo, 2011). Consequently an unsatisfactory university ranking may lead to a major re-strategising of research practice and the set design of research facilities in a unviersity, but often does not involve a major re-strategising of teaching practice and and its alignment to the set design of learning and teaching space in a university**.**

8.3 What lessons from healthcare space design in the health sector can meaningfully inform the approach to learning space design in the higher education sector?

One of the most galvanising aspects of space design activity in the health sector over the last decade has been the recognition of the challenges and benefits of translating the practice of healthcare into healthcare space design research and the translation of the outcomes of

healthcare space design research into meaningful realisations for healthcare practice. To facilitate a symbiotic translation, the emergence of the discipline and professional role of 'translational developers' in the healthcare sector is key (Norman, 2010). In the context of the forms of knowledge in the sector that we refer to above, these roles help translate ideas about space design and health outcomes from being a 'knower code' to a 'knowledge code'.

The idea of a new professional category of 'translational developers' as a discipline and legitimate role in the sector has helped to demystify the challenges in the healthcare space design; the difficulty in translating the needs stemming from a deep understanding of what it takes in healthcare pratice to improve health outcomes into research questions which shape sustained efforts into understanding how healthcare space design can improve health outcomes. Without sustained and systematic attention to this part of the healthcare space design process, progress in the field would have been much slower than it has been.

Evidence of the intent to develop a sector-level 'knowledge code' in the health sector can be seen in the publishing profile of professional journals focusing on space. The *Health Environments Research & Design Journal* focuses on providing evidence-based research of the benefits of physical healthcare space design for health outcomes. There are similar journals in the higher education sector, but none are yet to commit to systematically publishing evidence of the links between physical learning space and its associations to learning outcomes. This is not to say that there are no publications on this matter, but rather that at the level of the sector, there is yet to be a systematic body of evidence and publishing vehicle on the associations between learning outcomes and physical learning space. Similarly, the idea of a role for translational developers in the higher education sector is yet to take hold.

In the higher education sector, a professional role whose responsibility involves translating the practice of education into research questions that guide learning space planning is non-existent (although the concept of an educational planner is gaining acceptance in school scector planning and design with an accreditation framework in the process of being developed by CEFPI). If such a role existed, disciplinary accreditation bodies would be able to define the roles, and call on the expertise of translational developers who could play a role in more precisely describing the links between curriculum needs, building design and campus planning for the purposes of learning.

The absence of this type of knowledge is evident in some of the key instruments in the higher education sector. The risks and interdependency between the provision of degree programs and learning space is yet to be reflected in the threshold standards for higher education award provision (TEQSA, 2011). Similarly instruments used to evaluate the student experience, such as the University Experience Survey, the Graduate Destinations Survey and the International Student Barometer, do not recognise the interdependencies amongst space and learning. Reading the items in these surveys suggests that the conceptual link between learning and teaching space and learning outcomes has progressed little further than recognising that an absence of 'access' to quality learning and teaching space will impede aspects of the learning experience. If the sector embrace the idea of 'translational developers'

those whose role was to help to develop a sector-level knowledge code for campus design as places of learning, a new forms knowledge would help to bridge the divide between research and practice into learning space. Such knowledge could be referred to as 'translational science' or 'translational engineering' (Norman 2010). Norman goes further (as a Dean of Architecture) in suggesting this concept could be extended to the idea of a 'translational designer', which we suggest is one who bases designs on primarily on a shared evidence-based body of knowledge rather than on the input of 'knowers' who have credibility.

> *'design is still an art, taught by apprenticeship, with many myths and strong beliefs, but incredibly little evidence. We do not know the best way to design something.' (Norman, 2010).*

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