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Foreword



I'm delighted to introduce this report on Spaces for learning. Over £600 million is being invested in Further and Higher Education estates over the next few years. Several entirely new campuses are in development, as well as various new builds and upgrades. So it's a good time to reflect on what people are trying to achieve with their new buildings, and to discuss this thinking with each other.

These buildings, these spaces, are for learning. We hear a lot about how much learning is changing. We also know that learners too are changing; there are many more learners in Scottish further and higher education than there were ten years ago, and they are more diverse - in terms of age, ability and background. They have different expectations of learning: some people still want to listen to lectures, while others want to learn using networked and mobile devices. But buildings last longer than ten years, and increasingly they have to be able to meet a wide range of learner needs, both now and in the future.

In 2005, the Scottish Funding Council commissioned AMA Alexi Marmot Associates, with haa design, to consider these kinds of trends, as they affect the design and use of space in further and higher education, and to reflect on the research literature on the link between physical space and effective learning. AMA's report includes case studies of campus developments at Scottish institutions, as well as noting international trends. It is intended to set the scene, and prompt discussion.

Scotland's colleges and universities are diverse, with different missions, contexts and cultures. But there is a lot we can learn by bringing colleagues together, to share experiences and think about our buildings. In October 2005 we held a national conference which was attended by 130 staff from Scotland's colleges and universities. Colleagues discussed their ideas about spaces for learning: planned developments, the rationale for particular designs, and some of the key considerations - in terms of space, cost, and above all, more effective learning.

The conference showed that colleagues are very interested in these issues and keen to learn from each other. We want to encourage those discussions, to inform the building and development of learning spaces. I am very grateful to AMA and haa design for providing - in this report - such a useful starting point for those discussions.

A handwritten signature in black ink, appearing to read 'I Murning', written in a cursive style.

Ian H Murning
Chair, Scottish Funding Council Property and Capital Investment Committee
Feb 2006

1 Executive summary

- A significant amount of estates development is currently underway in Scottish colleges and universities at a time of major change in educational technology and in learning and teaching modes.
- This report is intended to encourage discussion between estate management and academic staff on the best form of campus developments, in light of emerging learning trends relevant to their institutions.
- It summarises a five-month programme of research which included a literature review, interviews with representatives of national educational organisations, four case studies of new learning environments in colleges and universities, and an online survey on educational trends sent to all further and higher educational institutions in Scotland.
- Traditional teacher-centred models, where good teaching is conceptualised as the passing on of sound academic, practical or vocational knowledge, are being replaced with student-centred approaches.
- The shift to a knowledge-driven economy, with less emphasis on factual knowledge and greater emphasis on the ability to think critically, is driving demand for a more qualified, highly skilled, creative and flexible workforce.
- The increasing diversity of student populations has prompted a new, more tailored, approach to learning. The shift towards student-centred teaching modes has been supported by a growing body of research and theory pointing to the benefits of a range of learning styles and individual preferences.
- Three key learning styles, supported by a strong knowledge base, are useful in conceptualising new learning spaces:
 - Learning by reflection
 - Learning by doing
 - Learning through conversation
- E-learning and m-learning continue to expand learning opportunities. The trend towards student-centred learning has and is being enabled by ubiquitous computing on and off campus, in formal and informal learning settings. E-learning, m-learning and increasing use of sophisticated audio-visual tools can complement traditional teaching modes to create successful 'blended learning'.
- A new survey on learning and teaching trends, developed for this research achieved a 51% response rate. Respondents selected trends that they expected to increase; the top five all involved the application of IT. In some cases this had a direct relationship to physical space, such as technology enhanced social spaces and use of wireless networking across the institution.
- New environments for learning are being designed or reshaped, in response to changing pedagogical styles, to incorporate new information technology and to adapt to changing numbers and abilities of learners.
- Formal teaching spaces for large groups with a 'sage on a stage' are becoming less common than smaller, less formal settings where students learn from one another as well as from their appointed teachers.
- Seven types of new environments for learning are described in this report: group teaching/learning; simulated environments; immersive environments; peer-to-peer and social learning; clusters; individual learning; and external spaces.
- The four case studies of new learning environments in Scotland cover group learning spaces, peer-to-peer and social learning spaces and learning clusters. These were drawn from John Wheatley College; the University of Strathclyde; Edinburgh's Telford College and Glasgow Caledonian University.
- The research has revealed a wealth of experimentation in the English-speaking world and describes many examples of innovative learning spaces that integrate technology and pedagogic practices.
- The effectiveness of learning spaces is not easy to explore independently of the learning techniques, teacher style, information systems employed, and many other factors.
- We have unearthed a small number of interesting studies on learning spaces, mostly from the USA, covering the teaching of scientific subjects, especially maths, physics and engineering. We note, however, that many developments in improved learning occur daily through thoughtful experimentation and development by teachers, and are never formally evaluated.

- Compared to control groups, maths, science and engineering students using technology-enabled collaborative learning modes in purpose designed spaces showed an improved ability to solve problems, increased conceptual understanding and reduced failure rates.
- The literature review found no examples of outcome measures on whether citizenship values have been altered through different learning modes or in different learning environments.
- Literature evaluating learning environments indicates overwhelmingly that many educational buildings fail as spaces for learning due to poor air quality and inadequate environmental features such as light and acoustics.
- There is some evidence that students and staff respond particularly positively to enhanced buildings and landscaping.
- Teaching space should also be built for long-term sustainability to provide facilities that are not only comfortable and cost-effective to operate and maintain, but that improve the learner's understanding of sustainability as part of their wider citizenship learning.
- Data on density at an institutional level indicate that universities are becoming more space efficient, at a time when new student-focussed learning modes are being introduced.
- In typical teaching rooms (such as lecture theatres, classrooms, and seminar rooms), new learning styles sometimes have the effect of increasing the space per seat, either to allow for different furniture arrangements at different times, or for different learning modes in one teaching session.
- Further investigation of the relationship between density, space efficiency and learning mode is needed.
- Looking ahead, it is likely that relatively fewer seats will be provided in lecture rooms and classrooms. However the area per seat will increase significantly as will the cost, especially for technology. Overall, lecture rooms and classrooms will require more space per student than they do now and space for more informal, unscheduled learning spaces will increase.
- Little is known about the relationship between new learning modes, density, cost in use, space management and staff resources.
- Learning space is only a means to an end. The mission of further and higher education institutions is effective student learning, the creation of an educated, skilled workforce with strong social values and citizenship skills. If this can be achieved by investing more in space and supporting technology it may be a price worth paying. If by so doing, more efficient use can be made of academic staff time, then it would certainly be well justified.
- We have identified several ideas that would help encourage more experimentation and the development of effective learning spaces in Scotland. Some would be best undertaken by individual institutions and others by the design and IT sector.
- SFC can play a key role in promoting initiatives, promoting post-occupancy study and sponsoring further research.
- From our investigations we have distilled 12 key steps to help institutions create and evaluate effective learning spaces without delay.

Twelve keys to creating successful learning spaces

- 1 Articulate a learning plan.
- 2 Integrate your plans - learning, strategic development, estates.
- 3 Involve all stakeholders - academic, IT, estates, learners.
- 4 Select an informed design and implementation team.
- 5 Learn from others - site visits, case studies, discussion forums.
- 6 Experiment with new ideas.
- 7 Integrate suitable ICT and audiovisual tools.
- 8 Introduce flexibility for different learning modes over time.
- 9 Re-skill users to make best use of new spaces in new learning modes.
- 10 Manage the space well - bookings, layout, maintenance.
- 11 Insist on learner and teacher feedback on learning effectiveness.
- 12 Publicise the findings.

2 Introduction

A significant amount of estates development is currently underway in Scottish colleges and universities, at a time of major change in educational technology and in learning and teaching modes. The Scottish Funding Council (SFC) has commissioned research to ensure that investment in estates and estate management is informed by research into effective learning and student-centred approaches.

This report summarises the findings. It is intended to encourage discussion between estate management and academic staff on the best form of campus developments, in light of emerging learning trends relevant to their institution. A seminar marked the launch of the report, and signalled the importance that should be given to improving learning environments so as to aid educational outcomes in Scotland.

The research was conducted over a five month period by AMA Alexi Marmot Associates, architectural space consultants and haa design, an architectural practice based in Glasgow. Their work was ably guided by David Beards, Sandy McAllister and Robert McGregor of the Scottish Funding Council. Invaluable insights were given by 62 people in 29 institutions who responded to a specially devised questionnaire on teaching and learning trends, and by people in the four colleges and universities who allowed us to study recent developments demonstrating new learning approaches. Interviews and conversations with people in several other Scottish educational organisations and academic institutions elsewhere contributed to our thinking. Our thanks are due to them all.

The report gives an overview of trends in learning and teaching that play a major role in shaping the physical learning environment (section 3). Features of new learning environments in Scotland and other parts of the English-speaking world are described and illustrated (section 4). Evidence on the effectiveness of learning spaces is summarised, together with implications for sustainability, density, utilisation and space management (section 5). Actions that can be taken by colleges and universities, suppliers and the SFC are outlined (section 6).

Appendices describe the research methodology (appendix 1), and the people and organisations contacted (appendix 2). Educational trends in Scotland, psychological insights and e-learning (appendix 3), and the main trends perceived by people in Scottish institutions that responded to the survey are summarised (appendix 4). Ideas of people interviewed in educational bodies form appendix 5. Case studies of new learning spaces in four Scottish colleges or universities are described in appendix 6. The report closes with abbreviations, a glossary, and references (appendix 7 and 9).

3 Trends in learning and teaching

Approaches to learning in educational settings are changing. Traditional teacher-centred models, where good teaching is conceptualised as the passing on of sound academic, practical, or vocational knowledge, are being replaced with student-centred approaches which emphasize the construction of knowledge through shared situations. Barr and Tagg (1995)¹ suggest that this shift from an 'instruction paradigm' to a 'learning paradigm' has changed the role of the higher and further education institution from 'a place of instruction' to 'a place to produce learning'.

This is partly driven by changing educational requirements. The shift to a knowledge-driven economy is driving demand for a more qualified, highly skilled, creative and flexible workforce. There is less emphasis on factual knowledge, and more on the ability to think critically and solve complex problems. Knowles (1984)² argues that, in the modern world, the most socially useful thing to learn is the process of learning.

The consequent need for ongoing skill development results in a growth in adult learners. In Scotland, participation rates of young people in tertiary education are already over 50% with enrolments increasing annually. Many students are studying on a part-time basis, particularly within further education. The life-long learning strategy set out by the Scottish Executive³, highlights the key role its HE and FE institutions will need to play in widening participation, improving social inclusion, and in the creation of an enterprising workforce in Scotland.

The increasing diversity of student populations has prompted a new, more tailored, approach to learning. The shift towards student-centred teaching modes has been supported by a growing body of research and theory, pointing to the benefits of a range of learning styles and individual preferences.

There has been a long tradition of psychological inquiry into learning, from early behaviourist approaches focused on simple stimuli-response reactions, to more recent conceptualisations, which place learning in a social and developmental context. A theory of learning that prevails today, social

constructivism, holds that all meaning and knowledge is created through social interaction. Central to this theory is the idea that new knowledge and understanding are created based on what people already know and believe, and that learning is a process of identifying, challenging and changing these beliefs.

An extensive literature review by the National Academy of Sciences⁴ identified three key learning styles that are supported by a strong knowledge base:

- 1) Learning through reflection:** Studies into cognitive science have demonstrated that individuals who have the opportunity to reflect on information, to evaluate their own learning process and to identify for themselves new directions for study, are more effective. Learning through reflection is by necessity a solo activity.
- 2) Learning by 'doing':** Originating with seminal works by Piaget in the 1950s there is now much evidence that actively engaging in and working through practical tasks can assist learning. This might include computer-based simulations or physical simulation of real-life environments. Learning of this type can include both group and solo activities.
- 3) Learning through conversation:** Central to the theory of social constructivism, learning from active discussion with teachers and other students, is an incredibly effective way of improving learning outcomes. Learning through conversation is by necessity a group activity.

Unfortunately there are few empirical studies that link this body of research to the environment in which learning takes place. However, much of the research does have broad implications for the design of learning environments to support these three main learning styles and this is discussed further in section 4.

¹ Barr, R and Tagg, J (1995) A new paradigm for Undergraduate Education From Teaching to Learning, Change, November, p13-25
² Wilson, Jenny, 2004, Understanding learning styles: implications for design education in the university, University of Technology, Sydney, January, p394
³ Scottish Executive, 2003, Life through learning: Learning through life, The life long learning strategy for Scotland, Scottish Executive, February.
⁴ Bransford, John D, Brown, Ann L, Cocking, Rodney R, 2000, How People Learn: brain, mind, experience and school, National Research Council, National Academy Press, Washington DC.

The future of technology

The trend towards student-centred learning has and is being enabled by ubiquitous computing on and off campus, in formal and informal learning settings. E-learning, m-learning and increasing use of sophisticated audio-visual tools can complement traditional teaching modes to create successful 'blended learning'.

Defined as 'networked access to digital learning materials and communication systems to deliver and support learning'⁵, the potential for e-learning to revolutionise the delivery of education has been much vaunted. As the cost of hardware continues to fall, connectivity becomes faster and simpler, and more sophisticated simulation technologies are developed, there is little doubt that this proves to be the case.

While there are many excellent examples of e-learning initiatives, the impact of digital technology on pedagogy within traditional teaching spaces will in the long run be more significant for many people in education.

A recent study by JISC⁶ into the impact of technology on physical space suggests that schools, colleges and universities will retain a physical presence, although the space will be used in a more flexible way. Equally, lecturers, teachers and tutors will remain at the heart of the learning process but their roles will evolve. The JISC study also supports findings from a report into the future of e-learning in Scotland by SFC⁷, which point to the importance of pedagogical rather than technological drivers in the development of effective e-learning approaches.

A smaller, but rapidly growing, trend is the application of technologies based on mobile technology, 'm-learning'. A report by JISC⁸ into the future of mobile technologies suggests that they will play an important role in the future of education, as most students already own a laptop, handheld or sophisticated mobile phone. Moreover, they support the aims of the lifelong learning initiative by giving access to new audiences and they allow information and learning to be tailored to individual preferences, a growing trend based on constructivist pedagogy.

Learning and teaching trends survey

A short questionnaire was devised for this project to explore the extent to which the main trends identified during our research were perceived to be taking place within Scottish education. 37 key trends were selected relating to changes in the:

- demographic diversity of student intake
- institutional approach to teaching and learning
- IT provision, use of multimedia and campus connectivity
- provision of traditional and innovative teaching and study spaces.

The survey was sent to 121 individuals from each of the 64 Scottish institutions. A response rate of 51% was achieved. Key findings are summarised below, with a full discussion of results in Appendix 4.

Most trends identified in the survey were perceived to be on the increase. The exceptions were the use of lecture style teaching methods and the number of taught contact hours per student. Detailed analysis of the data by institution type revealed that the perceived decline in the use of lecture style teaching methods was specific to HE institutions.

The top five trends identified all involved the application of IT. In some cases they had a direct relationship to physical space, such as technology enhanced social spaces and use of wireless networking across the institution. While this general view was shared between FE and HE institutions, there were subtle variations. Where HE institutions focused on the use of interactive technology in the classroom, FE colleges focused on the use of multimedia technology.

A comparison of the top five trends identified by respondents from different professional groups identified significantly different trends. IT professionals saw IT-related trends as the greatest growth area, while estates management professionals were far more inclined to predict changes in the nature of the physical spaces being provided. Senior managers appeared to take a more holistic view, incorporating some aspects of IT, physical space, sustainability and citizenship.

5 Scottish Funding Councils, 2005 Joint SFEFC/SHEFC E-Learning Group: Final Report, SHEFC.

6 JISC, 2005 How innovative technologies are influencing the design of physical learning spaces in the post 16 sector

7 Scottish Funding Councils, 2005 Joint SFEFC/SHEFC E-Learning Group: Final Report, SHEFC.

8 Anderson, Paul, Blackwood, Adam, 2004, Mobile and PDA technologies and their future use in education, JISC Technology and Standards Watch: 04-03, November.

4 New environments for learning

We are now in what has been described as the fourth phase in the evolution of buildings for tertiary education. The earliest was the inception of universities, communities of scholars integrated into the urban fabric in centres such as Oxford, Cambridge, St Andrews, Glasgow, Aberdeen and Edinburgh. Redbrick universities of the nineteenth century were the second phase. The third was the post-war creation of campus environments. Now is the era of expanded access to education, lifelong learning and pedagogical changes from a teaching-based culture to a student-centred learning environment for student 'consumers' who take a far more pro-active role in shaping their education than earlier generations⁹. It is also the era when real and virtual learning spaces coexist.¹⁰

New environments for learning are being designed or reshaped in response to changing pedagogical styles, to incorporate new information technology, and to allow for changing numbers and abilities of learners. Formal teaching spaces for large groups with a 'sage on a stage' are becoming less common than smaller, less formal settings where students learn from one another as well as from their appointed teachers.

New buildings are not essential for the creation of new learning environments. Radical learning approaches can also be carried out in intelligently refurbished academic or other urban buildings.

Many new models of spaces for learning have emerged over the last few years. Important examples are described and illustrated below, drawn from the four Scottish case studies examined for this project (appendix 6), examples from elsewhere in the UK, and innovations in other countries.¹¹ Some take a fresh and radical approach to educational building design. However, most are variants on known space types enhanced by the introduction of new technology and flexible furniture for different learning modes.

We have classified learning spaces into seven spatial types: group teaching/learning; simulated environments; immersive environments; peer-to-peer and social learning; clusters; individual learning; and external spaces. Important concepts for each type are described below, and implications for their size and form, technology and furniture are drawn out.

4.1 Group teaching/learning spaces

Lecture rooms and classrooms form a large component of the estate in further and higher education institutions, and will continue to dominate in the future. However the traditional format of these spaces is being transformed to incorporate multiple learning modes. The role of academic teachers is gradually moving from that of 'sage on the stage' to 'guide by the side', while the student is combining the role of quietly reflective absorber of ideas with that of active participant.

Size and form

- Moving learners away from a format that focuses all seats on a single teacher, to one, which allows learners to sit closer to the teacher and/or to view and learn from each other. Long, rectangular spaces with a teacher focus at one end are out. Squarer shapes are in.
- Case study rooms in business schools, typically designed with tiered, u-shaped seating so that students can see one another as well as the lecturer, provide a balance of peer-to-peer learning with interventions from the course facilitator. Henley College of Management is a good example of this type of learning environment.¹²
- Strathclyde University (see case study in appendix 6) has arranged furniture in a small tiered lecture room so that students can swivel forward to see the lecturer and projection screen, or back to work on a PC. This allows them to alternate between learning from the 'sage' and active solo or group learning aided by a computer and digital learning material.
- At Virginia Tech, the Math Emporium has been operating since 1997 as a single vast space within a former department store, open 24/7, with 500 computers in pods of six. It was designed to solve a serious resource shortfall, a result of an increase in students enrolling without commensurate additional staff. Many parallel learning activities take place there including 'lectureless' online learning, with staff on hand 15 hours daily. Spaces for one on one tuition, tutorial labs, regular lectures and refreshments, surround the main emporium.
- North Carolina University's SCALE-UP project has converted a 100 person lecture room for physics students into a classroom where they sit in three groups of three around large round tables, which have at least three networked laptops. The setting is

⁹ Pearce, M (ed) 2001, *University Builders*, London, Wiley-Academy.

¹⁰ Brown, B and Lippincott, J (2003), 'Learning spaces: more than meets the eye', *Educuse Quarterly* No. 1, pp14-16.

¹¹ Fisher, K Rubida Research (March 2005) TEFMA seminar 'Mapping pedagogy and space: the emerging hybrid campus'

¹² *ibid*

like a banquet hall with lively interaction between students and their roving instructors. SCALE-UP (Student-Centred Activities for Large Enrolment Undergraduate Programs), aims to establish a highly collaborative, hands-on, computer-rich, interactive learning environment especially suited to physics and engineering subjects.¹³ It is part of the PER (Physics education research) initiative that designs instructional environments and curricular materials based on knowledge of how learners can better understand physics.

- MIT has developed the TEAL program (Technology Enabled Active Learning) to aid physics teaching. Like the North Carolina example, it uses collaborative learning in teams of three, grouped around large tables of nine people in a room for 120 learners. Each team has a networked laptop connected to surrounding projection screens. Desktop experiments and visualisations developed by the team can be shown to the whole class¹⁴. Thirteen cameras record the activity at each table. The instigator, Professor John Belcher, believes that this is a superior way to teach physics and should be adopted more widely, even in cheaper, scaled-down formats with less intensive technology. The main barrier is the inertia of some academic staff in adapting to new teaching modes.

Technology

These spaces often incorporate:

- Technology for more active learning modes, such as personal response systems (PRS) that allow learners to vote on questions posed by presenters and everyone to see the results.
- Installation of one or more computer projectors, large projection screens or interactive white boards on more than one wall surface.
- Infrastructure for wireless broadband or mobile telephony to allow individual access to the internet via personal computers or handheld devices.
- Installation of cameras to film the proceedings so they can later be viewed by learners at their own time and pace.
- Installation of equipment for real-time transmission of information from elsewhere.

Furniture

- The size, mobility, stackability and adjustability of furniture are important to the success of these spaces.
- For efficient space-use, lecture room seats and writing surfaces were traditionally fixed in rows and bolted to the floor. This discourages using the space for alternate learning modes.
- Learner-centred layouts frequently seat students together at small group tables, such as star clusters, banquet style circular tables or other forms. The furniture encourages small group conversations to aid learning.
- At the University of Strathclyde, banana-shaped desks were introduced in some rooms to encourage teams of three or four engineering students to work together between whole group learning (see case study). In other rooms, straight small desks serve the same purpose.

4.2 Simulated environments

Active modes, learning by doing, take place in simulated environments where learners can be taught safely and prepared for 'real world' environments. Disciplines such as nursing and health, which were formerly learnt on the job through an apprenticeship system, are increasingly being taught first in an academic environment. This has created a demand for more simulated environments in colleges and universities. Examples include:

- skills laboratories for nursing and medical health sciences that emulate hospital and home care environments. Some make use of patient robots programmed to signal their ailments and to complain if they are poorly handled by learners. Recent clinical skills classrooms include the Health and Wellbeing Centre at Sheffield Hallam and the University of New Mexico¹⁵.
- classrooms for training student schoolteachers;
- office environments for teaching receptionist and secretarial skills;
- hairdressing and beauty salons;
- catering kitchens and restaurant for teaching skills to people wanting to work in the hospitality and catering industries;
- workshops for teaching mechanical skills (eg car repairs).

¹³ www.ncsu.edu/per/scaleup.html;
www.physics.ncsu.edu:8380/physics_ed/Room_Design_files/frame.htm
¹⁴ Information can be found on http://web.mit.edu/8.02t/www/802TEAL3D/teal_tour.htm.
 The authors are most grateful to Professor John Belcher for the enthusiastic email communication on MIT's TEAL program.
¹⁵ Fisher K, (op cit)

Significant issues in new simulated learning environments are:

Size and form

- Selection of sizes and proportions so that simulated rooms that are used infrequently can be redeployed for other purposes. For example, a school hall that is normally used to demonstrate how primary schoolchildren can be taught sports, dance and music, can double as a gym for the trainee teachers to use for their own health and wellbeing, as long as adequate lockers and showers are incorporated.
- Some rooms need to be oversized compared to their real world equivalents to accommodate a class of learners. For example, a skills room for training social workers or community nurses in handling the elderly at home may have an oversized bedroom, bathroom, kitchen and living room.
- Observation of people using the simulated environment through one-way mirrors is occasionally a requirement.

Technology

- Every one of the above examples requires wireless broadband, fixed computers, and/or increasing amounts of technology for the facilitator/demonstrator to use. Data cabling, computer projectors and screen, and/or smart boards are needed, for example, in primary school classrooms.
- In some simulated environments, video cameras are required to record how students perform, so they can be debriefed on their level of competence. Cameras demand special attention to heights, angles of vision and lighting. In some instances they also need a workstation and storage area for a media technician to control and manage the film.

Furniture

- Mobile or stacking furniture is a great advantage in these spaces to allow multiple room use. However, much of this type of furniture is bulky or heavy, which discourages rearrangement.
- Simulated primary classrooms need to balance the requirement of providing seats sized for small children against the fact that they will be used mainly by adult learners.

4.3 Immersive environments

Immersive environments are those where virtual representations play an important role in drawing learners into contact with complex information. The information may come in real time from another location, or from prepared sources. They are analogous to television newsrooms, IMAX cinemas, large entertainment venues with huge screens showing parallel events and 'HIVES' (highly interactive virtual environments) used by the petrochemical and mining industries. Typical immersive environments in education are relatively small spaces for ten to twenty people, with several large, possibly curved, screens for projecting information so that occupants are literally surrounded by the data. In some cases the viewer can interact with the projected information. Three-dimensional simulations are sometimes included. A 'pilot' workstation for a skilled computer technician to control the data streams is normally needed. Examples in education are rare because of the high cost of the infrastructure. The Stanford Center for Innovations in Learning, SCIL, is creating an international network of small, immersive environments, 'iSpaces', for collaborative, project-driven learning and working. The goal of iSpace, collaboration between Stanford University and KTH Stockholm, is to design and implement the infrastructure that will allow multiple groups to use iSpaces over sustained periods of time. Other examples come from North American medical courses and Texas Tech University.

4.4 Peer-to-peer and social learning spaces

Spaces that facilitate peer-to-peer learning, and the positive effect of being in a learning group that is part of a learning community, are of growing importance in many colleges and universities. Seminar rooms have traditionally contained the 'group conversation' form of learning. They are being overtaken by more informal gathering places for social learning, 'a physical relaxation of the academic 'institution' ... with a 'soft' zone of informal area for sitting, informal teaching and flexible seminar spaces...' ¹⁶

These spaces often incorporate:

- Computer commons, cyber cafés or Internet cafés, that provides computer access to the Internet with or without refreshments. Examples include the University of Paisley's Internet café, Strathclyde University's Java Café; the Real Learning Café at Glasgow Caledonian University.
- Group rooms in libraries and learning resource centres designed for collaborative working and talking, rather than the traditional library silence for solo work.

16 Cook, Peter (2005), Blueprint No 236, November 2005, p84 on the proposed London School of Economics postgraduate building conversion.

- Studio learning for art and design courses, where learners work individually or in teams in an environment that encourages comment and discussion about each person's work.
- Shared-access computer rooms in residential halls, to alleviate the digital divide by providing computers in rooms where discussion is allowed.
- The University of Queensland completed the Collaborative Learning Centre in the Sir James Foot Building in May 2005. Similar in concept to the Saltire Centre at Glasgow Caledonian University, it is used for scheduled classes, informally by students and as a conference and workshop venue for external organisations. It contains a café and has extended the learning environment into the adjacent courtyard. Evaluations of the new facility are being actively sought.¹⁷
- The need for computer-equipped social learning spaces is of growing importance in the FE sector where computer ownership tends to be lower than in HE.
- The sophistication of hardware and software needs to be higher so as to exceed that of individually owned computers.

Furniture

- Desks and chairs in computer commons and Internet cafés are usually quite small and basic as most are used for short stays only. Some may be at standing height.
- In studios and workshops, robust furniture and finishes are needed to withstand long hours of use, and occasional dangerous substances or implements.

Size, form and location

- Computer commons and Internet cafés are increasingly being installed in spaces near lecture theatres, on main circulation routes and gathering nodes, and on the ground floor of large educational buildings.
- In some examples, intermingling between students and faculty is encouraged (for example in the Learning-Teaching Center, University of Dayton, which includes a café and fireplace lounge aimed at becoming the 'heart and soul of the campus community').¹⁸
- Queen Margaret University College is now constructing a new facility in Musselburgh, East Lothian, where welcoming, creative spaces for mingling and gathering are a key part of the design.

Technology

- The need for the institution to provide large numbers of computers will eventually diminish as technology prices continue to drop, all students have been exposed to computing from early childhood education, and access to information is pervasive.

4.5 Learning clusters

Learning clusters are groups of learning spaces designed for different learning modes. Learning clusters have come into being since research highlighted the benefits of using multiple learning modes to reinforce understanding. They also help cope with the fact that a different number of learners register for each course. Traditional clusters include large group learning spaces and small seminar (or 'syndicate') rooms. Newer clusters incorporate interactive and group learning spaces, social learning spaces as well as more traditional lecture halls or classrooms, albeit with enhanced technology.

The characteristics of learning clusters can include:

- Within one large single space, some interesting areas have been created for multiple learning modes to be used simultaneously.
- The ability to teach several groups simultaneously using different learning modes is accommodated in rooms such as the 'teaching pods' in Wolverhampton University. Acknowledging that students of today multi-task and are able to concentrate in environments that have multiple stimuli, they have created a space designed with a small area of fixed seating in tiers, and another area with grouped desks equipped with PCs for solo work.

¹⁷ Cook, Peter (2005), Blueprint No 236, November 2005, p84 on the proposed London School of Economics postgraduate building conversion.

¹⁸ <http://www.uq.edu.au/facilities>; University of Queensland (14/15 March 2005) 'Future Learning Environments Workshop'.

- Open learning environments on a vast scale have been created recently. South East Essex College's vast new building integrates social spaces with a series of flexible 500m² teaching modules that can be linked and subdivided with moveable partition walls in numerous combinations to support changing curriculum needs¹⁹.
- Stow College has created the SuperFlex and Engineering Technology Centre which has 100 networked PCs used for ICT based learning activities for individuals or groups. Groups of up to twenty people can be taught together from one mobile control-teaching unit.
- The University of Strathclyde has excelled in promoting learning clusters in several buildings (see case study).
- In Glasgow University, the Gibson Street church has been restored to create a learning cluster comprising a lecture theatre and small groups spaces with moveable walls, fully equipped with interactive whiteboards.
- Similarly, the Cottrell Building at Stirling University includes a 100-seat lecture theatre, two forty-person rooms with demountable walls, and a breakout space, all enhanced with excellent new audio-visual facilities.
- West Lothian College has established the 'hub', a teaching environment to encourage students to feel at ease and stimulated in returning to formal learning. It is a colourful, flexible space with fixed and mobile elements that can be reconfigured rapidly.
- Further away, Singapore Polytechnic is creating a large campus based on the concept of identical 'learning pods' for groups of fifty students to work together in teams, in large groups with a lecturer, or solo.²⁰
- At Perth College wireless laptops are available for use in the library and the core teaching space, enhancing flexibility of use with or without technology.
- In some instances such as Cox Hall, Emory University, large floor cushions and monitors at floor sitting level have been provided in deference to the preferred position adopted by some students.²¹
- Good lighting and adjustable chairs are the most important elements together with quiet acoustics and indoor air quality. Power and data are essential for most spaces, although much of the time books and paper may also be used.
- Multimedia equipment for video and music viewing or output is in growing demand. High quality printers are sometimes required. In studio and workshop environments, many different forms of output may be used.

4.7 External spaces

External spaces, especially space between buildings, can play an important role in aiding learning. Fresh air helps in keeping people alert and therefore more able to learn, though the amount of time that people can use external spaces for learning is naturally limited by climatic and weather conditions. Wireless broadband supplies information to these spaces in a manner that was formerly impossible. In the UK, little teaching and learning takes place at all during the more benign summer months. External spaces in colleges and universities are mostly used informally by individuals for reflective learning and by small groups. Examples from milder climates, such as external amphitheatres for lectures and performances, are unlikely to be appropriate. However, some spaces for occasional group learning can be formed through sensitive micro-climatic design of sheltered courtyards and gardens. MIT in Cambridge, Massachusetts has managed to incorporate an external amphitheatre and a high level open plaza, as part of the 2004 Stata Center, designed by Frank Gehry, for computer science, artificial intelligence and philosophy teaching.

4.6 Individual learning spaces

Effective learning usually involves time in active, solo study and writing or creation mode. The spaces in which this occurs are typically in library areas, computer rooms and study bedrooms. Some people are capable of concentrating in many other environments, but they are the exception. The main changes to these traditional spaces are the introduction of more computing technology (or mobile telephony serving the same purpose), and attention to better ergonomic and environmental conditions.

¹⁹ Learning and Skills Council, (March 2005), World Class Buildings: Design quality in further education, LSC and RIBA Client Forum.

²⁰ Fisher, K (op cit)

²¹ Herman Miller Inc. (2004) A view of the changing campus: How learning environments can support changes in higher education p 2.

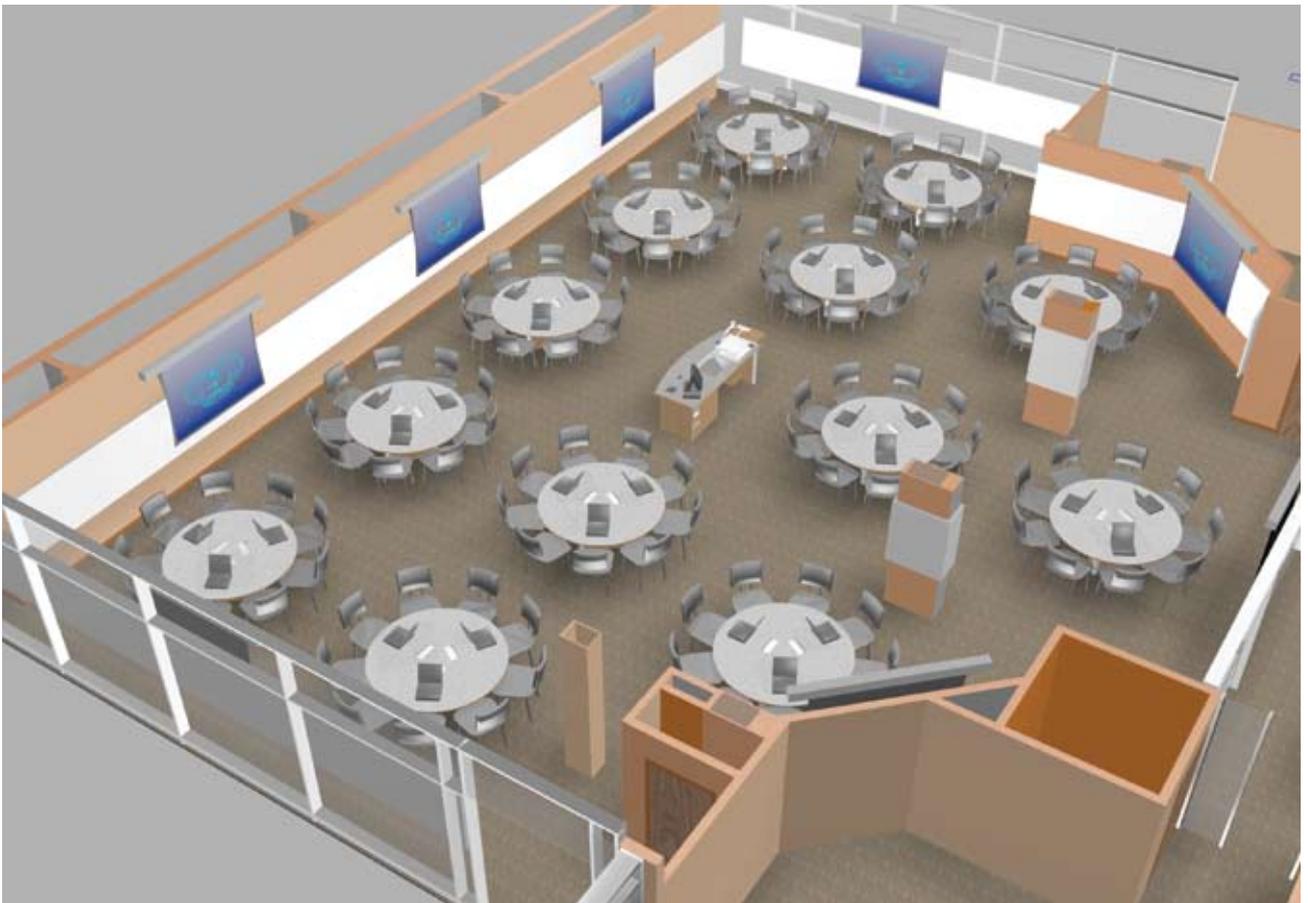
Group teaching / learning spaces



Peter F. Drucker Graduate Management Center, Claremont University
(photo: courtesy of CO Architects formerly Anshen + Allen Los Angeles)



James Weir Building, University of Strathclyde
(photo: AMA)



Technology enabled active learning (TEAL) classroom for engineering, MIT, Massachusetts Institute of Technology
(Image: Mark Bessette of the Center for Educational Computing Initiatives)

Simulated environments



Health skills lab, University of Wolverhampton
(photo: AMA)



Health skills lab, University of Wolverhampton
(photo: AMA)



Sports skills lab, Foss building, York St John College
(photo: AMA)

Immersive environments



Customised learning space, Stanford University
(photo: courtesy of Stanford Center for Innovations in Learning)



Immersive environment
(photo: courtesy of American USA)



Customised learning space, Stanford University
(photo: courtesy of Stanford Center for Innovations in Learning)

Peer-to-peer social learning spaces



Computer stations, Anglia Polytechnic University

(photo: AMA)

Cafeteria computer drop in, Sheffield Hallam University

(photo: AMA)



Dining decks, South East Essex College

(photo: courtesy of South East Essex College)

Wifi cafeteria, University of Wolverhampton

(photo: AMA)



Learning clusters



Math Emporium, Virginia Tech University

(photo: Rick Griffiths, Virginia Tech University)



Computer cluster, Foss building, York St John College

(photo: AMA)



'Learning pod', classroom of the future, University of Wolverhampton

(photo: AMA)

Individual learning spaces



Individual learning space
(photo: Rowan Huppert for AMA)



Study bedrooms need connectivity more than special furniture or fixtures
(photo: Rowan Huppert for AMA)

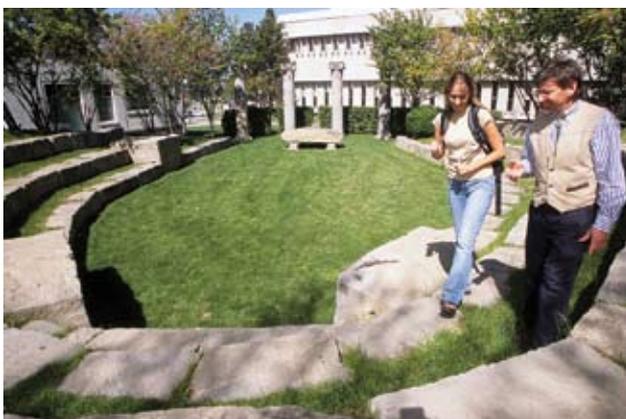
External learning spaces



Outdoor learning environment
(photo: Rowan Huppert for AMA)



Outdoor learning environment
(photo: Rowan Huppert for AMA)



Outdoor lecture amphitheatre,
Albertson College, Idaho
(photo: courtesy of Albertson College)



Outdoor lecture amphitheatre,
Albertson College, Idaho
(photo: courtesy of Albertson College)

5 The effectiveness of learning spaces

5.1 Complex relationships

The impact of different learning spaces is not easy to explore independently of the learning techniques, teacher style, information systems employed and many other factors. A recent report sponsored by the Scottish Council for Research in Education, (SCRE) into the effect of class or classroom size on learning outcomes, acknowledges the difficulty of reaching definite conclusions on the effect of class size alone. Even if a relationship were found, there may be more resource-effective ways of producing the same educational outcome.²²

To some educational researchers, built space is not even acknowledged as a possible contributing factor to student learning outcomes. The ETL project (Enhancing Teaching-Learning Environments in Undergraduate Courses) models potential influences on student learning but excludes the physical environment.²³

From our literature review we have unearthed a small number of interesting studies on learning spaces, mostly from the USA, covering the teaching of scientific subjects, especially maths, physics and engineering, that are described below. We note however that many developments in improved learning occur daily through thoughtful experimentation and development by teachers, and are never formally evaluated.

5.2 Outcome measures

Formal research gives feedback on measures such as class attendance rates, dropout rates from courses, subject understanding and the long-term retention of specific information. Student satisfaction is also monitored. Some studies are well designed, exploring outcomes for an experimental and a control group. For example, the iCampus project at MIT, sponsored by the University and Microsoft research, found that first year physics students taught with media-rich visualisation software in a classroom redesigned to facilitate group interaction, improved their conceptual understanding of the subject matter.²⁴

Evaluation of the outcomes for more than 800 students in experimental and control groups show that MIT students in the TEAL group described earlier, improved their conceptual understanding of the subject matter compared to the control group. The majority of students appreciate the benefits of interactivity, visualization and hand-on experiments and would recommend the course to others.²⁵

Data on 16,000 traditional and SCALE-UP students at North Carolina University, show that the latter have an improved ability to solve problems, increased conceptual understanding, better attitudes and reduced failure rates, especially for women and minorities.²⁶

Evaluation of Virginia Tech's Math Emporium showed improved scores on standard tests, and reduced failure rates compared to earlier groups. 43% of students strongly agreed that they had more interaction with other students and instructors than in other classes.²⁷

An Ohio State University study enrolled 3250 students over one academic year. Traditional modes of course instruction included three large weekly lectures plus twice-weekly laboratory sessions. Part way through the course, students were separated into three groups which used teaching spaces appropriate to their preferred learning style, as assessed from a questionnaire. One group was taught via large lectures; another used small group discussions, and the third independent online learning. There were no significant differences in learning outcomes by mode of delivery. However, the end of year results showed higher grades, lower course attrition and increased course satisfaction, compared to earlier year groups.²⁸

The literature review found no examples of outcome measures on whether citizenship values have been altered through different learning modes or in different learning environments.

22 Wilson, V, 2002, Does small really make a difference? A review of the literature on the effects of class size on teaching practice and pupil's behaviour and attainment SCRE Research report No. 107

23 Entwistle, N, (Aug 2003), University teaching-learning environments and their influences on student learning: An introduction to the ETL project,

24 Syllabus Media Group, 2003, Designing the Space: A conversation with William J. Mitchell, Campus Technology: From Syllabus Media Group, June 2005, <http://www.campus-technology.com/article>

25 Dori, Y and Belcher, J (2004), How does technology enabled active learning affect undergraduate students' understanding of electromagnetic concepts? The Journal of the Learning Sciences, Vol 14(2)

26 www.ncsu.edu/per/scaleup.html;

27 www.math.vt.edu; www.educause.edu/ir/library/pdf/hli0012.pdf

28 Acker R, Miller, M, 2005, Campus Learning Spaces: investing in how Students Learn, Educause Centre for Applied Research, ECAR Research Bulletin, Vol 2005, Issue 8, April 12.

Educational facilities generally

In the further education sector, it is held that 'excellent design has the capacity to enrich the learning experience, to raise the aspirations of teachers and learners and help education and training to flourish', and 'makes learning stimulating'.²⁹ Justification for this view is rarely found in formal research studies. However, the value to the institution of well-designed buildings has been recently explored by CABE and HEFCE. Their study concluded that staff appreciated well-designed facilities more than students.³⁰ A related study indicates that the quality of the facilities has a considerable influence on a student's choice of university³¹.

Recent surveys of student opinion as part of the Teaching Quality Information survey show that students generally evaluate college and university facilities favourably. Scotland's OnTrack survey of more than 7,000 HE and FE graduates³² asked several questions about the learning experience. 66% of respondents said they have adequate access to computer facilities. 60% thought the contact hours with teaching staff were good, and 70% thought the size of the group in which they were taught was good. The quality of equipment in laboratories and workshops was rated positively by only 41%. The balance of time between formal attendance and private study was felt to be positive by 52% of people. In future years, it would be useful to include specific questions on the adequacy of different learning spaces in the survey. Nevertheless, the available data highlights areas where improvements in facilities and learning can be made.

5.3 Design and specification: scale; air/heat/light; look and feel

Literature evaluating learning environments shows overwhelmingly that many educational buildings fail as spaces for learning due to poor air quality and to inadequate environmental features such as light and acoustics. This has been shown in PROBE studies in the UK³³, by Chris Watson in many evaluations made in Australia, New Zealand and the UK³⁴, and in an excellent US review of whether school facilities affect academic outcomes.³⁵

At MIT, Bill Mitchell of the Media Lab, a 'cyberguru' has concluded that you need to 'build space around the people rather than technology'. Despite the huge investment by MIT into the iCampus project, he found that 'fundamental human needs like comfort, natural light, operable windows, good social ambience, nice sort of quality and views out the window are still extremely important in creating good educational facilities.'³⁶

5.4 Sustainability

Teaching spaces should also be built for long-term sustainability. Sustainability in colleges and higher education is increasingly expected to provide not only facilities that are comfortable and cost-effective to operate and maintain, but that also affect the learner's understanding of sustainability as part of their wider citizenship learning. By demonstrating sustainable operations and spaces, the message of how careful use can be made of resources can be transmitted indirectly, as an important goal to be incorporated throughout their lives³⁷.

Sustainable practice has been to the forefront in many recent educational buildings in Scotland including John Wheatley College, Lauder College Aspire Centre, and Edinburgh's Telford College.

5.5 Density, space utilisation and space management

Density

Data on density at an institutional level indicate that universities are becoming more space efficient, at a time when new student-focussed learning modes are being introduced. EMS data for higher education institutions show a consistently downward trend in the net internal area per student FTE.³⁸ In individual buildings, however, it is likely that new learning styles may require more space per student FTE, all other things being equal. We have found little discussion of this topic in the literature.

In typical teaching rooms (such as lecture theatres, classrooms, and seminar rooms), new learning styles sometimes have the effect of increasing the space per seat, to allow for different, flexible arrangements of furniture at different times, or for different learning modes in one teaching session. The Strathclyde University case study demonstrates that, compared with typical space in a raked lecture theatre of about 0.8m² to 1.0m² per seat, up to 3m² per seat is needed when PC positions and swivel chairs are also included. In many FE classrooms, a figure of 5m² per seat is often required, depending on the learning format and discipline. This variety suggests that space

29 LSC, op.cit. pp 5, 6.

30 CABE, 2005, Design With Distinction: The value of good building design in higher education, the Commission for Architecture and the Built Environment, ODP, London, March.

31 Price, F, Matzdorf, F et al (2003), The impact of facilities on student choice of university, facilities, Vol 21, No 10, pp 212-222.

32 See www.mori.com/ontrack for results of student satisfaction.

33 www.cibse.org/pdfs/Bdbordass.pdf; www.usablebuildings.co.uk: Probe Studies, post-occupancy evaluation, Mar. - Apr. 2001, Building Research & Information, Vol. 29, No. 2.

34 www.postoccupancyevaluation.com

35 Schneider, Mark, 2002, Do school facilities affect academic outcomes?, National Clearinghouse for Educational Facilities, November.

36 Syllabus Media Group (op cit)

37 Bartlett, P, and Chase G, 2005, Sustainability on Campus: Stories and strategies for change, Cambridge Mass., MIT Press.

38 Estate Management Statistics, The fifth EMS Annual Report, 2003-04.

norms should be sufficiently flexible to allow institutions the freedom to plan learning spaces to match their specific pedagogical vision.

While group learning spaces typically require more space per seat, social learning spaces can be provided efficiently within 'balance' areas converting part of these areas into more useable space. This happens, for example, when groups of computers are located adjacent to main circulation routes or in milling space outside classrooms and lecture theatres. The Saltire Centre at Glasgow Caledonian University takes this principle still further, as does the proposed new facility for James Wheatley College. However, the detailed design of such spaces needs to provide circulation areas generous enough to allow egress in the case of fire, and to avoid unpleasant overcrowding.

Further investigation of the relationship between density, space efficiency and learning mode is needed.

Utilisation

Utilisation in educational facilities is typically measured as the number of hours a 'classroom' is used compared to the available hours, multiplied by the number of occupied seats compared to capacity. A target of 30-40% is usually adopted, across a 40 hour week. Very few institutions attain that level, even with increasing numbers of students and diminishing space per student overall.

Where are the students? The explanation may be found partly in the gradual introduction of more learner-centred educational modes. As long as many, if not most, lecture rooms and classrooms are still used in more teacher-centred modes, students are also learning in their own style, in their own time, elsewhere. Teachers who are sensitive to more learner-oriented discovery modes, may sometimes choose to leave their allocated room empty and take the learner group elsewhere. Part-time work, family responsibilities and high drop out rates among students also reduce room utilisation.

Looking ahead, it is likely that relatively fewer seats will be provided in lecture rooms and classrooms. However, the area per seat will increase significantly, as will the cost especially for technology. Overall, lecture rooms and classrooms will require relatively more space per student than they do now, while at the same time, space for more informal, unscheduled learning spaces will increase. To maintain space efficiency across college and university estates, office space for academic and administrative staff will become more efficient.³⁹

Space management

Classrooms designed for new learning modes sometimes have adaptable furniture that can be used in different formats. Teachers need to specify the required layout when the room is booked, and time needs to be timetabled for facilities staff to alter the arrangement. This may have the effect of slightly reducing the utilisation of such rooms. As an alternative, furniture that can be relocated rapidly and safely by users avoids this problem.

Most new learning modes also rely on a higher level of investment in computing infrastructure and audio-visual equipment than in traditional teaching modes. Ideally, such infrastructure needs to be simple to use, with standard, robust control features, to avoid reliance on IT or audio-visual staff.

To help new learning spaces work well, input from all parties involved in their operation should be welcomed in designing and specifying new buildings or alterations to existing spaces. This includes academic and technical staff, learners, IT and audio-visual people, estates and facility managers, room timetablers and the people who set up the rooms as required.

Little is known about the relationship between new learning modes, density, cost in use, space management, and staff resources. Some of the USA examples of new learning environments show that they were introduced because of the need to use academic faculty time more effectively, at a time when student numbers were growing and staff numbers decreasing. More research is needed in this area to understand the complex relationships.

Learning space is only a means to an end. The mission of further and higher education institutions is effective student learning, the creation of an educated, skilled workforce with strong social values and citizenship skills. We have found no evidence that citizenship is improved by better learning environments. However, if the delivery of the SFC mission proved to require greater investment in space and facility management than has been traditional, together with higher levels of investment in ICT infrastructure and technology, it may be a price worth paying. If by so doing, academic staff make better use of their time, then it would certainly be well justified.

39 For a further discussion of space efficiency, see the Space Management Group website www.smg.ac.uk and the working paper by AMA Alexi Marmot Associates and Davis Langdon (2005), Assessment of the impact of design on space efficiency.

6 Creating improved learning spaces

In the course of this research project, we have identified a number of ideas that would help to encourage more experimentation and development of effective learning spaces in Scotland. Some actions are best undertaken by individual institutions, others by the design and IT sector, while SFC can play a key role in promoting initiatives and sponsoring research.

6.1 What individual colleges and universities can do

- Articulate a learning and teaching plan linked to the strategic development and estate plans.
- Audit the learning styles that are possible within the existing estate and technological infrastructure, and identify any gaps.
- Encourage experimentation in new learning modes from enthusiastic members of staff and learners.
- When new developments or refurbishments are planned, encourage discussion between people in academic departments, educational development, estates and IT, on the most suitable learning environments for their teaching and learning styles.
- Use tools to help academic staff reflect on how best they wish to teach, and how best to help students learn. Questionnaires, visioning workshops and visits are all helpful⁴⁰.
- Visit good examples elsewhere to learn from best practice.
- Seek out and select architectural and design teams for capital projects based partly on their familiarity with new learning modes. Incorporate this requirement into the OJEU procurement process.
- Introduce modest changes into traditional lecture theatres, classrooms and seminar rooms to improve the learning environment.
- Provide appropriate training and support for academic staff in learning how to use new facilities designed for different learning modes.
- Help initiate new learners in the use of different environments and resources to aid their education.
- Work actively with the people responsible for timetabling, facility management, IT and audiovisual equipment and room setup, to agree how spaces will be managed.
- Seek feedback from students and staff on their response to different learning environments.
- Conduct post-occupancy surveys every time a major capital development is completed in order to learn lessons and thereby improving the next investment. The best surveys embrace many aspects of the built environment and learning outcomes.

- Seek funding from outside suppliers and other bodies to experiment with learning spaces in a 'learning laboratory'.

6.2 What the design and supplier industry needs to do

- Develop ergonomic furniture, which is mobile, easily configurable, efficiently stackable, robust and attractive.
- Design tables for small groups to work collaboratively.
- Invest in the design of robust ICT and audio-visual equipment, with standard user interfaces, that is intuitive to use by faculty and learners.
- Sponsor research to test and evaluate new furniture, equipment and software designed to improve learning.
- Provide funding to university researchers to develop and test learning concepts and products in a 'learning laboratory'.

6.3 Opportunities for SFC

- Urge institutions to articulate a learning and teaching plan linked to the strategic development and estate plans.
- Encourage the exploration of new ideas and innovative pilot projects in the design of new or refurbished learning spaces. For example, make an annual award for the most innovative learning space completed in the past year.
- Consider creating a webpage publicising the latest innovation in learning spaces, linked to related websites.
- Support the exchange of information with international groups working on new learning environments.
- Foster interdisciplinary debate with academics, learning development units, IT and estates groups.
- Consider incorporating more questions on the quality of learning spaces into the annual OnTrack student survey.
- Encourage post-occupancy evaluation of all recently completed projects, and the use of guidance from the HEDQF.
- Stimulate learning from post-occupancy evaluation.
- Sponsor further investigation into the relationship between density, space efficiency, space management and learning modes.
- Support the development of briefing notes for learning spaces - technical descriptions of typical new learning environments, their features, technology, furniture and management. Make the briefing notes available to all institutions, in print and/or via the web.

⁴⁰ See for example the Prototype Learning Space Design Survey from the TLT Group (Teaching, Learning and Technology) www.tltgroup.org

APPENDIX 1: Research methodology

Several different modes of enquiry were used to explore this topic, as described below. Knowledge of the design of educational spaces gained from professional practice and research carried out for HEFCE on space-management in universities has also been incorporated.

Literature review:

- An extensive review of literature sourced through web and print was conducted over a four-month period.
- Key areas of focus included:
 - trends in higher and further education
 - how people learn best
 - the relationship between technology and learning
 - the impact of physical space upon learning outcomes
- In addition, an analysis of student prospectuses from many HE and FE institutions in Scotland was conducted to explore how new pedagogical approaches and spaces for learning are being marketed to potential students.

Interviews:

- Telephone interviews were conducted with representatives of four national educational organisations:
 - HM Inspectorate of Education (HMIE)
 - Scottish Further Education Unit (SFEU)
 - Higher Education Academy (HEA)
 - Quality Assurance Agency (Scottish office)
- The purpose of the interviews was to:
 - obtain expert opinion on changes taking place in tertiary education, with specific reference to the Scottish context
 - obtain views on the impact of physical space on learning outcomes and any best practice examples
 - identify additional relevant research/materials.
- A number of interviewees from additional institutions were contacted but were unavailable for interview during the study period.

Case studies

- Four case studies were conducted to provide a detailed perspective on the quality of newer learning environments currently being designed and built in Scotland.
- A list of institutions with recently completed or ongoing building projects of interest was drawn up in collaboration with SFC. From these, a shortlist of eight was reached, from which spaces at the following four institutions were finally selected:

- John Wheatley College, Easterhouse and East End
- University of Strathclyde, James Weir Building
- Edinburgh's Telford College, West Granton Road
- Glasgow Caledonian University, Saltire Centre

- Each institution was contacted by letter/email and asked if it would be happy to participate in the study. All were keen to be involved and were subsequently visited by members of the project team who spent several hours at each site observing and analysing learning spaces and conversing with key members of staff.
- Each visit was supplemented with desk research, floor plan analysis, and checking of facts with the institution.

Learning and teaching trends survey

- Based on findings from the literature review, a short online survey was devised to explore the extent to which widely quoted trends in higher and further education are perceived to be impacting the Scottish tertiary education sector.
- The survey focused on trends in four key areas:
 - student demographics
 - teaching methods
 - technology
 - teaching and learning spaces.
- Respondents were also asked to rate the impact of certain spaces on student learning outcomes and to provide examples of any exemplary learning spaces within their own institution.
- A series of emails inviting responses to the survey were sent to representatives from each of the 65 Scottish institutions. In total, 121 individuals were contacted, encompassing a broad range of roles and responsibilities, including:
 - Principals, Vice Chancellors, other senior managers
 - Estates Managers
 - Room timetablers
 - People in teaching and learning development units
 - People in information and communications technology.
- The survey was made available for ten weeks to allow people to respond during or after the summer recess. Several reminders were sent out.
- Results were analysed to explore the overall rate of change predicted. Perceived differences between HE and FE institutions and between people in different roles within the institution were investigated. Where possible results have been compared against available data sources.
- A full description of the results is shown in Appendix 4.

APPENDIX 2: People and organisations consulted

We would like to thank the people we contacted as part of this study and who kindly gave us much of their time and provided valuable information and insights.

Jim Boyle	Professor of Mechanical Engineering, University of Strathclyde
Bruce Heil	Deputy Principal, Edinburgh's Telford College
Bob Hunter	University of Birmingham
Peter Jamieson	University of Queensland
Ian Graham	Principal, John Wheatley College
Alex Kirk	Deputy Principal, John Wheatley College
Iain Lowson	HM Inspectorate of Education
John McCann	Deputy Chief Executive, Scottish Further Education Unit
Eleanor Magennis	Assistant Director Space-management and Planning, University of Strathclyde
Norman Sharp	Director Quality Assurance Agency (Scotland)
Christine Siebelt	Cluster Manager, Jordanhill Crawford Complex, University of Strathclyde
Brenda Smith	Assistant Director of Programmes Division, Higher Education Academy
Chris Watson	Director, Post-occupancy Evaluation, Wellington, New Zealand
Les Watson	Pro Vice Chancellor, Glasgow Caledonian University

We would also like to thank the 60 individuals from the following institutions who took the time to complete the survey of learning and teaching trends:

Banff & Buchan College	Oatridge College
Bell College	Perth College
Cardonald College	Robert Gordon University
Cumbernauld College	Sabhal Mor Ostaig
Dumfries and Galloway College	Stow College
Glasgow Caledonian University	UHI Millennium Institute
Glasgow School of Art	University of Aberdeen
Heriot Watt University	University of
James Watt College of Further & Higher Education	Abertay, Dundee
Jewel & Esk Valley College	University of Dundee
John Wheatley College	University of Edinburgh
Kilmarnock College	University of Glasgow
Napier University	University of Paisley
	University of St Andrew
	University of Stirling
	University of Strathclyde
	West Lothian College

APPENDIX 3: Educational trends

This section summarises key trends that influence the creation of effective learning spaces. It is not intended to be an exhaustive review of the enormous body of literature available on educational policy, e-learning and other relevant technologies, or the psychology of learning. Relevant policies, theories and data that inform design have been selected.

Education in the new economy

- Knowles (1984), "The most socially useful thing to learn[ing] in the modern world is the process of learning".⁴¹
- Approaches to what constitutes effective learning have changed over the past 50 years, from the rote memorisation of facts and figures to an ability to problem-solve and apply knowledge to new situations.
- While early 20th century education focused on the acquisition of knowledge and specific skills, there is today a greater focus on critical thought, clarity of expression and complex problem-solving. Hence, the complexity and range of learning requirements have changed.
- This is primarily driven by changes in the skills required for work in the new knowledge economy, which demands a more qualified, highly skilled, creative and flexible workforce.
- As a consequence, the education sector will continue to play an increasingly important part in most people's lives. Tomorrow's workers will need to be more prepared than ever before to change employers and roles regularly and to continue learning, training and acquiring skills throughout their lifetime.
- Since employability is a key goal for most learners, it follows that 'one of the primary objectives of colleges and higher education institutions must be to help learners to [build on] their previous experience, and [give them] opportunities to develop enterprising skills and attitudes'⁴².

41 Wilson, Jenny, 2004, Understanding learning styles: implications for design education in the university, University of Technology, Sydney, p394, January.
42 SFCE/SFCFE Learning to Work, Enhancing employability and enterprise in Scottish further and higher education (2005), p10.

Policy and educational context of Scottish Further and Higher education

- There are 43 further education colleges and 21 higher education institutions in Scotland.
- Funding within the tertiary education sector is distributed via the Scottish Funding Council (SFC) – non-departmental public body responsible for the distribution of more than £1.5 billion each year.
- The Scottish Executive holds responsibility for educational policy. The Executive has set out an agenda for the modernisation of the tertiary education sector in Scotland. It emphasises the role of education and training in the growth of the Scottish economy and its role in the provision of lifelong learning, social inclusion and citizenship and the creation of an enterprising workforce.
- The life-long learning strategy developed by the Scottish Executive highlights the growing importance of skill development in creating a competitive economy as Scotland's working population ages. The strategy is aimed at achieving 'the best possible match between the learning opportunities open to people and the skills, knowledge, attitudes and behaviours which will strengthen Scotland's economy and society'.⁴³
- In line with this strategy, Scottish universities and colleges are making education accessible to a widening band of students by offering a greater range of flexible or part time study options. Many of these institutions offer 'flexible learning' opportunities, some of which are also marketing their online and distance learning courses to further widen potential participation rates.⁴⁴
- To improve the opportunities for life-long learning and social inclusion, the Scottish Executive is looking to the further education sector to improve collaboration and innovation, highlighted in a growing trend towards mergers between colleges. In an article published by the Scottish Further Education Unit, Irons (2003)⁴⁵ suggests that willingness and ability to collaborate will be a necessary element in the development of colleges.
- There is also a drive to blur the boundaries between further and higher education through initiatives such as the '2+2' model. More than 40% of Scottish higher education is currently delivered through further education institutions.

- In line with the targets of the Scottish Executive, the funding council has a vision 'to create and develop an outstanding and sustainable system of tertiary education, learning, training and research' focused on: the improvement of learning and skills in Scotland; fair access, participation and progression in and through tertiary education; the creation and transfer of knowledge; a coherent system of well-led, innovative and responsive college and higher education institutions.
- To further these aims, the formerly two funding councils for Further and Higher Education have recently merged, creating the unified Scottish Funding Council (SFC).

Who studies in Scotland?

- The total number of students involved in higher and further education in Scotland is on the increase. The participation rate within Scotland is already over 50%⁴⁶ and Scottish universities are popular with international students.
- As shown in Figure 1 there are approximately 402,000 students studying in FE colleges in Scotland (an overall increase of 5% from 1998-99 figures) and approximately 196,000 students studying in HE institutions (an overall increase of 11% from 1998/99 figures).
- Part time students account for 27% of students at HE institutions, and 82% of students in FE colleges (figure 1).
- Statistics published in a report by the Scottish Executive⁴⁷ show that:
 - 76% of all students in Scotland are Scottish.
 - The majority of non-Scottish students are from other parts of the UK, with approximately 2% from other parts of the world.
 - Slightly more than half of students in Scotland are female.
 - 94% of Scottish students are Caucasian.
- As illustrated in Figure 2, mature students over 25 years of age within FE colleges make up 56% of the student body.
- Unfortunately, there are no directly comparable data for HE institutions. However, figures show that 60% of the student body are aged over 21.

⁴³ Scottish Executive, 2003, Life through learning: Learning through life, The life long learning strategy for Scotland, Scottish Executive, February.

⁴⁴ Analysis of 2005 available Scottish prospectuses conducted by AMA as part of this research.

⁴⁵ Scottish Further Education Unit, 2003, Collaboration and the college estate, Iron, A

⁴⁶ Brown, Mike, 2005, Merger surge: Scottish colleges are finding strength in unity, The Guardian, 7th June, pp 21.

⁴⁷ Scottish Executive Statistics Publication Notice, 11 May 2005

Figure A1: Changes in student numbers by institution type 1998-2004

Type	Mode	source	1998-99		2003-04		% growth
			headcount	%	headcount	%	
HE	Full time	1	131,239	74.3%	143,134	73.0%	9.1%
	Part time	1	45,365	25.7%	53,053	27.0%	16.9%
	TOTAL	1	176,604		196,187		11.1%
FE	Full time	2	66,268	17.4%	71,807	17.9%	8.4%
	Part time	2	314,496	82.6%	330,410	82.1%	5.1%
	TOTAL	2	380,764		402,217		5.6%

- (1) Figures for students in SHEFC funded institutions HESA 2003-04 by headcount. Figures exclude the Open University in Scotland and the UHI Millennium Institute.
 (2) Figures provided by the SFC in-house statistics.

Figure A2: Maturity of students by institution type, 1998-2004

Type	Age	source	1998-99		2003-04		% growth
			headcount	%	headcount	%	
HE	Young	1	70,189	39.7%	72,765	37.1%	3.7%
	Mature	1	106,415	60.3%	123,422	62.9%	16.0%
	TOTAL	1	176,604		196,187		11.1%
FE	Young	2	154,523	43.8%	155,134	41.9%	0.4%
	Mature	2	198,017	56.2%	214,993	58.1%	8.6%
	TOTAL	2	352,540		370,127		5.0%

- (1) Figures for students in SHEFC funded institutions HESA 2003-04 by headcount. Figures exclude the Open University in Scotland and the UHI Millennium Institute.
 (2) Figures provided by the SFC in house statistics.
 Note: Figures for HE define 'mature' as aged over 21. Figures for FE define 'mature' as aged over 25.

Ways of learning: theoretical approaches in educational psychology

- Early 20th century attempts to study learning systematically took an objective approach, viewing it as a process of forming connections between stimuli and response (behaviourist approach).
- While this approach served to explain simple cause and effect learnt responses, it failed to capture the more complex relationships between emotion, cognition, motivation and learning.
- During the 1950's, a series of seminal studies into child cognition by Jean Piaget illustrated that learning is a developmental process in which fixed conceptualisations of the world ('schemas') can be challenged - and ultimately changed - through the active exploration of concepts. In simple terms this can be understood as 'learning through doing'.
- Piaget was one of the first theorists to recognise the importance of social context in the learning process. Piaget's work (1962) built upon earlier work by Vygotsky (1896-1934), whose 'social development theory' recognised cognitive development as a life-long process, driven by social interaction and social learning.

- Vygotsky's theory is of particular relevance to education as he recognised the key role that teachers and peers can play in widening the gap between knowledge (attainable through independent learning), and in-depth understanding (attainable through directed and collaborative problem solving). In other words he demonstrated that students are able to perform tasks with adult guidance or peer collaboration that they could not achieve alone.
- More recent conceptualisations of Vygotsky's work can be seen in the theory of social constructivism, which holds that all meaning and knowledge is created through social interaction. Central to this theory is the idea that new knowledge and understanding are created, based on what people already know and believe. Translated into an educational setting this powerfully suggests two things. Firstly, successful tuition requires an understanding of the views an individual or group already hold. Secondly, that active participants, be they student or teacher, are engaged in the learning process.

- Advanced studies of cognition, most notably in the field of cognitive science, have demonstrated that successful learners also engage in 'metacognition' – they demonstrate an 'awareness of the process of learning'. Studies into the differences between experts and novices in subject areas such as mathematics and physics have illustrated that experts are more able to reflect on their progress while learning, make changes and adapt their learning strategies if they are not performing well.
- There has been much debate within psychology and education as to the importance that individual differences (such as gender and age) have on preferences for learning styles and comprehension levels. While many studies have been conducted in this area, the relationship between these and other variables such as motivation, IQ, and social context are very complex and therefore no conclusive findings can be reported.
- An extensive literature review by the National Academy of Sciences (2000)⁴⁸ identified three key learning styles, consistent with the theories outlined above, which are supported by a strong knowledge base. These can be summarised as:
 - learning through reflection
 - learning by 'doing'
 - learning through conversation.
- Consistent with the theories cited above, approaches to learning are changing. Traditional teacher-centred models, where good teaching is conceptualised as the passing on of sound academic, practical or vocational knowledge, are being replaced with student-centred approaches, where content and knowledge are constructed through a shared understanding. This is well described by Barr and Tagg (1995) as the shift from an 'instruction' paradigm to a 'learning' paradigm⁴⁹.
- Bligh (1998)⁵¹ concluded from an extensive literature review of studies which compare teaching methods that lectures are:
 - no more or less effective than other methods in transmitting facts and information
 - not as effective as discussion methods in promoting thought
 - relatively ineffective for teaching values, inspiring interest in a subject or for personal or social adjustment
 - relatively ineffective for teaching skills.
- Research in other academic environments, including primary and secondary schools, can provide some indication as to how learning outcomes are influenced by space types. Key research conducted in American schools exploring the impact of size found that, in general, students in smaller classes performed better⁵².
- Many studies also point to the use of space to facilitate group discussion and informal tuition. Student-led sessions have been found to result in wider-ranging discussions and more complex learning outcomes (Tang, 1998), and some research indicates that group problem-solving is superior to individual problem-solving (Evans, 1989)⁵³.
- Evidence from architectural courses suggests that students learn technical skills more efficiently and incorporate them more readily into the building design process when they are acquired on an as-needed basis during ongoing design projects (Allen, 1997)⁵⁴.
- There is also evidence that suggests private study space is important. Teaching practices congruent with a metacognitive approach to learning (that focus on sense-making, self-assessment, and reflection on what worked and what needs improving) have been shown to increase the degree to which students transfer their learning to new settings and events.
- Differences in learning styles suggest that a range of teaching approaches is appropriate. A 10-year research programme at the University of Technology, Sydney, demonstrated that by helping students to understand their own learning styles, improved comprehension levels and reduced attrition rates were achieved.⁵⁵
- In summary, evidence suggests that a range of teaching and learning environments should be available. These spaces should be viewed by academic professionals as tools suited to particular tasks and designed to support the particular mode of required learning.

Empirical and applied research findings

- While there are many studies of cognitive science that explore learning styles, there are few empirical studies that link this body of research to the environment in which learning takes place. However, much of the research quoted below has broad implications for the design of learning environments.
- Studies have shown that without a break, the maximum concentration span of students in lectures is about 10 – 15 minutes⁵⁰.

48 Bransford, John D, Brown, Ann L, Cocking, Rodney R, 2000, How People Learn: brain, mind, experience and school, National Research Council, National Academy Press, Washington DC.

49 Barr, R and Tagg, J (1995) A new paradigm for Undergraduate Education, From Teaching to Learning, Change, November, p13-25

50 Bligh, Donald, 2000, What's the use of lectures?, Jossey-Bass, San Diego, California.

51 Bligh, Donald, 2000, What's the use of lectures?, Jossey-Bass, San Diego, California.

52 Pate-Bain & Achilles, 1992, Class size does make a difference, Phi Delta Kappan, November

53 All studies quoted in Bransford, John D, Brown, Ann L, Cocking, Rodney R, 2000, How People Learn: brain, mind, experience and school, National Research Council, National Academy Press, Washington DC.

54 Allen, Edward. (1997). Second studio: A model for technical teaching. Journal of Architectural Education, V51, Issue #2, November.

55 Wilson, Jenny, 2004, Understanding learning styles: implications for design education in the university, University of Technology, Sydney, January.

Technology, e-learning and distance-learning

- The term 'e-learning' has been used to cover a broad range of issues. It was recently defined in an SFC report as 'networked access to digital learning materials and communication systems to deliver and support learning'⁵⁶.
- The potential role of e-learning in revolutionising the delivery of education has been much vaunted. As the cost of hardware continues to fall, connectivity becomes faster and simpler, and more sophisticated simulation technologies are developed, there is no doubt this will continue.
- A discussion paper from Project Kaleidoscope⁵⁷, a US network of science-based teaching professionals, cites a number of areas in which technology can be used to enhance learning, including:
 - developing authentic problems parallel to those adults face in the real world and facilitating reflective inquiry
 - using modelling to bridge between experience and abstraction
 - providing a range of media and tools to support independent learning
 - facilitating increased interaction between tutors and students through the use of email and discussion forums
 - enabling students to learn from a diverse population of tutors and peers through the creation of virtual 'cyberlabs'
 - increasing the quality and availability of learning resources by creating interdisciplinary online tools shared with other institutions.
- Scotland has been particularly innovative in the use of technology and e-learning to support distance-learning initiatives, possibly because its colleges and universities are distributed across a diverse landscape, from large cities to remote highland areas.
- One Scottish university, the UHI Millennium Institute, is a virtual network of 15 colleges and research institutions located throughout the Highlands & Islands. The institute supports a large remote population and has been designated a higher education institution since 2001.
- Statistics suggest that the number of students in distance learning has been increasing steadily over the past five years. 10% of higher education students in Scotland are currently distance-learners. Interestingly, the number of students in the Open University in Scotland grew by 21% between 1998 and 2004.
- While there are many excellent examples of e-learning initiatives, there is a tendency to exaggerate the anticipated rate and nature of change. To many educationalists, the impact that digital technology is having on pedagogy within traditional teaching spaces will be more significant in the long run.
- A recent study by JISC into the impact of technology on physical space concludes that learning in the future is likely to be tailored to individual needs. However, there will still be schools, colleges and universities with a physical presence, albeit used in a more flexible way. Lecturers, teachers and tutors will still be at the heart of the learning process but their role will evolve.⁵⁸
- The JISC study also suggests that it is important to understand fully the pedagogic and operational drivers behind technological innovation in space. Where there are no pedagogic drivers in the creation of technology-enhanced spaces, effective new teaching styles are unlikely to develop.
- This is in line with conclusions in a recent report by SFC⁵⁹ exploring the future role of e-learning in Scottish tertiary education which state that e-learning tended to succeed when driven by pedagogical needs, not by technology. Given that education is a social process, the report recommends that institutions should consider how e-learning techniques could be best integrated with traditional teaching methods in order to achieve a 'blended learning' approach.
- The SFC report into the future of e-learning also notes that, for Scottish institutions to take advantage of e-learning opportunities, there is a need for continued investment in the JANET national infrastructure (Joint Academic NETwork). It also states that for e-learning to have the potential to transform the educational landscape, there is a need for greater collaboration between institutions and other national organisations.
- Investment is also needed in technologies based on mobile technology - 'm-learning'. A report by JISC⁶⁰ on the future of mobile technologies cites three reasons why they will play a strong role in education: prevalence of ownership in the 16-24 age group; support of the lifelong learning initiative through access to new audiences and widening participation; and that they support the prevailing constructivist pedagogy.

56 Joint SFEFC/SHEFC E-Learning Group Final Report, 2005, p11

57 PKAL Roundtable of the Future, 2001, Information Technology In the Service of Student Learning, Project Kaleidoscope.

58 JISC study (2005) How innovative technologies are influencing the design of physical learning spaces in the post 16 sector

59 Joint SFEFC/SHEFC E-Learning Group: Final Report (2005)

60 Anderson, Paul, Blackwood, Adam, 2004, Mobile and PDA technologies and their future use in education, JISC Technology and Standards Watch: 04-03, November.

APPENDIX 4: Learning and teaching trends survey

Who responded?

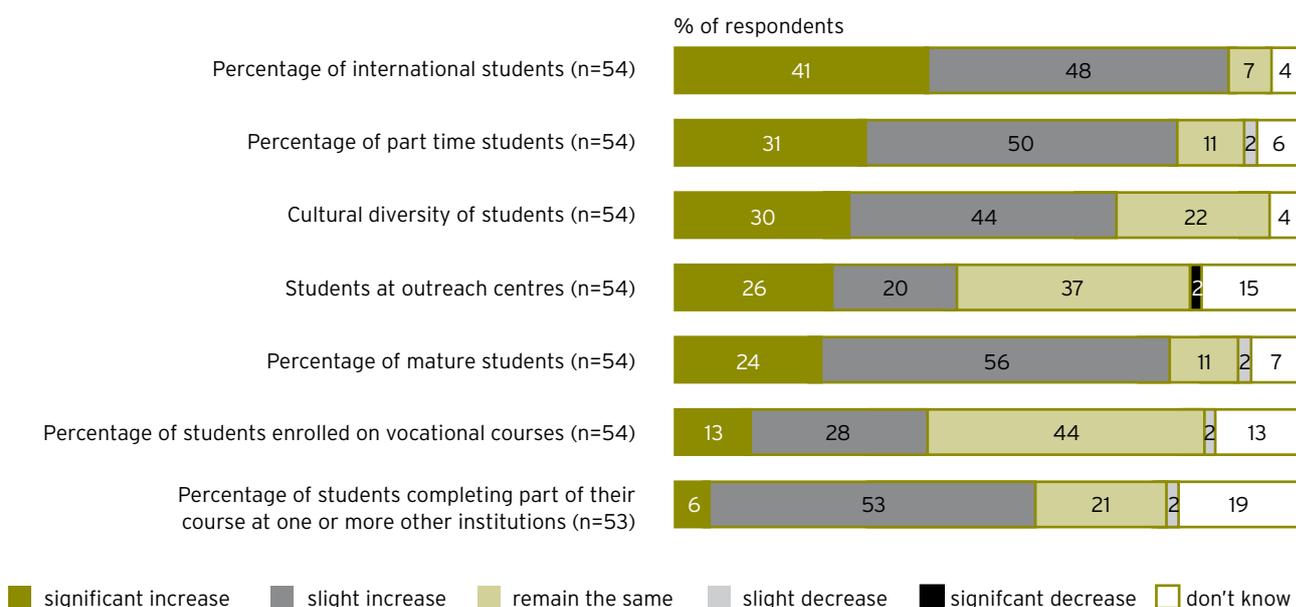
- A target response rate of 51% was achieved (62 responses to 121 invitations)
- Responses were received from a total of 29 individual institutions:
 - 16 colleges
 - 13 HEIs
- The majority of responses were received from Senior Managers, Estates Managers and IT professionals.

Summary of key findings

- The survey identified 37 key trends relating to changes in the:
 - demographic diversity of student intake
 - institutional approach to teaching and learning
 - IT provision, use of multimedia and campus connectivity
 - provision of traditional and innovative teaching and study spaces.
- Most trends identified in the survey were perceived to be on the increase. However, there was a perceived reduction in the use of lecture-style teaching methods and in the number of taught contact hours per student.

- A detailed analysis of the data by institution type revealed that the perceived decline in the use of lecture style teaching methods was specific to HE institutions
- The top five trends identified all involved the application of IT. In some cases this had a direct relationship to physical space, such as technology-enhanced social spaces and use of wireless networking across the institution.
- While this general view was shared between FE and HE institutions there were subtle variations. Where HE institutions focused on the use of interactive technology in the classroom environment, FE colleges focused on the use of multimedia technology.
- A comparison of the top five trends noted by respondents from different professional groups identified significantly different key trends. IT professionals saw IT-related trends as the greatest growth area and estates management professionals were far more inclined to predict changes in the nature of the physical spaces being provided. Senior managers appeared to take a more holistic view, incorporating some aspects of IT, physical space, sustainability and citizenship issues.
- More than three-quarters of respondents perceived that the diversity of students enrolled at their institution would increase over time, with increases in the number of international students and part-timers, culturally-diverse and mature students.

Figure A3: Perceived changes in student demographics



Note: Percentages may not total 100 percent due to rounding

Source: AMA learning and teaching trends survey, September 2005

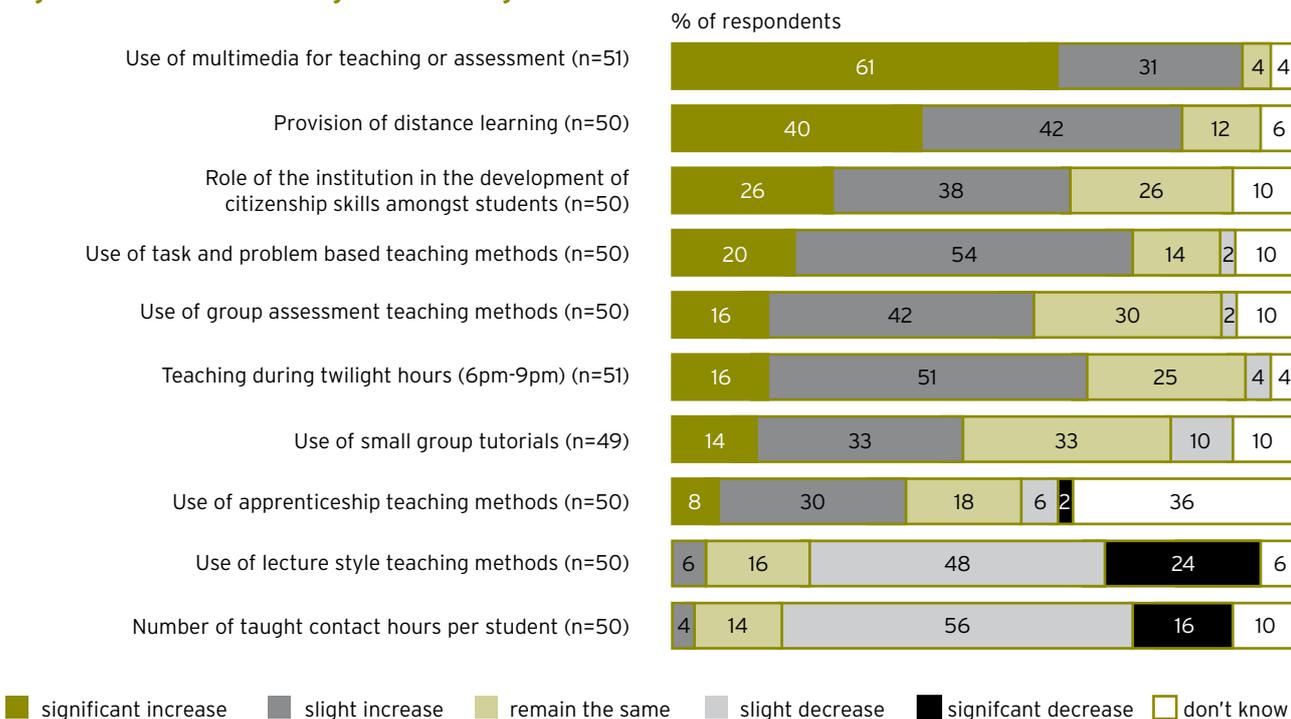
- The percentage of international students was perceived as the main growth trend, with 41% of respondents anticipating a significant increase.
- More than half of the respondents felt that students were increasingly likely to complete part of their course at more than one institution.
- Almost half felt that a growing number of students would be taught through outreach centres, although a similar number felt this would remain unchanged.
- Slightly less than half of the respondents expected increased enrolments on vocational courses.
- Figure A4 illustrates the actual trends in student demographics for a six-year period from 1998. It is interesting to note that the current percentages of part-time students, mature students and non-Scottish and non-UK entrants have not changed greatly over time. The percentage of non-Caucasian students in higher education, which has almost doubled in both HE and FE, is the main discernible trend.
- The use of lecture-style teaching methods and the number of taught contact hours per student are the main downward trends noted by respondents. No respondents felt that either would increase significantly over time.

Figure A4: Student demographics, 1998-2004

	Type	Data Source	1998-99	1999-00	2000-01	2001-02	2002-03	2003-04
% Part time	HE	1	25.7					27.0
	FE	2	82.6	82.3	82.9	83.9	83.1	82.1
% Mature students	HE	1	60.3					62.9
	FE	2	56.2	56.8	57.2	57.2	58.1	58.1
% Non- caucasian	HE	1	5.0					9.0
	FE	2	2.4	2.9	2.9	3.4	4.2	4.5
% Non-Scottish students	HE	3						29.6
	FE	2	3.1	2.2	1.5	1.8	1.4	1.5
% Non-UK students	HE	1	7.6					13.7
	FE	2	1.3	1.1	1.1	1.1	0.9	1.0
% Male	Overall	3	46	45.6	44.8	44.5	44.4	44.2
% Female		3	54	54.4	55.2	55.5	55.6	55.8

Data sourced from (1) HESA Stats and (2) SFC Stats and (3) Scottish Executive
 * Note: For HE mature students are 21 or over on 31st of August of the academic year
 ** Note: for HE mature students include those students aged 25 and older

Figure A5: Perceived changes in teaching methods

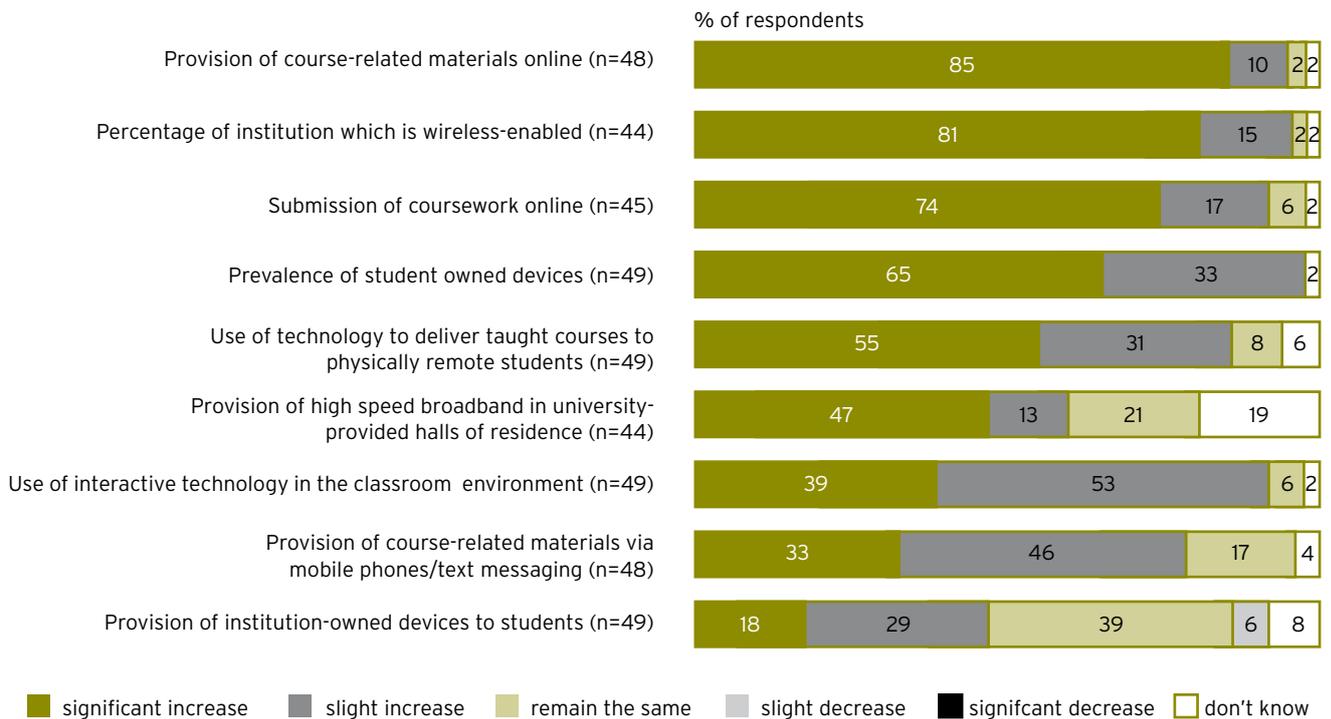


Note: Percentages may not total 100 percent due to rounding

Source: AMA learning and teaching trends survey, September 2005

- The use of multimedia for teaching or assessment and the provision of distance learning were perceived to be increasing significantly.
- Increases were also anticipated in the use of task and problem-solving-based teaching methods, small group tutorials and group assessment, although the latter were considered to be less significant. Results also suggested that a number of respondents felt these practices would continue at the same level, which may indicate that they had already been introduced.
- 67% of respondents felt that teaching between 6pm-9pm was likely to increase in the future, although most felt the increase would only be slight.
- All respondents felt that their institution would continue to play a role in the development of citizenship skills amongst students.
- The provision and submission of course materials online was seen as a significant growth trend by the majority of respondents. This is allied with a significant growth in the use of technology to deliver courses to remote students.

Figure A6: Perceived changes in technology in learning environments

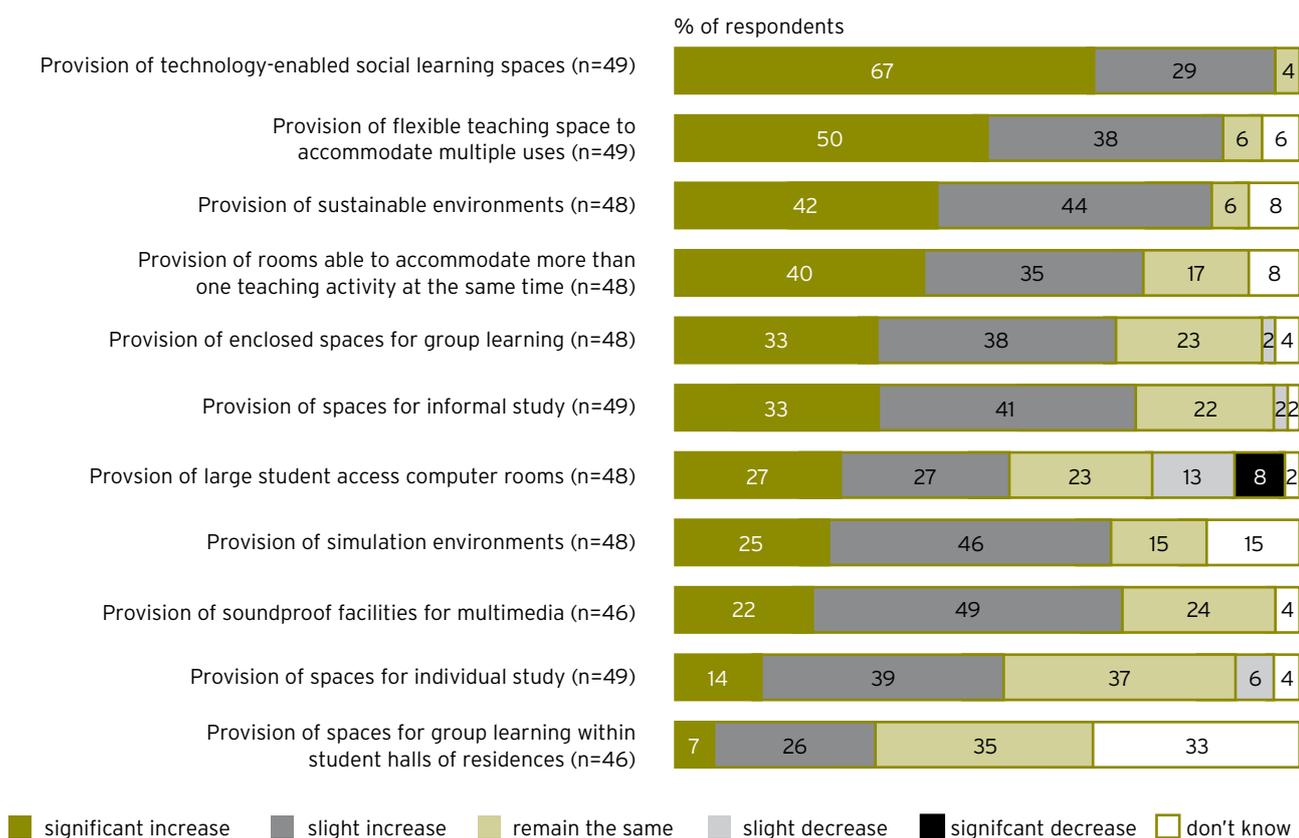


Note: Percentages may not total 100 percent due to rounding

Source: AMA learning and teaching trends survey, September 2005

- Almost all institutions anticipate growth in the use of wireless networking, with 85% anticipating that this will increase significantly. This is paralleled by a slightly smaller number of respondents who indicated that the provision of high speed broadband in student residences was on the increase.
- The use of student communication devices, including interactive technology in the classroom environment, and the provision of course related materials via text message were also perceived to be growth trends, although less significant.
- Results also suggest that, while the prevalence of student owned devices is increasing significantly, institutions are also thinking about making institution owned devices available to students, with 49% seeing this as a growing trend.
- Almost all respondents felt that the provision of technology-enabled social learning spaces would increase, with 67% believing the increase would be significant.
- The results strongly indicated that many institutions understood the importance of the flexibility of space, as they foresee increased provision of rooms that accommodate multiple uses and multiple, concurrent, teaching activities.
- The provision of specialist spaces, including simulation environments and soundproof facilities for multimedia spaces, was also perceived to be increasing, although less significantly.

Figure A7: Perceived changes in teaching and learning spaces



Note: Percentages may not total 100 percent due to rounding

Source: AMA learning and teaching trends survey, September 2005

- More traditional teaching and learning spaces, including enclosed spaces for group learning, large access computer rooms, and spaces for individual and informal study were perceived to be on the increase by some, although roughly a quarter of respondents anticipated that provision would remain the same.
- There was greater uncertainty regarding the provision of spaces for group learning within student halls of residence, with 33% of respondents suggesting an increase, but others anticipating that it would remain the same or that they simply did not know.
- 86% of respondents saw the provision of sustainable environments as a key trend.

How do perceptions differ between FE and HE institutions?

- Figure A8 provides a comparison of the number of respondents perceiving an increase for each trend included in the survey. The most salient points identified are outlined below.
- FE institutions saw a more diverse future in terms of the locations in which students might complete part of their education, with over 20% of respondents identifying an increase in the

number of students in outreach centres and the number of students completing part of their course at more than one institution.

- FE colleges also anticipated a more significant growth than HE institutions in the number of students completing vocational courses. They also perceived themselves as playing a far greater role in the development of citizenship skills amongst their students.
- The provision of institution-owned devices to students was perceived to be a growing trend by twice as many respondents from FE colleges as from HE institutions.
- With regard to changes in the types of teaching spaces provided, FE colleges perceived a greater increase in both the provision of rooms able to accommodate more than one teaching activity at the same time and the provision of large access computer rooms with fixed PCs.
- While increases in the amount of teaching during twilight hours (6pm-9pm) was seen as a growth area by both types of institution, the trend was perceived to be greater within the HE sector.

Figure A8: Trends by institution type (percentage of respondents perceiving an increase)

	Overall	HE	FE	Variation between HE and FE
Provision of large student access computer rooms (with fixed PCs)	54	37	83	46
Role of the institution in the development of citizenship skills amongst students (values skills and understanding necessary to act and behave as an active citizen in society)	64	48	89	41
Provision of high speed broadband in university-provided halls of residence	60	73	35	38
Provision of institution-owned devices to students (e.g. laptops, mobile handsets)	47	33	68	35
Percentage of students enrolled on vocational courses	41	30	57	27
Provision of rooms able to accommodate more than one teaching activity at the same time	75	66	89	23
Design of the place of residence	57	50	73	23
Percentage of students completing part of their course at one or more other institutions	58	50	71	21
Students at outreach centres	46	39	57	18
Provision of spaces for informal study	73	80	63	17
Provision of sustainable environments (e.g. reclaimed building materials, energy use, recycling)	85	79	95	16
Provision of spaces for individual study	53	47	63	16
Percentage of mature students	80	85	71	14
Teaching during twilight hours (6pm-9pm)	67	72	58	14
Use of small group tutorials	47	42	56	14
Provision of spaces for group learning within student halls of residences	33	38	24	14
Provision of enclosed spaces for group learning (e.g. seminar rooms, group work rooms in libraries)	71	76	63	13
Use of multimedia for teaching or assessment (video clips, flash animations)	92	88	100	12
Campus (environment generally)	76	71	83	12
Provision of soundproof facilities for multimedia (training, recording, playback)	71	67	79	12
Use of technology to deliver taught courses to physically remote students (either in real-time or recorded)	86	90	79	11
Provision of simulation environments (e.g. skills labs, HIVES)	71	67	78	11
Number of taught contact hours per student	4	0	11	11
Other social facilities	50	54	44	10
Connectivity in the place of residence	76	72	81	9
Provision of course-related materials via mobile phones/text messaging	79	76	84	8
Use of task and problem based teaching methods	74	71	79	8
Use of group assessment teaching methods	58	55	63	8
Use of lecture style teaching methods	6	3	11	8
Location factors	60	58	65	7
Use of apprenticeship teaching methods	38	35	42	7
Submission of coursework online	91	89	95	6
Percentage of international students	89	91	86	5
Provision of distance learning	82	84	79	5
Use of interactive technology in the classroom environment (e.g. audience response systems)	92	93	89	4
Prevalence of student owned devices (e.g. laptops, mobile handsets)	98	97	100	3

How do perceptions differ according to respondents' roles?

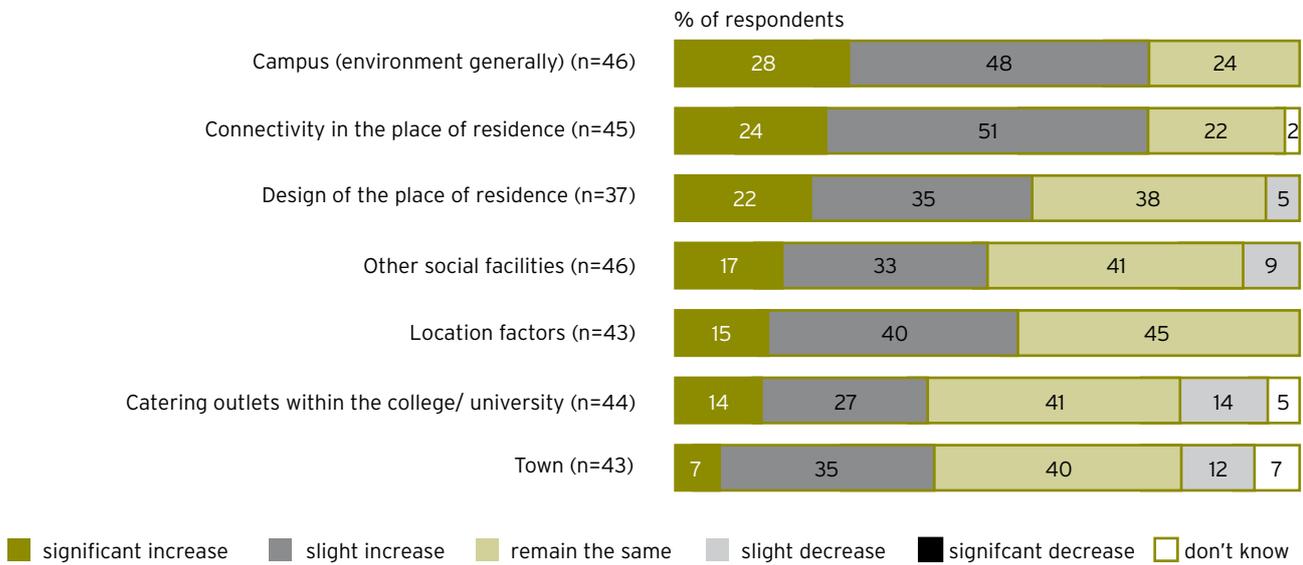
- Estates staff were more inclined to predict changes in the nature of physical spaces being provided. In particular, they saw greater increases in the use of twilight hours for teaching and the provision of more flexible teaching space.
- Conversely, IT professionals saw IT-related trends as being the greatest growth area.
- Senior managers were slightly more inclined to perceive changes in a range of factors, including greater variation in student intake, some aspects of IT, physical space, sustainability and citizenship values. They were also more likely to predict an increase in the use of apprenticeship teaching methods and small group tutorials although this may reflect the fact that more senior manager respondents came from the FE sector.

- While senior managers perceived a growth in the provision of large access computer rooms (with fixed PCs) and the provision of simulation environments, this view was not shared by respondents from IT departments.
- Overall, senior managers were more likely to respond that most aspects of the environment had a positive impact on the student experience.
- Respondents from estates management perceived a far greater impact of the design of the student halls of residence than other respondents.

What attributes of the physical environment have a positive impact on the student learning experience?

- The quality of the overall campus environment and the provision of internet connectivity within student halls of residence were considered to have the highest impact.
- The location of the institution, the provision of other social facilities and the design of the place of residence were also perceived as impacting on learning experiences by approximately half of the respondents.
- There were no significant differences in opinion between respondents from HE and FE institutions in relation to physical environment attributes.

Figure A9: Perceived importance of physical environment on student learning experience



Note: Percentages may not total 100 percent due to rounding

Source: AMA learning and teaching trends survey, September 2005

Exemplary projects

As part of the survey in trends in learning and teaching, respondents were asked to identify any recent projects they thought demonstrated an innovative approach to the provision of spaces for learning. Figure A7 below lists these projects together with details of the institution and the type of space they represent.

- Over 27 projects in more than thirteen institutions were described by respondents.
- Many of these involved the creation of social learning spaces for informal collaborative group work. Café-style facilities were integral components of several.

- Many institutions also reported the creation or refurbishment of Learning and Resource Centre (LRC) environments.
- Projects included the use of wireless networking and the refurbishment of lecture theatres with state-of-the-art IT.
- Most projects reported at least some form of student consultation in both the design and evaluation of the space.

Figure A10: Projects identified in survey of learning and teaching trends

Full name of institution:	Type of institution:	Name of project:	Space Category
Banff & Buchan College	College	Improve flexi learning centre	Individual learning space
Banff & Buchan College	College	Navigation Control Simulation	Simulated environment
Banff & Buchan College of FE	College	Ventilated Catering Kitchen	Simulated environment
Banff and Buchan College	College	Flexible Learning	Learning cluster
Bell College	HEI	Creation of training ward	Simulated environment
Glasgow Caledonian University	HEI	Enhanced multimedia presentation facilities in labs	Group teaching/ learning spaces
Glasgow Caledonian University	HEI	Learning Café	Learning cluster
Glasgow Caledonian University	HEI	Saltire Centre	Learning cluster
Glasgow Caledonian University	HEI	Real@Caledonian	Peer-to-peer and social learning
Glasgow Caledonian University	HEI	Learning Centre	various
Heriot-Watt University	HEI	Halls of Residence	Individual learning space
Heriot-Watt University	HEI	Residences Bar	Peer-to-peer and social learning
James Watt College of Further & Higher Education	College	Community Learning Centre	Learning cluster
John Wheatley College	College	East End Campus	various
Napier University	HEI		Group teaching/ learning spaces
Napier University	HEI	AV Provision in teaching rooms	Group teaching/ learning spaces
Napier University	HEI	Jack Kilby Computer Centre	Learning cluster
Napier University	HEI	Craiglochard Campus	Learning cluster
Perth College	College	Wireless Laptop Project	Peer-to-peer and social learning
Perth College UHI	HEI	Open Access IT Centre	Learning cluster
Perth College UHI	HEI	Campus Link	Peer-to-peer and social learning
Stow College	College	SuperFlex and Engineering Technology Centre	Learning cluster
Stow College	College	The Learning Hub	Peer-to-peer and social learning
The Glasgow School of Art	HEI	Lighting Workshops	Simulated environment
The University of Stirling	HEI	Upgrading and Expansion of Student IT/Language Facilities in Pathfoot Building	Group teaching/ learning spaces
The University of Stirling	HEI	Upgrade of Faculty of Management and Related Teaching Facilities in Cottrell Building	Learning cluster
University of Dundee	HEI	Tower Extension Lecture Theatre	Group teaching/ learning spaces
University of Dundee	HEI	New Teaching Block	Group teaching/ learning spaces
University of Glasgow	HEI	Gibson Street Church	Learning cluster
University of Paisley	HEI	Internet Café	Peer-to-peer and social learning
University of St Andrews	HEI	School III Lecture Theatre Redesign	Group teaching/ learning spaces
University of St Andrews	HEI	Bute PC Laboratory redevelopment	Group teaching/ learning spaces
University of Stirling	HEI	Lecture Room refurbishment	Group teaching/ learning spaces
University of Strathclyde	HEI	Wireless Lawn	External spaces
University of Strathclyde	HEI	James Weir Teaching Cluster	Group teaching/ learning spaces
University of Strathclyde	HEI	John Anderson teaching cluster	Group teaching/ learning spaces

APPENDIX 5: Summary of interviews with key organisations

Telephone interviews were conducted with the following individuals:

Brenda Smith	Higher Education Academy
Norman Sharp	Quality Assurance Agency Scotland
John McCann	Scottish Further Education Unit
Iain Lowson	HM Inspectorate of Education

The common themes that emerged from these interviews are described below.

- The 1990s saw a revolution in teaching methods, particularly within the FE sector. The main development has been a move towards a student-centred approach.
- This is reflected in evaluation and assessment methods in Scotland where the main focus is on how well the student is supported in the learning process.
- There is a huge amount of literature and published research on the process by which people learn which has supported this development. This is primarily focused on delivery and operational issues.
- There is little published research on the impact space may have on effective learning outcomes. Most evidence is either anecdotal or based on measures of student satisfaction with courses, and does not directly address issues relating to the impact of the environment.
- In spatial terms, the early forerunners of student-centred approaches were Learning & Resource Centres, which focused directly on student requirements.
- There is a clear growth in the provision of social learning spaces, particularly cafés, in both HE and FE. These spaces are successful because they are social, accessible, friendly and provide refreshments. They best support informal learning styles and small group work.
- The most effective new learning environments seen in the sector have involved joint planning from all involved parties at the outset of the project.
- In FE there has been a growth in the provision of rooms to accommodate multiple activities and large access IT rooms to support independent learning. However, there are some concerns that there is too great a focus on independent learning in FE.
- Space has a psychological impact - high quality fixtures and finishes can increase motivation to attend courses.
- For teaching spaces, the overriding requirement is flexibility of use. This will increase in importance, and is a key requirement of new build or refurbished spaces.
- There is a need for inclusive design, both in terms of physical accessibility and technological competence. While technology is heralding change in the sector, support must be provided to those who are least competent - among both students and staff. Technology will not remove the need for physical space for learning. It will be most successful in augmenting teaching methods (blended learning) and in maintaining quality connections with students who are remote from their institutions. There is a need for more structured research into the impact of space and technology on learning outcomes.

Case study 1

John Wheatley College, Easterhouse and East End



External perspective of the new building now under construction in the East End.

(image: courtesy of ABK Architects)

Established in 1989, John Wheatley College (JWC) is a FE college located in the socially deprived areas of Easterhouse and Glasgow's East End. Described as a 'college without walls', its primary mission is to make education accessible to people who have missed out on traditional routes. It puts greater emphasis on the teaching relationship than on the physical environment in which teaching takes place.

JWC specialises in non-advanced, mainly part-time education and pays particular attention to students with learning difficulties and disabilities. Its broad curriculum includes building and construction trades, business administration, childcare, computing and information technology, hairdressing, hospitality, photography and graphic art.

The main campus, on Westerhouse Road, in Easterhouse and currently JWC's only purpose-built building, is being enlarged to incorporate a community library, theatre and swimming pool. The design both of this and of its proposed new East End campus building in Haghill is driven by the effect the learning space has on student attitudes and behaviour.

The Westerhouse Road building

The Westerhouse Road building was completed in 2001 to the administration's specification within SFEFC funding guidelines. It is a 4,700m² concrete frame building constructed on a 6m module, with demountable stud partitioning or sliding/folding internal walls. It is easily navigable and non-institutional in feel, despite its traditional central lift lobby and corridor with 'classrooms' down either side. Keeping the fire doors in the corridor open on magnetic releases creates a bright, light circulation space with a clear view down its length.

The 40m² classrooms offer reasonable layout flexibility, at 7.3m deep and (around 40m²). Ceiling height is 2.7m, giving an easy domestic feel and providing good visibility. Most are equipped with an electronic white board and ceiling mounted projector. Dado trunking gives access to a fully networked ICT system.

Overall, the spaces are arranged in a way that meets the requirements of the type of teaching JWC offers. However, in some instances flexibility of room size is hindered because power and data services are fixed to walls between classrooms, and there are noise transference problems between rooms. Also, the college felt that the prescriptive

nature of SFEFC funding prevented it from making the most of the corridor space, a problem it has tried to overcome in the new East End campus building. Interestingly, the least used rooms are the one formal lecture theatre and the one seminar room too small for a group layout.

The East End Campus

This building, located next to The Forge shopping centre and currently under construction, is the result of a specific briefing process involving all staff. Compared with other JWC buildings it is a major step forward. It is larger and more 'special' than the low-key Westerhouse Road building and goes beyond what the College was able to achieve there, yet feels more established and institutional.

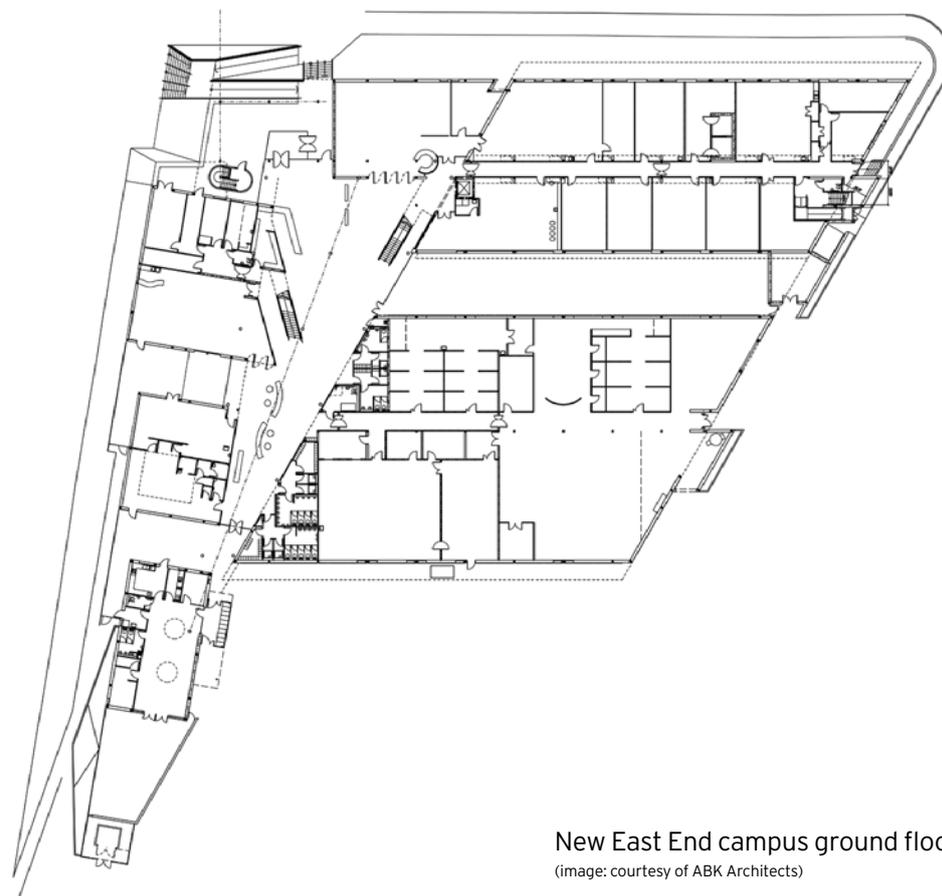
The main difference to the Westerhouse Road building is the way the circulation space has been configured to provide informal learning and interactive spaces.

While respecting the 50/50 teaching/non-teaching space ratio of the funding criteria, this building moves away from the straight-jacket of a narrow corridor feeding traditional classrooms. Instead it has a central concourse, which incorporates wireless learning 'hot spots' with informal learning facilities including over 40 workstations, in line with JWC's accessibility mission.

The classrooms differ from those at Westerhouse Road in that most of them are bigger (49.5m²). They are similarly equipped, with ceiling mounted projectors, interactive white boards, video streaming, and simple, stackable tables. Raised floors allow flexibility in the arrangement of computer facilities and an improved cable-management system allows for easier upgrades. Recognising the importance of furniture and fitting out, £700,000 of the £12 million budget is allocated to this.

New East End campus south elevation.

(image: courtesy of ABK Architects)



New East End campus ground floor.

(image: courtesy of ABK Architects)



John Wheatley College,
Westerhouse Road.

(photo: AMA)



Simulated environment: teaching kitchen.

(photo: AMA)



Simulated environment: kitchen.

(photo: AMA)

Conclusion

The East End campus building is an improvement on JWC's other buildings. It is likely to be better looking and its lively concourse will become its social heart. However, the classrooms differ little from those in other buildings or in Edinburgh's Telford College (see case study 3). While the cable management system will increase flexibility, higher specification (eg better soundproofing) may reduce it. Providing applied-skills learning spaces almost always compromises flexibility. The advantages of drawing students together and encouraging an overlap between disciplines needs to be weighed against the difficulties of accommodating building-specific teaching spaces within a loose-fit environment.

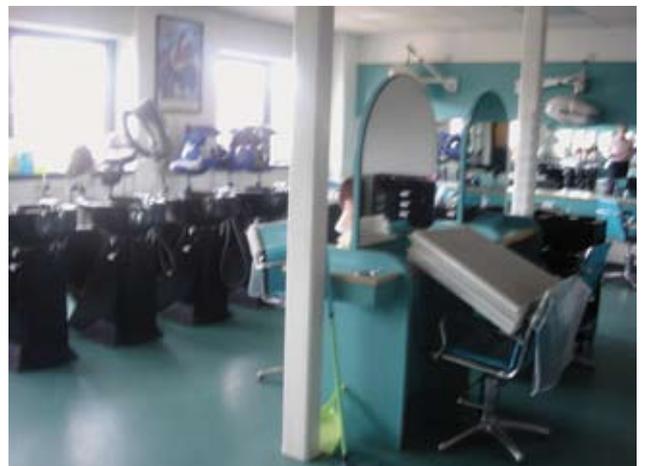
That the simple, robust teaching spaces are similar to those in the Westerhouse Road building, even after extensive discussions with staff, is an endorsement of their functionality. It is interesting to note that the flexible learning spaces do not differ much from the general teaching classrooms, again after extensive consultation.

JWC's head wanted to maintain and develop the college's excellent relationship between staff and students. As you would expect with its mission to attract young people from deprived backgrounds into education, JWC is good at this and places human relationships, rather than state-of-the-art equipment and stylish architecture, at the centre of what it does.



Simulated environment:
physiotherapy
and beauty
salon.

(photo: AMA)



Simulated environment: hair dressing salon.

(photo: AMA)

Case study 2

The University of Strathclyde, James Weir Building



Group teaching, James Weir Building.

(photo: AMA)

Founded in 1796 and constituted as a university in 1964, the University of Strathclyde has a mixture of building types, ages and quality. Although constrained by the character of its building stock, it has nonetheless encouraged innovations in technology that extend beyond the campus and offer a flexibility different to that being pioneered in other institutions.

The innovations at Strathclyde started with the Dearing Committee's review of higher education in 1995, which highlighted the need to refocus on teaching and learning and the fact that few HE lecturers were trained to teach. Professor Arbutnot, from Strathclyde, sat on the subcommittee looking at the use of technology in teaching and challenged the university's faculties to respond to this. The department of mechanical engineering, based in the James Weir building, successfully requested funding to trial the classroom-based feedback system then being pioneered by Harvard and the University of Massachusetts, Amherst. A further influence was the growth of customised, user-orientated teaching material, which the staff in the mechanical engineering faculty were quick to adopt.

Also, despite its international reputation and fierce competition for places, the department was concerned by the dropout rate of over 25% of students in the first two years. They attributed this to a failure to engage the interests of students, and in particular to the large lecture rooms where students at the back felt alienated from a 'chalk and talk' lecturer at the front with often indifferent teaching skills.

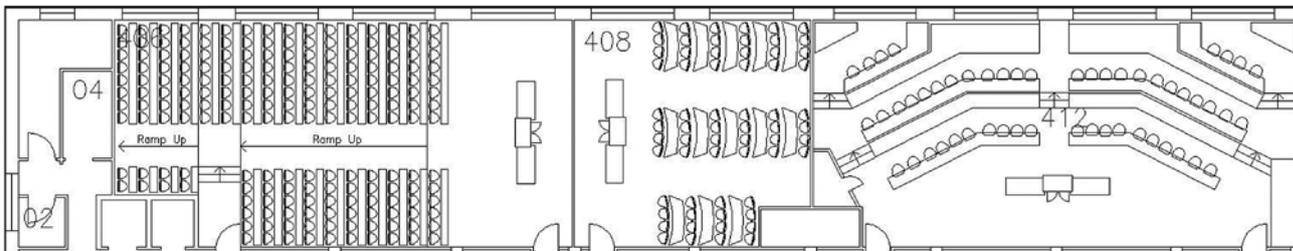
There was also a desire to introduce a wider variety of teaching methods, either in one place, or in a cluster of closely related spaces. This has been achieved by using technology to free up some traditional spaces for different uses plus, in response to the changing profile of courses, a suite of spaces made available to lecturers on an ad hoc basis. Spaces of this type now exist in the James Weir and Graham Hill buildings, in the Crawford Complex and on the Jordanhill Campus.

The James Weir building

Constructed in 1964 as a state-of-the-art mechanical and chemical engineering teaching facility, the James Weir building is a good illustration of how flexibility is dictated by the structural and dimensional characteristics of a building. It is built on a steep hill and has bespoke engineering laboratories in the basement and ground floors. The requirement for both specific and generic teaching spaces resulted in a concrete frame building 21 metres wide, with a 3 metre wide circulation corridor giving access to 8.8 metre deep teaching spaces on either side and a slightly different configuration on the upper floors.

Some conventional auditorium style-seating has been replaced. One auditorium now has swivel chairs, allowing students to turn round and access computer workstations on a work surface behind them; in another, seats are divided into four person banana-shaped tables for group working. In the remaining conventional lecture theatres, larger writing tables have been installed to allow for laptops as well as A4 writing pads. Similar principles have been applied to other rooms, such as the Business Department and the seminar rooms in the Crawford Complex, where loose furniture can be configured in groups of four to six to allow team working in an informal atmosphere.

At the start of their course, students are assessed on their subject, computing ability, personality, where they are living or where they are from, and placed in 'cohorts' for the year. Students in each cohort then get to know and help one another, and work together. The 'banana' seating configuration was developed to accommodate these cohorts of four persons. It encourages students to learn from and interact with each other, enables them to switch easily between group work and formal teaching, and uses technology to facilitate the presentation of information. The formula, which has been in place for four years, is considered to be hugely successful, with 90% continuing attendance, compared with 50% for the old-style classes.



Floor plan of the refurbished spaces, James Weir Building.

(image: courtesy of University of Strathclyde)

Its success prompted the university to develop similar suites of space, using technology and innovative seating arrangements, when it refurbished the third and fourth floors of the building.

Professor Jim Boyle, Head of the Mechanical Engineering Department, says that in an ideal world his department would have a third of its space for studio work, a third for core engineering teaching and a third for problem-based learning. At Strathclyde, it was not possible to accommodate this in one large, flexible, multi-functional studio space and the changes made to the James Weir Building have achieved a good compromise. The flexible spaces are generally fully booked, even though they would function better if they were closer together.

Lighting the central circulation areas (3 and 4.5 metres wide) has been improved, the walls repainted and the space made more useable by removing lockers and installing seating for occasional working in some of the recesses. This has improved students' attitudes to the building by providing a useful facility. Unfortunately, the seating is of poor quality and is showing signs of wear.

Conclusions

While the changes are a success, they have been restricted by budget and by the building itself. Most rooms still operate as conventional lecture theatres (although improved by the installation of interactive technology including personal response voting systems).

However, Strathclyde has thought through what it can achieve and implemented it effectively. It has taken the sophisticated use of technology a stage further than most other institutions, both in terms of how teaching spaces can best be used, and in the way that course material can be drawn from a range of sources, compiled to a high standard, tailored for individuals and distributed electronically. The reduced dropout rates illustrate clearly the benefits of engaging with students and the importance of having a variety of teaching spaces to support the different modes of teaching and learning.



Banana shaped desks assigned to four person student cohorts to facilitate interaction.

(photo: AMA)



Group learning, James Weir Building.

(photo: AMA)



Double projection screen, James Weir Building.

(photo: AMA)

Case study 3

Edinburgh's Telford College, West Granton Road



Model of the new Edinburgh's Telford Campus, West Granton Road.

(image: courtesy of HOK)

With 20,000 students, Edinburgh's Edinburgh's Telford College is one of the largest FE colleges in Scotland. Established in the 1960s, it currently extends across three campuses in the socially deprived areas of Pilton and Muirhouse and a fourth site at the Gyle. However, a new campus at West Granton due for completion in 2006 will replace these.

West Granton Road Campus

Like many FE establishments, Edinburgh's Telford College needs to break down barriers against education among people for whom formal education has failed. While Edinburgh's Telford College seeks to prepare some students for higher education, the focus is firmly on vocational training and gaining employment within local industry.

The college recognises the importance of making full use of flexible learning and ICT, particularly with regard to making learning as accessible as possible. It goes further, helping students learn communally by gearing teaching spaces for interaction and discussion, and blurring the boundaries between formal teaching circulation and social spaces. This

plays to the psychology of a generation that sees technology-driven interaction as fun, thereby making learning more fashionable and attractive.

The West Granton Road campus implements the above strategy within the constraints of the site and this has resulted in a tightly packed, four-floor building. The building is U-shaped, with two long arms extending around an open courtyard. There is the dramatic social space, the hub - a significant shift away from the low status canteen on the old campus. On the two upper floors of the building are open plan staff areas where the majority of staff will be hot desking, something new in education buildings.

The Learning Resource Centre, a flexible, open plan space, is a significant improvement on the equivalent space in the old campus. It combines a traditional book and computer-oriented library with enclosed and semi-enclosed work and project areas. It is likely to be more structured and quieter than either the Glasgow Caledonian University Saltire Centre (see case study 4) or the central concourse of the Westerhouse Road Campus at John Wheatley College (see case study 1). The space is 18 x 70m and similar



View of social and dining space.

(image: Steve Atkinson)



Internal view of the main reception,

(image: Steve Atkinson)



External perspective of the new campus.

(image: courtesy of HOK)

in character and strategic approach to a large, open plan office. It makes efficient use of space and introduces an atmosphere of innovation that spills out into the college as a whole.

From here, extending down either 'arm' are two 'learning streets', which service the first floor classrooms that make a transition from independent learning to teaching. The streets, generous central circulation spaces, incorporate alcoves for 'purposeful socialisation' equipped with computer workstations, like the rest of the campus, and wireless data access. The learning streets are key to the college's flexible learning plan and will ensure that learning is not restricted to formal classrooms - they will help create an atmosphere of pervasive learning.

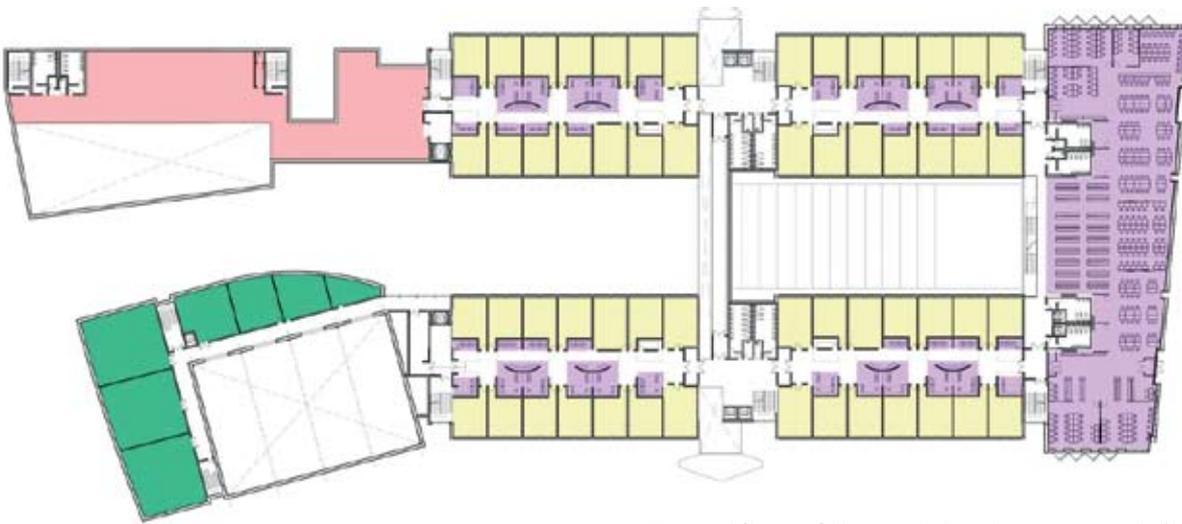
The streets and teaching classrooms are equipped with raised floors to accommodate future technology. Vertical ducts and the arrangement of permanent and moveable walls will determine the configuration of future modifications. Throughout the college and wherever Internet access is available, students can 'enter' the Virtual Learning Environment, through which they can communicate with their tutors and fellow students as well as access learning materials.

Flexibility has been incorporated into the general teaching spaces in a variety of ways:

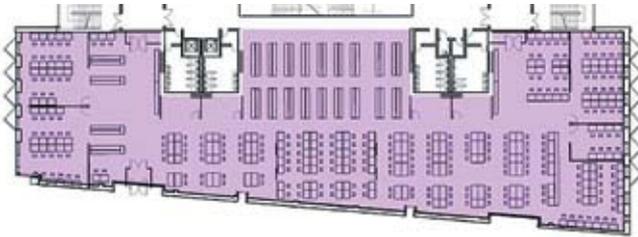
- raised floors provide cabling to all areas
- stud walls between classrooms enable easy removal or modification
- sliding/folding doors are provided between some classrooms for flexibility in classroom size
- mains services within walls is restricted to corridors, (although in a few instances electronic whiteboards and other equipment has been located on crosswalls, limiting their flexibility)
- wet services are provided where possible for flexible uses
- cable management is kept separate from loose furniture (except in specific computer training areas) so it can be rearranged quickly
- room sizes vary from 30m² to 72m².
- Computer laboratories are paired, with glazed walls, and may be either used as two separate labs, or as one large teaching space.

A distinction in possible flexibility is drawn between spaces for practical trades and general teaching spaces. Simulated environments, such as the hairdressing salons, have specific design requirements for drainage, special ventilation or additional floor loading capacity. These determine how they can be used.

The classrooms are divided by walls with high specification for sound-proofing. The design is also influenced by the sustainability agenda and use of natural ventilation, which has resulted in openings onto the learning streets and atrium that affect the arrangement of the street levels and the wall space available in the classrooms. Most rooms have been made as open plan as possible in order to enable easy change and reconfiguration as industry or educational needs change.



Ground floor of the West Granton campus building.
(image: courtesy of HOK)



Ground floor plan of Learning Resource Centre.
(image: courtesy of HOK)



View of typical learning street at first floor level.
(image: courtesy of HOK)

Conclusion

The campus represents a significant step forward in the provision of innovative teaching and learning, especially with its facilitation of independent learning. New AV equipment has been introduced into most classrooms as well as wifi throughout the college. The layout is efficient and likely to generate an exciting and energetic atmosphere. Interestingly, the formal teaching spaces, while incorporating certain electronic features, do not differ substantially from the classroom spaces of the old campus. Rather, emphasis is on the easy availability of electronic data via comprehensive cabling and data infrastructure. This makes good sense as IT equipment will undoubtedly change while the cabling / data infrastructure will change less frequently, and is more important in yielding teaching opportunities over time.

The biggest change has been the move to 'independent learning', where general access to learning is key. This psychological shift away from learning only in classrooms to an environment where learning is possible anywhere, at anytime, is enhanced by the design of the campus.

Case study 4

Glasgow Caledonian University, Saltire Centre



View of the front entrance to the Saltire Centre.
(image: Richard Barrett, courtesy of Glasgow Caledonian University)

Glasgow Caledonian University was granted university status in 1993 and quickly established itself as a fully-fledged institute of higher education. It describes itself as a '21st century university' and is determined to put learning and teaching on the same level as research. It takes pride in the fact that over 27% of its students come from deprived communities and that it bridges the gap between higher education and the practical world of business and industry.

Glasgow Caledonian has embarked on an ambitious rebuilding programme, pulling together disparate buildings into a campus that is very much part of the city. Recent projects such as the Mbeki Building, the ARC and the highly significant Saltire Centre all help generate a sense of place without being exclusive. The programme is as much about technology and facilitating a new kind of teaching as it is about physical space and facilities. The internationally-acclaimed Saltire Centre is a prime example of how this can be achieved.

The Saltire Centre

Les Watson, a Pro Vice-Chancellor of Glasgow Caledonian University and the project champion, describes the university's primary challenge as that of reaching out to include those who have not previously considered entering higher education. It must engage with its students, make them want to be there and make them excited, not intimidated, by the prospect of learning. It has to make education fashionable and fun. Les Watson points out that in business and industry people learn from each other and, for students especially, this is the most powerful way of learning, complemented by formal instruction and reflective understanding.

The Saltire Centre recognises the importance of flexible learning, supported self-learning and similar learning concepts that are made possible by the electronic delivery of information. It goes further, by making itself the starting point of the learning process and by encouraging 'deliberate socialising'. This includes accepting noise, combining learning environments with food and drink with the associated risk of damage to equipment and property. This approach places confidence in the students, trusting them to identify what constitutes acceptable behaviour. The University has proved that this approach can work, albeit on a smaller scale, at its popular Learning Café.

The Learning Café, launched in 2001 and located on the ground floor of the main library, was built to encourage social learning. It has a mixture of comfortable furniture, serves good coffee and food and welcomes mobile telephone use and general chat. Its success with students and staff resulted in the approach being expanded to the larger, 1,800 seat Saltire Centre.

The Saltire Centre, comprising 10,500m² over five floors, is multi-functional, flexible and open plan and delivers the full range of library services. It does this by focusing on people and the process of learning, rather than on storage and resource management. On each floor there are books, on open shelves and compact shelving, and facilities for studying, browsing and borrowing, as well as for relaxing and socialising.

The ground floor consists of a 2,500m² 'services mall', which provides a one-stop access point for all services for students. A main service desk, auxiliary desks, service kiosks, meeting pods, semi-private inflatable meeting corners, six private consulting rooms and access to the consulting suite are all set within a lively mixture of study space, a café and access to 40% of the centre's book stock on compact shelving.

The Saltire Centre could be seen as an unstructured 'educational soup' and, at nine times the size of the Learning Café, might not be so easy to operate. Yet on close examination it is clear that it has been well thought through and is based on sound research into the workings of open plan, flexible space. As can be seen from the plan and section, the centre offers a wide range of spaces to suit different people, learning methods and styles - from open and interactive to closed, structured study spaces. The large, open ground floor contrasts with the smaller scale top floor, and there is a gradual shift from noisy front ground floor to quiet back top floor. The interior design, furniture, fixtures and fittings have been carefully selected to complement the range of spaces within the Centre.

Conclusion

The Saltire Centre turns circulation and informal teaching spaces into a major resource. It highlights the essential role this type of space plays in modern teaching and encourages the combination of socialising and learning in a much more radical manner than in many other educational establishments.



Internal view of the Saltire Centre atrium.
(photo: Richard Barrett, courtesy of Glasgow Caledonian University)



View of ground floor of the Saltire Centre.
(photo: Richard Barrett, courtesy of Glasgow Caledonian University)



Students in the Learning Café
(photo: courtesy of Glasgow Caledonian University)



Students in the Learning Café, the predecessor of the Saltire Centre
(photo: courtesy of Glasgow Caledonian University)

APPENDIX 7

Abbreviations and Glossary

Many organisations and concepts have been referred to during this project. As an aid to the reader, the following guide is offered.

CABE	Commission for Architecture and the Built Environment
FE	Further Education
FEC	Further Education College
FTE	Full-time equivalent
GCU	Glasgow Caledonian University
HE	Higher Education
HEA	Higher Education Academy
HEDQF	Higher Education Design Quality Forum
HEFCE	Higher Education Funding Council of England
HMIE	HM Inspectorate of Education
HEI	Higher Education Institution
JANET	Joint Academic NETwork
JISC	Joint Information Sub Committee
LSC	Learning and Skills Council
PRS	Personal Response System (electronic voting)
QAA	Quality Assurance Agency
SCRE	The Scottish Council for Research in Education
SFC	Scottish Funding Council
SFHEFC	Scottish Further and Higher Education Funding Council
SFEU	Scottish Further Education Unit

Asynchronous learning - learning which does not take place in real time (eg learning via email, video messaging, online coursework)

Active learning - learning where the student is engaged in thinking critically about their existing knowledge and directing future study

Blended learning - e-learning combined with traditional learning

Computer commons - social space equipped with computers

Collaboratory - a place designed to support collaborative learning (see below)

Collaborative learning - learning that involves interaction between students/peers

Cyber café - see internet café

E-learning - networked access to digital learning materials and communication systems to deliver and support learning

Immersive environment - space with several large screens for projecting information so that occupants are immersed in the data; 3-dimensional simulations sometimes included

Information commons - library space for teachers and learners to explore information and resources

Internet café - space providing computer access to the internet plus refreshments

Learning-centred environment - an environment that pays careful attention to the skills, attitudes and beliefs that learners bring to the educational setting

M-learning - mobile learning via wireless access to mobile devices (laptops, handhelds or phones) to deliver learning materials and support services

Open learning centre - physical place facilitated with experts, online and paper based materials, where students can study at their own pace. Such spaces are often provided within libraries and can include presentation rooms

Peer-to-peer learning - learning which takes place between one or more students. (See also 'collaborative learning')

Pedagogy - study of the methods and application of educational theory

Self-directed learning - learner assumes primary responsibility for planning, implementing and evaluating the learning process. (See also 'active learning')

Skills laboratory - space where hands-on practical teaching and learning takes place

Student-centred learning - teaching methods that pay careful attention to skills, attitudes and beliefs that learners bring to the educational setting

Synchronous learning - learning that takes place in real time (eg classroom situations, video-conferencing, synchronised chat rooms)

Teaching cluster - a group of learning spaces offering a variety of learning modes

Transparent technology - supportive technology which is easy and intuitive to use

Virtual learning environment - virtual forum which integrates online learning with delivery methods and students tracking

Virtual Classroom - online discussion forum supported by digital materials

Wi-fi - commonly used to signify the 802.11b standard. A form of wireless networking which allows the connection of two or more computers without the need for physical cabling

APPENDIX 8

Conference October 2005

- Summary

To disseminate the findings of this report to Scottish Higher and Further Education institutions, the SFC arranged the Spaces for Learning conference, which took place on 31 October 2005 at Glasgow Caledonian University. Representatives from Estates, IT and technology, Senior Administration, Libraries and Learning Specialists attended from seventeen Higher Education and 32 Further Education Colleges to discuss and comment on the draft report. The day was well attended by 130 delegates, and the report was well received.

Following an introduction by Ian Murning (SFC) the Spaces for Learning report was presented by (AMA Alexi Marmot Associates). The presentation focused on case study examples of the portfolio of space types that are emerging to meet the needs of the new pedagogy, to exploit the opportunities brought by technology and the changing demographics of the learning population. Essential design qualities of these spaces were discussed and twelve keys steps to providing successful spaces for learning identified.

This was followed by a presentation by Fiona Parsons on the E-spaces study conducted for JISC by the University of Birmingham. The presentation gave an overview of the research methodology and guidelines for the effective introduction of learning technologies into learning environments. Case study examples were included.

Six workshops were offered (each repeated twice) to generate further discussion. Workshops explored the portfolio of space types identified in the Spaces for Learning report: Group teaching/ learning space; Simulation and immersive environments; Social / peer-to-peer spaces; Learning clusters; and Private study & external spaces. In addition, a workshop on Learning Technologies was offered by the University of Birmingham team and a hard-hat tour of the Saltire Centre, which was under construction at the time, was given by Les Watson.

A wide ranging set of thoughtful comments were recorded from the workshop participants. These are summarised below:

On creating good learning environments:

- The basics of good light, temperature and air quality, suitable locations, are always prerequisites for successful spaces.
- Differences between universities and colleges must always be taken into account. Colleges may need more support for change.
- Examples and site visits provide invaluable opportunities for learning.
- The importance of a strong project sponsor willing to keep the project high profile amongst staff and students, cannot be underestimated,
- Obtaining student views and needs helps to create the right type of place and atmosphere
- It is important that appropriate guidance and materials are available to support learning and teaching in new environments. Highly committed students and lecturers are essential to take new types of space and teaching methods forward.
- Feedback and Post-Occupancy Evaluation is essential, along with dissemination of lessons learned to the sector. Understanding of the impact of space on learning effectiveness is needed as this could help secure funding for new developments that is otherwise hard to get.

On funding mechanisms:

- It seems that the current driver in the sector is to reduce the floor area of the estates to be more efficient. If space utilisation is not to be a determinant of funding, what is?
- New approaches to space utilisations measures will need to be considered for different use patterns and a wider range of space types - it is still an important concept.
- The varying levels of available funding and timescales for projects impact on the ability of institutions to consult widely and really think about estates strategies.

On Group Teaching / Learning Spaces:

- Traditional lecture theatres will still be used in the future. Students and staff still value face to face methods, increasingly supported by IT.
- New teaching methods seem to require more space which may be in tension with messages about space efficiency. There is clearly scope to consider the use of better designed furniture although this is not always affordable.
- Centralised timetabling can aid efficiency, but there is a need to achieve a balance between efficient use of resources and appropriate learning environments for each subject.
- College students often work in very small groups with a high degree of technology and this requires more space(s) to divide up classes into many groups.

On Learning Clusters:

- Furniture rearrangements or varied room size requirements over the day may reduce real flexibility - clusters of rooms can be managed as a group to help mitigate this, ideally with a local cluster manager.
- Space clusters are usually found to be better utilised than other spaces.
- Concerns from colleges that there are additional costs involved in the management of flexible space. If this is not underpinned by funding for ongoing support then it is less likely that they will be implemented.

On Social / Peer-to-peer spaces:

- We need to stop talking about social space and embrace the term 'learning space' because even circulation space is becoming learning space.
- Social spaces are best located in open areas with a large throughput of people to encourage usage by a broad population.
- Questions arose as to how you justify social and peer-to-peer spaces in an outline business case? More evidence on demand and effectiveness need to be gathered.

- Some colleges reported being unable to use corridor spaces due to fire regulations. How do you balance non-combustible, fixed furniture with comfort and affordability?
- The extent to which social areas are provided with fixed IT needs to be thought about in relation to the view that students need some 'down time' areas without PCs, such as cafes.

On technology:

- Innovative teaching methods often require significant IT support. This is much more manageable if there is a policy of standardised specification and equipment.
- The skill set required to deliver teaching in a digital age must be considered. Knowledge gaps should be addressed by more training for teaching staff.
- In the future more students will own their own technology kit but issues of social inclusion will remain. Currently, desktop PC's provided on site are the machine of choice for most students.

On Private / External Spaces:

- Currently the SFEFC funding/bursary model requires a record of physical attendance that is perceived to discourage the creative use of off-campus learning.
- Learning should be drawn from the FE sector, which has extensive experience of non-campus learning (e.g. community premises, workplaces). Issues to consider include access to PCs, linking to college IT networks, and health and safety responsibilities.

APPENDIX 9 - References

The following references are offered for readers interested in further pursuing the subject matter of this report.

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