

Clicks, Bricks and Spondulicks

A Summary Report of the Proceedings of the OECD PEB Seminar

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Abstract

This report is a summary of the proceedings of a 3-day OECD-PEB Seminar held in Brisbane, Australia in March of 2003. The Seminar was jointly arranged by PEB, the Queensland Department of Employment and Training, the Australian Government's Department of Education, Science and Training, and was kindly hosted by the Queensland University of Technology.

Attended by around a dozen countries, the Seminar focussed on the relationship between information and communication technologies and the built environment. This was in response to the increasing use of e-Learning and other technology enhanced pedagogical approaches which are all having an impact on the existing and newly constructed physical infrastructure.

The Seminar picked up on themes and issues currently under consideration in the current PEB Mandate and Programme of Work. It also was instigated partly in response to the recently completed international survey of literature and case studies in the 'Clicks on Bricks' Project under the auspices of The Australian National Training Authority's Flexible Learning Advisory Group (FLAG).

The ten or so presentations, case studies, workshops and site visits have resulted in a teasing out of the often competing interests involved around planning, developing and managing both the ICT's and the built environment. The report should provide a useful overview and literature summary for policy makers and implementers alike in the higher education and training sectors.

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Introduction

Over the past decade the principal activities of the PEB Mandate of Work - the planning, design and management of educational buildings - have been influenced significantly by a wide range of factors and not least by the impact of new and emerging information and communications technologies (ICT's)¹. Further, much of the growth in post-secondary education student numbers has been accommodated by the increased productivity which ICT's have enabled, although the impact on pre-tertiary education is also the subject of considerable study².

In recognition of this situation, the PEB Program of Work 2002-2003³ determined that:

'As countries address the need to refurbish and supplement existing stock, one aspect of this is the relationship and interactions between capital investment in information technology (hardware and software) and that in physical infrastructure (bricks and mortar). While they have often been viewed as separate entities in competition for the same funds, the study (the subject of this report) will look at how these two areas of investment together can lead to more efficient and effective ways of educational delivery.' (OECD-PEB, 2002).

The Context of Capital Investment in Higher Educational Infrastructure

In this increasingly globalised new Millennium the economy is inexorably undergoing a transformation from the 'information age' to what is now commonly known as the 'knowledge age'. The OECD has recognised this evolution by shifting its focus, over the past 5 years or so, towards studying investment in human capital. The associated recognition of the underlying importance of education and training on human capital has resulted in the recent formation of the Division for Education and Skills.

The Program on Educational Building is a critical part of this Division, as physical infrastructure forms a major part of the budgets allocated for education and training. At the same time, Ministries of Education across the globe are being challenged to manage their physical resources more efficiently and effectively. There are greater numbers of students entering post secondary education with the participation rate in some OECD countries as high as 60%⁴. As a result of this increase in human capital investment these countries are critically re-examining capital and recurrent investments in the physical infrastructure which supports post-secondary education^{5,6}.

These reviews are also the result of an increasing trend in many countries towards the devolution to provincial, regional and local levels for the development, ownership, operations and management of educational buildings. In Australia the use of Private Public Partnerships and other collaborations such as the Private Finance Initiative in the UK are also introducing new strategies in the financing of capital investment in educational infrastructure. Associated with this growth in 'outsourcing' is a greater need and increased use of control mechanisms in the form of performance measures, monitoring and evaluation of educational facilities. These trends are growing in importance along with the popularity of the OECD Educational Indicators

Publications⁷. Further, there is consistent evidence of interest in the relationship between educational outcomes and educational buildings through continual studies around these measures⁸.

As a key initiative of the PEB Steering Committee a PEB Seminar concentrating primarily on vocational training and higher educational buildings and infrastructure was held in Brisbane in March 2003. This was, in part, as a response to the work on investing in human capital at the OECD, but also because a number of associated studies in understanding the relationship between ICT investment and associated 'bricks and mortar' are providing significant references from which to draw initial conclusions⁹. The 'Clicks on Bricks' study commissioned under the auspices of the Flexible Learning Advisory Group of the Australian National Training Authority examined a wide range of literature that linked the built environment and information technology for teaching and learning. The report is in three parts as follows:

- *The Impact of Clicks on Bricks: VET facilities planning in an information age.* This final report synthesises the underpinnings with current research into the potential impact of new technologies on the design and future use of physical facilities in VET.
- *Principles and Guidelines for the Best Practice Incorporation of New Learning Technologies in the Physical Facilities of VET.* A comprehensive set of practical tools useful for managers and planners involved in policy and implementation of technological infrastructure.
- *Principles for VET facilities planning in the information age - literature search and review.* The first outcome of the project - a comprehensive review of available literature and sources on the subject of impact of new information and communication technologies on physical VET infrastructure.

Whilst the Seminar was in part inspired by this extensive piece of work another objective was to build on another significant body of work carried out by PEB. This project, in collaboration with the European Investment Bank in Luxembourg in 1998-2000, explored investments in infrastructure to better understand the balance of, and competition for, capital funds¹⁰. Further, the Seminar sought to determine whether educational buildings and ICT's should continue to be seen as separate entities competing for the same pool of funds, or whether they should be treated as a holistic component of educational infrastructure. Educational buildings and ICT's are both technologies, and it may well be that they should be integrated in their planning, procurement and management.

The following key questions became the prime focus of the Seminar in Brisbane:

1. What are the current major trends in information technology and physical infrastructure capital investments that can be identified at the international level?
2. What are the major developments that will impact on educational information technology and the design of educational buildings?
3. What recommendations can be formulated regarding educational information technology and the design of educational buildings?

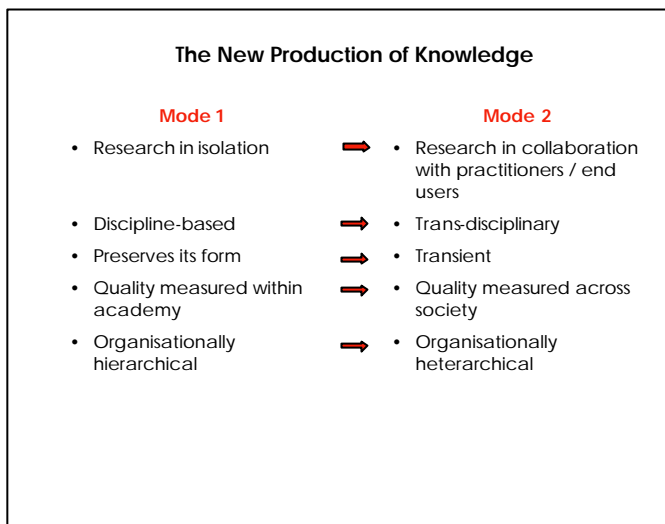
4. What action should be taken at the state, national and international level?

Investing in human capital in the knowledge age - issues, trends & current policies

Many of the concepts noted above have been tackled in ongoing research examining how new knowledge is produced. Mode 1 knowledge is based on traditionally accepted notions of academia, whereas Mode 2 knowledge¹¹:

‘Operates within a context of application. Here problems are not confined within a disciplinary framework. Knowledge production is trans-disciplinary rather than mono/multi-disciplinary and is carried out in non-hierarchical, heterogeneously organised forms that are essentially transient. It involves the close interaction of many actors throughout the process of knowledge production and as a result becomes more socially accountable and thus becomes diffused throughout society.

Mode 2 knowledge is reflexive and includes a wider, more temporary and heterogeneous set of practitioners, collaborating on a problem defined in a specific and localised context. Knowledge is always produced under an aspect of continuous negotiation and it will not be produced unless, and until, the interests of the various actors are included’. (Gibbons et al, 1994).



In this context key issues considered in this Seminar topic in the post-secondary education sector include the proliferation of e-Learning, the increased commitment to lifelong learning and the constantly reducing proportion of Government funding in many developed countries. Coupled with this are, of course, the multiple impacts of ICT advances, the increase in distributed and flexible learning and the emergence of virtual campuses. There are pedagogical implications from these developments, including a move towards student-centred learning away from the more traditional, widely practised and accepted teacher-centred (Mode 1) model.

This implies a move from learning in a set place, at a fixed time, and from one-to-many, towards learning in many places, at a range of times to suit the learner, and in modalities that extend from one-to-one through to many-to-many¹². This paradigm shift, Stuebing notes, is away from a closed system towards an open system¹³.

‘The old manner of matching supply and demand is a rigid system which often commits us to classrooms and lecture halls which may be unnecessary if the palate of choices was opened more broadly. The creative talents of the capital planning professional could be unleashed with the assistance of the educator

and the IT professional if, instead of beginning with quantitative goals such as so-many classrooms or so-many buildings, we began with qualitative goals which identified the offerings to be made to the learner.' (Stuebing, 2003, p18).

Stuebing also argues that four issues are critical to such a transformation – change, time, presence and language. Understanding *change* requires us to analyse how the learning environment can embrace continuous new opportunities made available through technological innovation (which may be very costly) and the corresponding shift in educational methods. As for *time*, we need to ask ourselves what definition of anytime-anywhere is relevant to our particular concept of a learning environment and how this definition will be supported?

Further, what contribution does the *presence* of the institution (physical and virtual) make for the learning process in terms of community, exchange and development (for all participants) and where are the boundaries to be found or drawn? Finally, the issue of *language* can also be a barrier to a successful transformation. Stuebing asks 'who are the key stakeholders in the process of creating the learning environment and what is the nature of their communication? How can patterns of communication be challenged to improve and develop to maximise the opportunities to develop a supportive learning environment for the community?' (p11).

A critical part of such a shift from a closed to an open system is the form of pedagogy used, the ICT available and the resultant need for a different spatial solution to facilitate such open and flexible modes of learning. These critical factors are implied in the four principles of planning, design, technology and business, supplemented by a fifth, the pedagogical process¹⁴. The final ANTA 'Clicks on Bricks' reports suggests that:

'There is no 'correct answer' to the question of what are the impacts of 'clicks on bricks', but many answers influenced by a huge range of circumstances, objectives, and resource variables. It is the responsibility of those in decision-making positions, in consultation with the stakeholders that they serve, to determine the 'best' combination of facilities, technology and professional resources to meet the needs of those stakeholders. This project to identify the range of factors involved will hopefully assist those decision makers in meeting their responsibilities at such exciting and challenging times in vocational education and training in Australia and the world.' (Whitaker et al 2002)¹⁵.

Whilst much progress has been made in building design trends¹⁶ and other capital investment studies as noted above, the challenge is to understand more deeply the impact of investment in ICT on learning outcomes and ultimately to bring the buildings and ICT together. Both are, after all, effectively learning technologies with, arguably, the only differentiating factor being their vastly varying life expectancies. For example, buildings might last 50-100 years, their interiors up to 20 years and the floor-coverings such as carpet 7-10 years. The ICT's on the other hand can have a life expectancy much less and in the order of 2-4 years. Integrated strategic infrastructure planning in this context becomes more complex and is discussed later in this report.

The OECD is correspondingly shifting its emphasis 'from buying equipment to educational returns on investment'¹⁷. This involves understanding the impact of a range of variables, the most common one being the number of students per computer. These statistics illustrate ranges from as low as 5 students per computer to as high as 35 students per computer across a range of OECD countries. There is also a wide variance of such investment across countries in relation to what might be possible when compared to the Gross Domestic Product available in those countries for educational investment.

Interestingly, technology has not necessarily made education cheaper. In particular in the tertiary sector the advent of online learning raises demands on teaching staff with increased student interaction and longer hours. Also online learning is limited in its effectiveness by the social nature of learning (that is, face-to-face is still largely seen as a more effective way of learning, with lower rates of attrition) and further it has high developmental costs. These costs can be hard to recoup, requires large class sizes to be cost efficient and can require new work organisation to be cost-effective – separating course development, teaching, student support and assessment (Sweet, 2003)

However, it can support lifelong learning skills and improve literacy. Sweet notes that in Nordic countries the increase in lifelong learning has resulted in improved participation rates in tertiary education (up to 60% as noted above), fostered a rapid emergence of autonomous learning, enhanced information processing and problem solving skills and has also achieved higher levels of cooperative learning. Yet quantitative research studies on the impact of ICT on learning outcomes to date have inevitably used 'yesterday's technology' as the time taken to do the studies, based on the existing technology of the time, means that new technologies and new outcomes are yet to be measured. They also often fail to specify that one of the key limiting factors of the studies is that they are predominantly restricted to very specific applications (such as mathematics teaching) and provide mixed messages on the effects of e-Learning.

Moves towards case-study based research offer more recent examples and better guides to policy development. Nevertheless, one major drawback of these studies is that they are often focussed on innovative examples of classrooms or schools and thus say little about the overall benefits of investment to the educational system as a whole. The OECD's Centre for Educational Research and Innovation (CERI) has found that returns on investment seem to vary from country to country

'Returns could depend upon which part of the education system you look at [and may be influenced by] teacher skills and working conditions, curriculum requirements, assessment requirements, how individual schools are organised how education systems are regulated, financing mechanisms, resourcing and infrastructure policies, and the physical organisation of classrooms.' (Sweet, 2003).

The ongoing CERI study has found that ICT practice is often directed at implementing innovations, it does not seem to replace traditional education and its integration into student learning makes the teacher's role even more important. ICT is not an agent of change by itself but it does favour those institutions that are

prepared for it and accordingly, it can support planned improvements. Success in the use of ICT depends on the level of infrastructure available, including equipment; Internet connections and especially technical support; the pedagogical skills of the teachers; the level of integration of ICT into the curriculum; and, importantly, the availability of training and development. Barriers continue to include the lack of time during working hours for the development of new ICT initiatives; teacher resistance; and limited infrastructure availability.

Despite these barriers online delivery has seen significant investment the world over. Key elements of such an extensive Online delivery program in New South Wales presented at the Seminar¹⁸ included cross-organisational collaboration in the development of 'learning-ware', with all materials shared across systems, accessing courses not otherwise available at the local campus, together with building web design skills capacity for the long term across the organisation. The online 'rollout' also improved flexibility and student access to vocational education study programs and helped to create enhanced and enriched learning experiences using blended learning and all-online delivery formulas.

The project objectives expected that a return on investment would be achieved from a reduction in capital infrastructure overheads and the incorporation of 'learning ware' in local, commercial and international training partnerships and licensing arrangements. Significant growth in interstate and international student programs is expected, as 'the Internet knows no boundaries'.

'The approach depends on numerous factors such as the culture and demographics of the target groups, the nature of the course itself, the online pedagogical approach chosen by the team as most appropriate for the target group and the learning outcomes required, the assessment methods chosen or necessary, available budgets, instructional design methodologies employed, and the multi-media expertise available. Most important is the feedback from the students themselves from trials and the independent assessors employed to review courseware.' (Poynter, 2003).

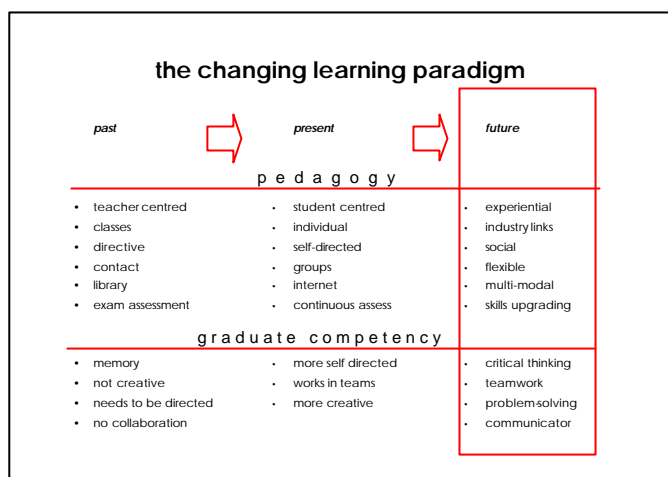
Possibly one of the most critical issues faced in integrating ICT planning with building planning is the difference in their life cycle expectancies, as noted above. The balance between the two is not only played out in funding strategies but also in social contexts. How to sustain communities of learners in both face-to-face contexts and virtual contexts is a key factor. Perhaps the major developments in ICT, either about to influence pedagogical approaches or already having a major impact, are voice over IP, wireless networks, the proliferation of laptop computers and the convergence of technologies being reflected in the emerging multi-media nature of mobile phones and hand held 'palmtop' organisers.

University campuses are increasingly being retrofitted with wireless 'hotspots' allowing students to work 'anywhere at anytime'. The groupings of students are changing from a dependence on the formal teacher-led environment of the traditional classroom to a much more informal and loose collaborative student centred approach. Learners are now logging in to networks as they have a cup of coffee in a café or cafeteria, or in the library or in a cloister or undercroft, depending on the climatic conditions and the design of buildings.

These emerging ICT's are stimulating new ways of learning with curriculum and pedagogical approaches being re-written to support project, resource, problem or team-based learning. These approaches are in turn demanding new physical learning environments to support these practices.

They are also supporting what research, professional and other employers of university and vocational training colleges are seeking. That is, a higher proficiency in 'graduate competencies' in students as they leave formal education to pursue their future careers.

Some of the key social drivers shaping education were also considered by the Syndicate Groups at the Seminar. Three perspectives were used to understand these drivers – *the broad issues*, a *learner focus* and a *policy focus*.



The first, *broad issues*, included the explosion in knowledge; changing from content to knowledge management; education as a consumable; technological change; and consumer expectations. The second, *learner focus*, included equity of access and gender issues; individual choice; cultural differences; lifelong learning adaptability (including continuing education); multi-disciplinary learning; internationalisation; demand for choice (online or face-to-face); quality of program/qualification; capacity to transfer credits (recognition of prior learning); cost of program (fees); and flexibility (time, place, module, course). The third issue, *policy drivers*, included creating a cohesive society; respect for diversity; global inequity; mass higher education; demands by Industry and Government, including prescribed training profiles; stable social policies; political policy-making in support of education; and the allocation of scarce resources.

Many of these issues were evident in the plenary presentations at the Seminar. For example, the Australian Science and Mathematics School, sited on the campus of the Flinders University in South Australia¹⁹, outlined how many of those issues listed above were tackled in an integrated way. The school was developed in response to a deficit in students choosing science and mathematics and this was having a marked impact on the future of science and mathematics teachers and indeed on the future pools of available researchers in the sciences itself. The school facilitates the teaching and learning of mathematics and science to senior secondary school students in a research environment.

Teachers engage in staff development, research is carried out into new technology-enhanced pedagogies and the occasional use of Flinders University science faculty staff fosters in students a willingness to pursue learning and careers in science and mathematics. The new sciences, such as nano-technology, are a key part of the

curriculum and they are introduced within new pedagogical and student assessment approaches. Students spend time equally in the school, the university facilities including, laboratories and cafeterias, and in the community, studying action research projects with industry partners. Staff in the school are challenged to teach in an innovative, student-centred environment in a building with no traditional classrooms or laboratories. Staff development is seen as a critical part of the success of the school, and the staff are trained to use the building as a 'learning tool', in much the same way as they are already trained in the use of information and communications technology.

Other examples presented in case studies at the Seminar included the Singapore Republic Polytechnic which, when completed, will be a completely wireless campus based on the principle of problem-based learning. Another was a University Mode 2 knowledge study which sought to understand the changing balance between Mode 1 spaces based around traditional classroom-based pedagogy (estimated at 87% of existing facilities) and Mode 2 pedagogy which is much more distributed and collaborative (currently estimated to be 13% of facilities). These and other examples all illustrated how pedagogy, ICT, the educational building and partnerships with the community are part of a seamless whole.

Innovations and developments in capital planning

The Seminar included a number of site visits which clearly illustrated the issues noted above. One visit was to a new project by the Queensland University of Technology (QUT) which is in the process of embracing a Mode 2 approach with its Kelvin Grove Urban Village²⁰. This development will 'create a community which links home, work and learning environments to foster a vibrant, diverse and sustainable way of life'. Within that complex sits (the under construction at the time of writing) Creative Industries Precinct that is:

'Providing a conducive environment for creatives and innovators, devoted to the growing of knowledge, research and applications in the Creative Industries. A purpose built, hi-tech site, the Precinct will be a centre of creative experimentation and commercial development, made possible by 24/7 all year around access, with wired and networked facilities, flexible working environments and exciting public spaces resulting in a vibrant community of like-minded individuals'.

A similar project is being considered at Brisbane's Southbank Institute of Technical and Further Education (TAFE), where a secondary school, vocational educational institute and a range of commercial partners will be collocated on the one site²¹. This project is in contrast to more traditional campuses which are largely constituted in Mode 1 format, with classrooms, laboratories and seminar rooms predominantly related to faculty disciplines. The Mode 2 facilities envisaged at Southbank are more responsive to learning with 'real-life' applications, collaboration, transience and informal learning and these approaches will also make greater use of technology rich environments.

In another example at QUT, growth in educational building floor area increased by 31% over the ten-year period 1992-2002²². Yet the increase in international students

and the growth of regional demands, coupled with new teaching methods, meant that still greater capacity was needed. It was therefore decided to integrate both the building and ICT programs in the capital planning process to achieve a coherent, asset management planning strategy, to foster greater integration of the two in practice, and to understand the dynamics between the virtual and the physical investment.

As a key part of its unique business plan QUT decided to re-emphasise the face-to-face component of teaching and learning as it wished to confirm that they were 'here' as a university, rather than 'not here' as is the model in virtual or corporate universities. At the same time QUT expects that the resource tension between the ICT and buildings infrastructure will continue, but that 'simplistic perspectives about mutual exclusivity will not'. This tension is, in part, an extension of the struggle between apportioning funding for refurbishment and maintenance of existing infrastructure (when there is an increasing demand for new buildings) with the constant need more floor space to accommodate growth in student numbers.

Conversely, Griffith University has opted for a middle path inclusive of new technologies, new pedagogies and new designs for learning environments²³. The University is strongly committed to the concept of flexible learning. This is a strategy which requires new approaches to pedagogy, increased technology enhancement in learning and to the development of a wide variety of flexible learning spaces and places on campus to support multiple-modality program delivery. Flexible delivery 'is an educational approach using a variety of student-centred teaching and learning methods, resources and flexible administrative practices that respond to the needs of a diverse student population'. To make Griffith's programs more flexible courses are being:

'Designed to meet the needs of a student population with increasingly diverse needs and are taking a program-wide view of assessment. They are also improving websites, providing access to more comprehensive information, on time. Finally they are improving staff-student communication and interaction (face-to-face or via the web).' (Davis, 2003).

For Griffith University, evaluation and review studies of flexible learning have found that this approach has given 25% of students the ability to study at their own pace, a further 20% of students study from a variety of resources or can study at home without going to campus, and all can gain web access to resources wherever they are able to log into the Internet. 13% of students believe that they are no longer disadvantaged if they do not attend class and 7% of staff believe that they have a lighter workload.

This commitment to flexible learning is evident in the significantly differing funding balance between ICT and buildings compared with the implied national average in Australia, as demonstrated in applications specifically for innovative projects illustrated in the table below. This outcome has to be viewed with some caution as the University grant applications may have concentrated on building new projects rather than software development projects which could skew the data. Griffith is consciously targeting ICT solutions to program delivery through flexible learning

approaches rather than the traditional classroom based model which clearly requires additional buildings to provide these face-to-face environments.

	Australian Government Special Capital Development Pool	Griffith University
Buildings	64%	10%
Computing hardware and networks	25%	25%
Software and content development	11%	65%

Proportion of funding allocated to ICT and Buildings in Innovations Grants

ICT funding becomes very much a strong focus in the context of the aforementioned Public Private Partnerships. In some countries ICT requirements are included in the project scope, whereas in others they are excluded. Inclusion brings complexities in terms of calculating life expectancies and the likely cost of renewal over for example, a 3 year cycle for the 25-30 year concession of the project. Also the type of ICT is likely to change significantly over the concession period whereas for the built infrastructure the individual building elements are likely to change little, except for some of the engineering services components such as air-conditioning, security and building control systems.

Funding allocations for ICT's are therefore very difficult to determine. It is more straightforward on a traditional owner-occupier model, such as the Australian Science and Mathematics School where the ICT component was budgeted at approximately 12% of the construction cost of the school. ICT renewal costs will be taken up in the recurrent operating budget, but it is still unknown whether the level of renewal funds will be available for essential building refurbishment and upgrading over time. Renewal in the ICT's is much better understood and implemented than is the renewal of the built infrastructure for learning, and it may be that significant benefits could accrue through knowledge exchange if both approaches were more integrated.

Implications for planners of ICT and educational buildings

There are emerging examples worldwide of PEB Member Countries focussing Government policy more closely on an integrated strategy for the ICT and the built environment. In the Netherlands, for example, the Dutch educational system launched a high-speed electronic network system across the country between 1996 and 2002, where all educational institutions and student homes were linked by broadband networks. The project, called Kennisnet²⁴, attempted to tackle the issue of shared language across the system and provided additional funds for teacher professional development. This rollout has not been without its problems however as, although 'a success in terms of its business case, the opportunity to embrace teaching methods and to maximise the offerings of the network has yet to take place, as people didn't want to confront the educational system' (Stuebing, 2003).

In Japan, this reluctance to change and capitalise on information technology and communications has been managed through recent legislation. In 2000, the

Government, through the Ministry of Education, Culture, Sports, Science and Technology (MEXT), introduced the Fundamental Law on the Formation of an Advanced Information Network Society (the IT Fundamental Law). This was followed in 2003 by the establishment of the e-Japan Strategy, the e-Japan Priority Plan and the e-Japan 2002 Program, all of which were designed to actively promote IT in the community.

In the higher education sector the Japanese Government has introduced increased numbers of IT courses for professionals. In response to the report of the 'University Council of MEXT on Higher Education in the age of Globalisation', the use of lectures over the Internet was recognised as a legitimate alternative form of the traditional face-to-face lecture²⁵. Nevertheless, some problems are still recognised.

'Whilst the IT are believed to modernise the whole society including the educational domain, one has to keep in mind that IT is a tool to be utilised prudently so as to make people's lives more efficient and rich. IT can be used as a tool to overcome geographical and time constraints, which makes it possible to choose the learning resources and opportunities that best fit individual learning needs. However, some have pointed out [the increased potential for the] isolation of individuals, weakening of human relations, lack of natural and social experiences, the proliferation of harmful information and moral hazards and regulation problems on networks as negative effects of the IT revolution.' (Mori & Seto, 2003)

Mori & Seto suggest that one direct way out of this problem is greater interdisciplinary planning across Government agencies and with industry. 'The authorities in the field of planning educational building should work together with authorities who are concerned with negative impacts such as the isolation of individuals, weakening of human relations, lack of natural and social experiences, etc. The synergy between interdisciplinary teams might resolve the negative impact and realise the best use of IT in schools. Moreover, because of the generic character of IT, cooperation between public and private sectors should be promoted in investing in information technology and physical infrastructure'.

Such a '*presence*' of learning places and spaces, as noted by Stuebing above, is critical to lifelong learners re-engaging with the learning environment. Many adults can be alienated by negative experiences when at school as children, and need to be encouraged through non-threatening environments to return to learning. For instance:

'In Glasgow the Learning City project found that *presence* was so important that the 'place' needed to 'move' to where the learner was most likely to be found. For example, one learning centre was created in the centre of a public swimming pool complex. This intervention allowed the young men working out in the pool and gym, to 'work out' on computers to gain new skills without leaving a familiar surrounding. When we put technology and learning together, we talk about opportunities and exciting challenges. Learning is also about creating 'safe' conditions for the learner.' (Stuebing, 2003).

Planners also have to deal with the myriad realities of what forms of ICT should be adopted in the short and long terms, the cost benefits of which path is chosen, and the whole of life costs of the options, including understanding the life expectancies of each of the elemental components of the learning infrastructure. At the University of Quebec in Montreal this issue was faced recently in the decision to upgrade telephony and computer data systems²⁶. Both of these systems had recently been deemed to be either at the end of their life expectancies or be working at a specification too low to serve user needs effectively in today's contemporary educational institutions. The 100Km of fibre optic network needed upgrading to support teaching, research and administrative capabilities. Concurrently the telephone system of 5,000 lines was close to retirement and was not able to be supported by manufacturers for much longer.

One option for their replacement was VoIP or voice over Internet protocol. This seamless system provides flexibility for collaborative teaching and research through its integrated communications, with voice being given a priority over the system. Such an integrated system was considered by the University to offer greater productivity, would save money by purchasing the combined system rather than upgrading two separate systems, improve reliability, and protect future network investments. In particular it was suggested that:

'Web based VoIP technology is having real growth potential as a communication tool, both for formal classes and for the research community. From an academic point of view the potential of technology to enhance research, teaching and learning must remain at the forefront. VoIP is going to be one of the key developments over coming years. By combining data and voice networks for what it would have cost to buy just the voice replacement investment is optimised. Further, an integrated communication environment will assure the backbone upon which to build enhanced interaction and to ensure that the infrastructure is flexible, secure, fast and open to multimedia.' (Dupuis, 2003).

Similar predictions are being made for wireless networks (for instance, at the Singapore Polytechnic noted above), although warnings are now being issued as to the implied acceptance of the less than ideal ergonomics of using laptop computers in a wide range of situations, many of which are not designed for optimal physiological performance. The rate of change in the ICT's far exceeds the rate of change in technologies directly related to the built infrastructure. Yet this rate of change is having a major impact on teaching, learning and pedagogical approaches. This in turn is having an effect on the physical environment as argued above, where more flexible and collaborative learning environments are needed. Despite this apparent disparity of life cycles, it is imperative that the planning of infrastructure for both ICT and buildings should be integrated, interdisciplinary and highly collaborative.

Implications for Policymakers

There is clearly a broad range of issues that call for immediate consideration by policymakers. The key themes that suggest further study appear to be the integration of capital planning processes; finding the correct balance in funding ratios

between ICT and buildings; the development of Mode 2 learning and research environments; balancing distributed and central learning spaces; the need for new performance measures for educational buildings; the need for increased professional development of staff; the potential for new government policies to foster innovation; and planning for future uncertainty.

[1] Integrated capital planning processes for ICT & building infrastructure.

ICT and educational buildings are clearly both technologies. LeCorbusier's 'machines for living' are in fact 'technologies for living', and buildings are one of the first technologies to be invented. Intelligent buildings, building management systems, passive and active environmentally sustainable systems and information technology and communications are now all merging as one within the building fabric and the campus as a whole, as one seamless technology. Students, teachers and researchers use these technologies effortlessly, as has been demonstrated at the Australian Science and Mathematics School²⁷. Building planning, design and management and ICT's should both be planned collaboratively, and QUT's bold initiative to merge the two is very timely. National funding authorities might consider extending the requirement for capital management plans for campus developments and maintenance to include an integrated approach which incorporates information technology and communications procurement and renewal.

[2] Tensions between funding ratios for ICT vs buildings.

There appears to be little data or performance measures available comparing, contrasting and tracking the balance of investment between ICT and educational buildings. It is recognised that there are real difficulties faced in collating data that is reliable, consistent and current across national boundaries for educational buildings. Whilst this might be also true for ICT expenditures, CERI has managed to interrogate developments in ICT investments across national borders. OECD PEB Member countries might once again consider the need for performance measures for educational buildings, particularly in light of accrual accounting, increasing maintenance liabilities and the need for refurbishment to take account of new pedagogical approaches. This data can be collated together with ICT investments with the integration of the two providing a much clearer and comprehensive picture of the investment in capital expenditure in post-secondary education.

[3] Refurbishment and new construction from Mode 1 to Mode 2.

Mode 2 learning environments, to some extent reflected in Griffith University's flexible learning centres and QUT's Kelvin Grove developments mentioned earlier, are critical to maximising the extent of student-centred learning and lifelong learning through ICT's as an enabler. Many existing campuses are approximately 90:10 in terms of Mode 1: Mode 2. Whilst the correct balance is unknown it is likely that many programs will for some time be best taught in Mode 1 contexts. However, capital management plans should explore the balance between the two, and link this balance to the pedagogical practices, professional

development programs, academic business plans and quality performance reviews of each institution. As a start, educational building performance measures could be included in quality assurance evaluations of institutions, alongside the already included ICT's and other well established and accepted educational performance measures.

[4] The balance between distributed learning centres & core campus models

There are large numbers of new campuses being opened which are often accompanied by the closure of other campuses, reflecting both demographic change and the cost of operating less than optimal sites. As the Glasgow City of Learning study showed learning centres or portals do not necessarily need to be associated with traditional core campuses. Indeed, to optimise the impact of lifelong learning and the re-entry of disaffected students, non-core campus learning centres might well become a norm. Distributed learning models supported by ICT and tutors should be considered as part of a capital management plan and as a valid means of serving dispersed and diverse community needs.

[5] The increased need for new performance measures

Managers of physical assets and planners at regional, national and global levels have continued to struggle with performance measures for educational buildings. These have primarily been traditional approaches such as building assessment, post occupancy and building evaluation studies. Rather than pursue the continual challenge of trying to encourage countries to account for their building assets in a consistent and structured form, usually complicated by national accounting requirements, it might be time to explore other performance measures as recommended by Stuebing. The qualitative level of learning outcomes per square metre, rather than simply the number of student hours per square metre, could become a new measure of performance of the effectiveness of educational buildings and the associated ICT's.

[6] Professional development of teaching staff

These programs have traditionally been associated with pedagogy, curriculum, finance, management and ICT training. It might well be time to examine the implication of space and place in teaching, learning and research, to provide a deeper understanding of how they all interact. The classroom, seminar room and lecture theatre all continue to feature prominently in education and training, despite the impressive impact of ICT on learning and teaching and the rather few examples of flexible learning illustrated at the Seminar in Brisbane. The emergence of Mode 2 forms of learning suggests that a more contemporary model of professional development is called for which examines a student centred approach together with the spatial implications. Case studies would be an excellent support to this approach, such as illustrated in the 'Designs for Learning' publication of PEB.

[7] Government policies for funding for infrastructure innovations

Such programs need to be extended to include restructuring and refurbishing existing buildings and campuses to include innovative teaching, learning and research methods. These innovative funding programs normally favour new buildings whilst a reorientation towards funding innovations within existing physical fabric and how it can be reconfigured to meet the challenges of new and emerging ICT's would be timely. Much of the existing educational infrastructure was built in the 1960's to accommodate the burgeoning 'baby-boomer' growth, and it is this infrastructure which is clearly ready for renewal in its lifecycle. Originally designed for Mode 1 teaching, learning and research, it now needs to be reconfigured and upgraded for Mode 2 activities.

[8] Planning for uncertainty

The methods adopted in traditional and rigorous strategic planning are being overtaken by rapid developments in ICT, emerging models of flexible learning, globalisation and the differing lead times and life cycles of both ICT and the built environment, as noted above. What is now required is a more flexible approach to planning and budgeting. In this scenario much more collaboration is required, across planning disciplines and departments, and in a continuing conversation which is iterative. Further, planners in association with the operational staff must interact constantly. In other words, the process is much like the production of knowledge in a Mode 2 context. At the Seminar such approaches were illustrated by Stuebing, Poynter and Rae, to name just a few examples.

Pathways to the future

This Seminar set out to examine the relationship between the built learning environment and ICT, and the cost implications of this continuing tension. The fact that both ICT and buildings are technologies suggests that it makes sense to integrate, plan and manage them as one. At the local or regional level innovations should be encouraged and teacher professional development in the interactivity of space, place & ICT should be a major focus. Further, integrated capital planning strategies should be increasingly adopted.

In the national arena policy development might focus on funding strategies for innovative projects (particularly refurbishment) and could also support increased research studies building on the work of the ANTA Clicks on Bricks study in Australia. National Ministries of Education might also examine ways to develop new performance measures for both educational buildings and ICT infrastructure, particularly related to learning, teaching and research outcomes – the so-called 'return on learning' suggested by Stuebing.

On the International stage there is clearly a need for more benchmark studies on educational buildings and ICT's in a similar vein to the OECD's Performance Indicators at a Glance²⁸. Another PEB compendium of exemplars could also be considered in which the relationship between educational buildings, ICT and educational outcomes / pedagogical approaches are more clearly targeted. This

might also demonstrate advances over the 10-year period since the seminal PEB publication of *Redefining the Place to Learn*^{29,30}.

This Review paper outlines some of the concepts presented at the Seminar to address the initial questions that were asked about *Clicks, Bricks and Spondulicks*. The questions set at the beginning were considered, debated and evaluated, with the following outcomes

1. *Current major trends in information technology and physical infrastructure capital investments* – these were examined and debated across the international stage
2. *Major developments impacting on educational information technology and the design of educational buildings* – a wide range of case studies were presented and considered in the participant workshops and site visits
3. *Education information technology and the design of education buildings* - recommendations were formulated on integrated approaches to the planning, design and management of ICT and buildings
4. *Actions at the state, national and international level* – these were extensively discussed and recommendations have been suggested

Above all what the Seminar found, however, is that investment in capital expenditure in educational facilities and ICT might be viewed in a new light, that of ‘return on learning’.

‘Current practise suggests return on investment is a key assessment criteria based on the building-life cycle and residual value. This philosophy is in contrast with the reinvention of education over the past decade which challenges us to be concerned with ‘Return on Learning’ rather than ‘Return on Investment’. Therefore, new assessment definitions and methods need to be developed to better recognise the educational ‘eco-system’ in which our decision-making thrives. An educational institution which is in tune with current market-based knowledge production articulates its operation in a business case, which optimises costs (as the mix of context and assistance) and value added (learning effect). The context, by definition, is the combined digital and physical environment. The business case describes the characteristics of the learning environment in qualitative terms.’ (Stuebing, 2003, p1).

Perhaps the most powerful message coming from this Seminar is that the two critical elements in learning infrastructure - educational buildings and ICT - should be seen as one entity. They should not be seen as competing for funds but as collaborating in ways which will see limited resources used in balance and to the best effect in terms of student learning outcomes. Both the ICT’s and the built environment are ‘technologies for learning’ and should be planned, managed and designed as such.

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