RESEARCH INTO IDENTIFYING EFFECTIVE LEARNING ENVIRONMENTS

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Introduction

The evaluation of school learning environments has for decades traditionally focused on the technical performance of the facilities with little attention being paid to their pedagogical performance or effectiveness.

There are a range of 'top down' imperatives which have driven such an approach, including the need to sustainably finance educational infrastructure and show evidence as to how this money is being spent successfully. This need is emerging following the funding approaches now being taken by such bodies as the European Investment Bank and in Public Private Partnerships. On the other hand 'bottom up' imperatives have considered the pedagogical performance of learning environments as a means of providing feedback to authorities especially in the process of procurement. This in turn has influenced the development of planning and design guidelines.

This paper examines more closely the educational learning environment and the qualitative and quantitative research measures that have been used in recent times to determine their effectiveness. It explores some of the pedagogy and environment performance measures that have evolved and views these in the context of emerging research and evidence which attempts to relate pedagogy (including student and teacher attitudes) to space. It examines some case studies and focuses on the recently developed DET Victoria pedagogy-space strategies. Finally some conclusions are drawn and suggestions made for possible future research directions.

Qualitative and quantitative measures

Performance measures are often associated with the practice of post occupancy evaluations (Lackney, 2001). Yet these approaches as noted above more often than not focus on the technical aspects of the learning environment. An increasing interest in the relationship between pedagogy and the learning environment is illustrated by the number of American doctoral thesis taking a quantitative research approach to the question. These have resulted in 'evidence-based' performance measures which relate building condition test scores. Indeed claims of improvements in test scores of up to 14% are made if building condition is improved (Earthman and Lemasters, 1996; Fisher, 2000).

Figure 1. DEST Australia

Qualitative approaches have also followed an evidence-based research focus. These have also attempted to link pedagogy and environment by identifying a range of key performance measures. There are a number of examples of such approaches including the OECD PEB compendiums[1], the DesignShare Awards[2] and Sanoff's (2001) classroom rating scale. The selection criteria for the OECD – PEB compendium had six categories of which two concentrated on learning environments. The first asks how the design stimulates children's early teaching and learning experiences. The second asks respondents to illustrate how the facility is adapted to new forms of learning and research or uses ICT to optimise capital planning or property management.

The DesignShare awards have six categories of which only one focussed on the learning environment – 'enhance teaching and learning and accommodate the needs of all learners'. This incorporated a number of

elements including: follow the research in the learning sciences; students doing not just receiving; creating not just re-creating; students problem-solving; cooperative, project based, interdisciplinary; emphasis on learning styles, multiple intelligences and the special needs of students; school buildings are important learning tools; and finally accelerate research on the impact of the physical environment on student achievement.

Sanoff's classroom rating scale asks respondents to score the six classroom layouts on a range of questions as noted in the illustrations. This compared layouts across eleven criteria which were subjectively commented on by the respondents.

Figure 2. Sanoff's classroom rating scale
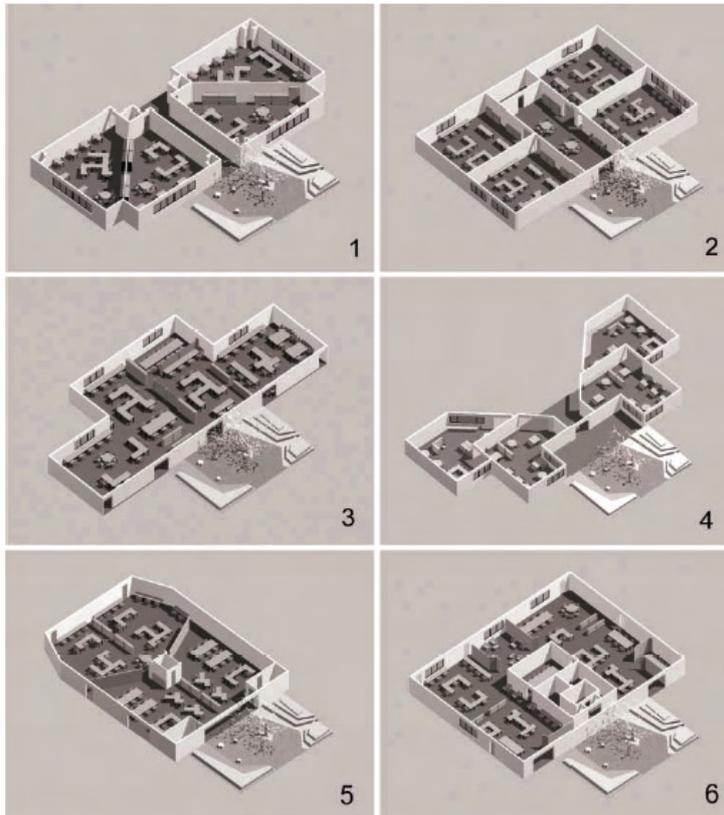
Figure 3. Classroom Rating Scale

Please select the best classroom arrangement that would satisfy each of the following statements:

	1	2	3	4	5	6
1- Students have some opportunities to move around	☐	☐	☐	☐	☐	☐
2- Students can engage in activities, manipulating objects and materials	☐	☐	☐	☐	☐	☐
3- Seating arrangements vary, including small groups, pairs, individuals, and total group	☐	☐	☐	☐	☐	☐
4- Individual students and small groups can chose from alternative learning activities	☐	☐	☐	☐	☐	☐
5- Small groups of students can work independently on projects or assignments	☐	☐	☐	☐	☐	☐
6- A variety of teaching methods can be used by teachers	☐	☐	☐	☐	☐	☐
7- Team teaching is easily facilitated	☐	☐	☐	☐	☐	☐
8- Teachers can make quick, clear transitions from one activity to another	☐	☐	☐	☐	☐	☐
9- Teachers can move around the classroom interacting with individuals and groups	☐	☐	☐	☐	☐	☐
10- Students have a sense of identity and belonging	☐	☐	☐	☐	☐	☐
11- Circulation is minimized	☐	☐	☐	☐	☐	☐

It would probably be an improved model if design criteria accompanied each of the six models so that each could be accompanied by a description of the design features and differences. Nevertheless this model does provide a strong pedagogical focus on the question of learning environment design lacking in many other evaluative approaches. Sanoff also provides rating scales for the 'outdoor classroom' and for the classroom itself in terms of its character and effectiveness for learning.

Research and evidence relating pedagogy and space

Clearly the most effective consolidated resources for research on the design of learning environments are offered by both the Educational Research Clearinghouse (ERIC) and the National Clearinghouse for Educational Facilities, the latter being sponsored by the US Ministry of Education (www.edfacilities.org). Another emerging resource is DesignShare (www.designshare.com).

**Figure 4. Sanoff – Indoor learning space rating scale**

Figure 5. Sanoff – Indoor learning space

A number of studies which explore the links between pedagogy and the design of the learning environment are worth examining in more depth including problem-based learning (Wolff, 2002). There are also a number of national qualitative research case studies including those conducted by PriceWaterhouseCoopers (2000) for the Department for Education and Skills, United Kingdom, the Ministry of Education, New Zealand (2004), and some examples related in *Architecture of Schools* (Dudeck, 2000).

Figure 6. Research and evidence relating pedagogy and space
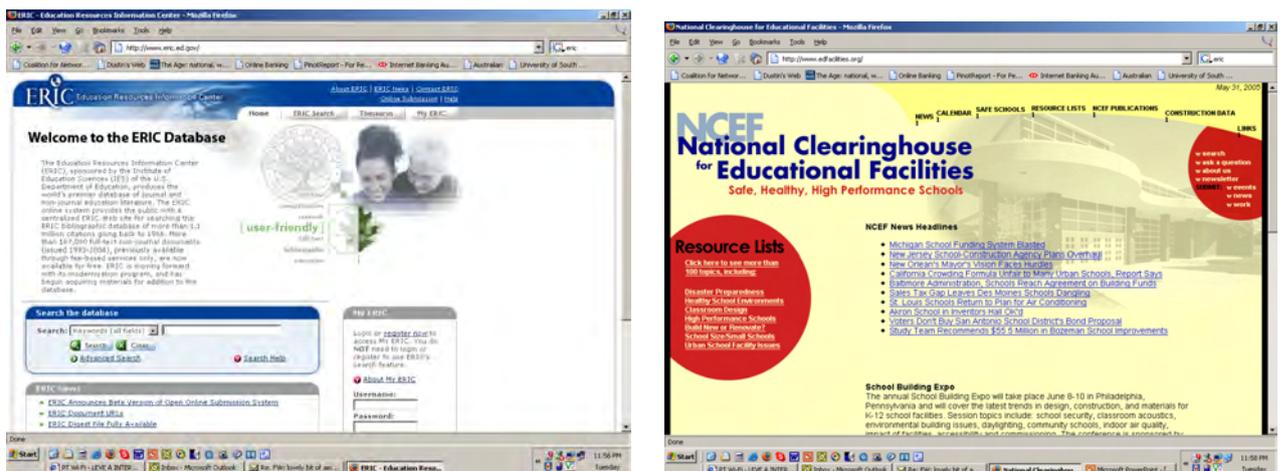
As part of a doctoral dissertation Wolff identified 32 design features that support collaborative, project-based learning. These factors include the idea that learning settings should be variably sized with individual workspace; have presentation space and 'cave' space; have spaces with access to food and beverage; include process galleries, studios, labs and a collaboration incubator; get away spaces or niches; display spaces and good access to technology.

The Department for Education and Skills, United Kingdom, has also attempted to measure the

financial and pedagogical value of school learning environments through a qualitative study carried out by consultants PriceWaterhouseCoopers (2000). This study focused on building performance which was based on an empirical assessment of the relationship between schools capital investment and pupil performance. It found that head teachers viewed capital investment as having a strong positive impact on pupil behaviour and motivation.

Figure 7. Wolff's Problem Based Learning Model
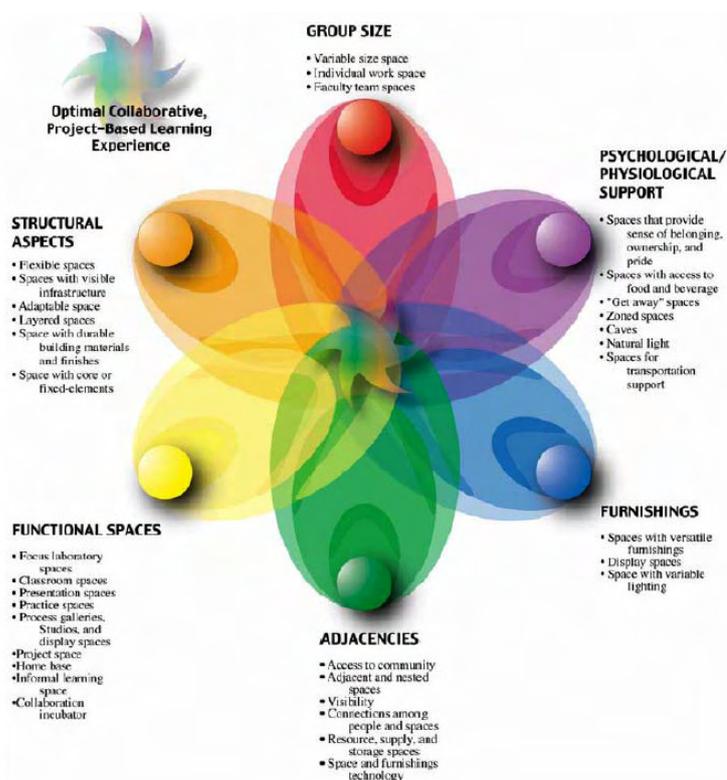
In the case of secondary schools it was reported that new facilities excited the interest of pupils. Inner city heads in particular observed a close correlation between the quality of the facilities and a sense that education is important, and that pupils are being valued by the system. For potential truants a comparison can be made between the comfort and quality of the school surroundings and those of the local shopping mall - all too often the mall was far superior. In a community secondary school a very marked effect on morale was observed. The adverse effect of building disruption on morale has been vastly outweighed by their pride in the new facilities and the effect this has had on their ability to deliver a programme of teaching in a style they consider professionally desirable. The new building allowed staff to change the way in which subjects are taught.

Designs were based on a deliberate policy of building in improvements to circulation to cut down on movement and contrary traffic flows which have improved student behaviour. Furthermore the better state and location of classrooms has enabled a much wider range of teaching strategies to be used. These approaches are tailored so that they minimise behaviour problems in 'difficult' subject areas. It was observed that both teaching and learning – and therefore attainment - have benefited from this approach.

In another study the UK National Curriculum and its implications for space and place have been evaluated (Dudek, 2000). This study explored strategies for reading development ranging from whole-class groups focusing on a white board, through to smaller groups reading to each other, to one-on-one sessions either in the classroom or in a separate reading room. It recommended reading niches off the main classroom to enable better concentration and audibility. As a separate resource, a mini-library within or close to each classroom was suggested as being highly desirable. A concession was noted in this study that space standards are 40% greater than the norm for this type of facility. The study advised that teachers are uniquely equipped to throw enlightenment on the particular social and physical context of their classroom spaces. Just as the teacher must be flexible, equally the modern environment needs to be flexible (Dudek,

2000, p. 55).

Another related study by the Ministry of Education, New Zealand (2004) attempted to understand factors that influence learning outcomes in classroom environments. The study was carried out in a number of stages. The preliminary qualitative phase consisted of in-depth face to face interviews with each audience. This was followed by a semi-quantitative survey pilot phase which used a self completion methodology for school related audiences and telephone interviews for design consultants. The target audiences for the project included teachers (primary, intermediate, and secondary), students (Year 5 – 13), principals and boards of trustees and design agencies. Key criteria such as the spaciousness of the classroom, its adaptability, the ability to control the layout, natural and artificial lighting and temperature control were all assessed. Many other criteria were also measured in the study.

Figure 8. Summary of Importance of Factors in Creating a Good Teaching Environment for Students in which to Learn
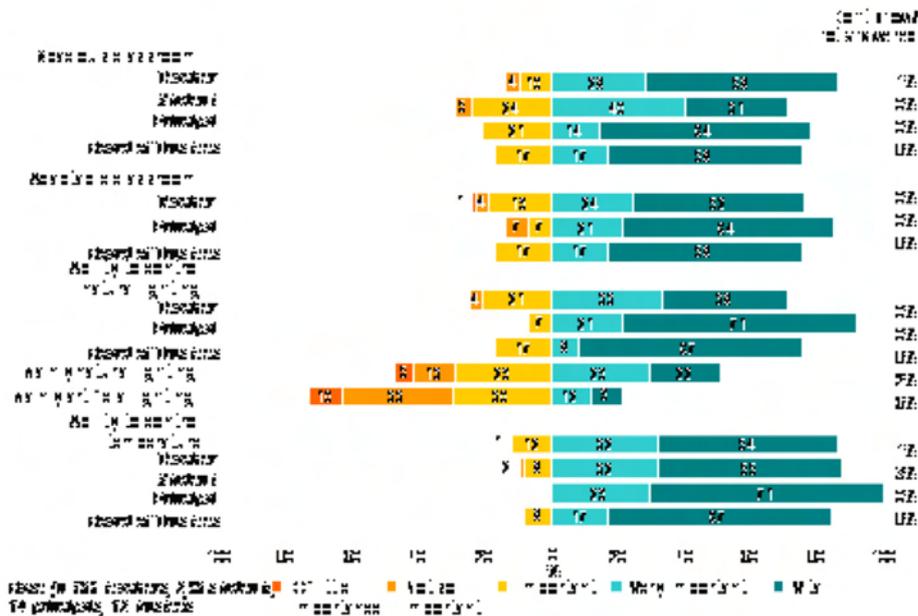
An other example included the evaluation of the size and arrangement of the classroom space. Such factors as 'large and spacious', regularly shaped room, easily adapted for different situations and close access to support spaces were assessed. As can be seen in the charts many of these factors were viewed as being of very high importance – indeed vital – to the efficacy of the learning environment for teaching purposes.

In Australia the Victorian Department of Education and Training (Fisher, 2005) study examined pedagogy-space performance measures. This preceded a major injection of capital investment into school infrastructure for R-12 schools delivered through the Leading Schools Fund (LSF). This concept was designed to pilot innovative pedagogies across 80 schools. Schools had to 'bid' for funding on a competitive basis (there are thousands of schools in Victoria) based on pedagogical, curriculum, professional development, technology and learning environment design strategies.

The study developed planning and design principles to assist facility managers, school councils, principals, teachers and architects to design new learning environments for new pedagogies. These planning and design guidelines were based on international and national case studies and required an evidence-based business case for Treasury to approve the financial strategy prior to implementation.

The strategy for the development of the link between space and place was based on a number of factors. Student competencies such as a positive attitude towards learning, literacy, numeracy and self-expression; students being successful across all areas of learning; a high level of personal, communication and social competencies; the ability to work independently within groups; experience in innovation;

creativity and problem-solving; the confidence to deal with technological and cultural change; the development of skill sets in wider community and the changing workplace; and the ability to access information and reflect upon it were all essential criteria underpinning the pedagogical approach to the LSF.

Figure 9. Importance of Classroom Size, Layout, etc.
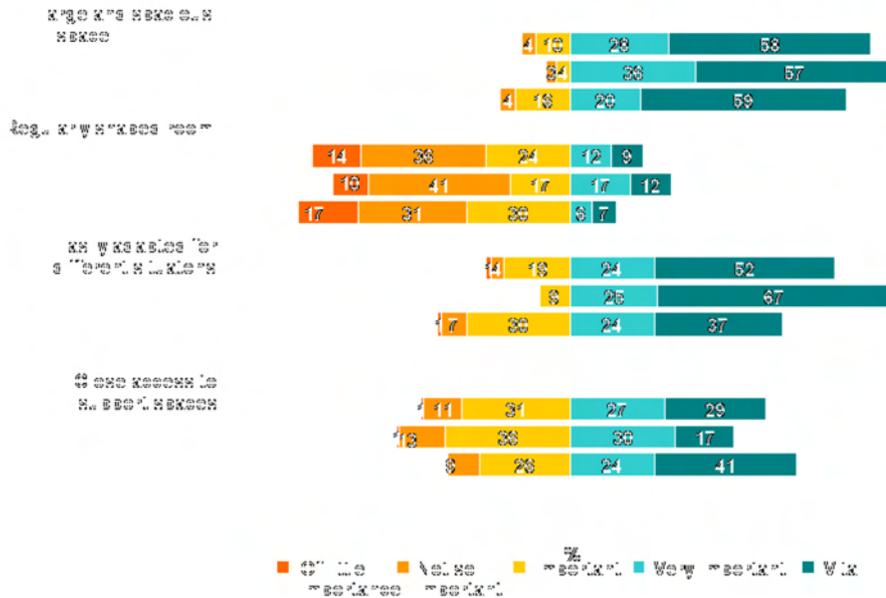
The curriculum standards framework was also used as a basis for analysis including factors such as the learning environment being supportive / productive; the learning environment promotes independence and self motivation; student needs, backgrounds, perspectives and interests are reflected in the learning program; students are challenged and supported to develop deep levels of thinking and application; assessment practices are an integral part of teaching and learning; and that learning connects strongly with communities and practice beyond the classroom.

Figure 10. Linking Pedagogy and Space (after Scott-Webber)

A key question in the study was how would the agency measure success of the LSF and what evidence could be used? Two approaches were evident. Firstly a traditional post occupancy evaluation as a qualitative study based on the refurbishment program carried out in 2001. Secondly achievement

improvement monitor data records held by DET could be evaluated and related to the redeveloped schools. Alternative performance measures could also be explored such as student retention rates, tracer studies on entrance to university or further education, vandalism and absenteeism data, student behaviour (detentions) etc. Also test scores before (2003) and after (2006) could be evaluated. Consideration could also be given to using OECD PISA (Programme on International Student Assessment) data or the upcoming project. These approaches are still being reviewed.

Figure 11. Matrix of Learning Settings (DETV and Fisher)
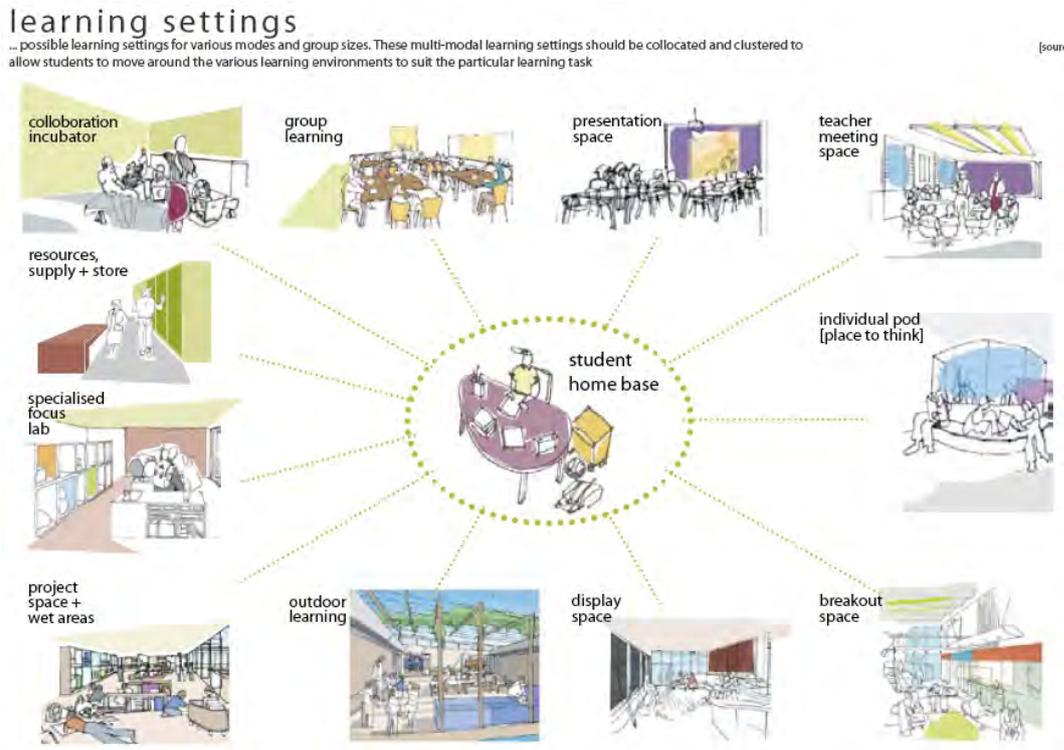
Conclusions and future research

In examining the literature in this area it can be said that there is insufficient qualitative/deep research on the relationship between pedagogy and design of learning environments. Furthermore any such research needs to be developed with classroom teachers to ensure its relevance to learning.

Figure 12. BREEAM Building Environmental Assessment Method
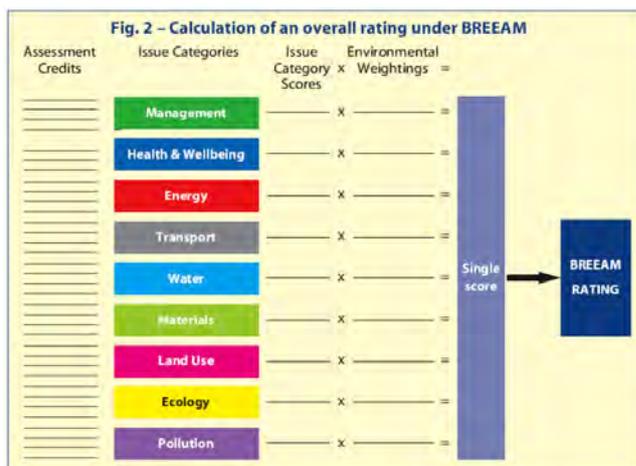
Research should follow five key steps:

1. What student abilities do we want to achieve?

2. How can we assess these attributes?

3. What pedagogies should be used to achieve these desired learning outcomes?

4. What learning environments should be developed to fit these pedagogies?

5. How can we develop a pilot program and evaluate it?

As a last word, it might just be possible to do this kind of research with the 'students as researchers'. For example, a program developed by BREEAM[3] includes a Schools Environmental Assessment Method which students and teachers can use as part of their learning. Such an approach could be extended to evaluating the learning environment itself along the lines of Sanoff's work. Over the past couple of decades we have spent vast effort in developing information and digital literacies in teachers and students. I believe that we should equally develop their spatial literacies and spatial vocabularies so that the learning environments they spend so much time in can become more relevant to the events occurring within.

Notes

1. See www.oecd.org/edu/facilities/compendium for further information about the OECD Programme on Educational Building's Compendium of Exemplary Educational Facilities.

2. See www.designshare.com for more information on the DesignShare awards.

3. See www.bre.org for further information on the Building Research Establishment, Schools Environmental Assessment Method (BREEAM).

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