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Scottish Funding Council

Matching post-16 estate investment to educational outcomes

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Executive summary

The Scottish Funding Council (SFC) is seeking to encourage colleges and universities to give due consideration to educational outcomes when planning their estate-related investment. This initiative comes at a time when a balanced regional infrastructure for the post-16 estate across Scotland is being developed.

This report summarises key findings within the body of research linking buildings and estates to educational outcomes, drawn from studies covering schools, colleges and universities.

Research on the effect of investment in educational facilities identifies several different clusters of important outcomes, including: learning outcomes; the user experience; physical environment factors concerned with indoor air quality; energy and carbon emissions. It reveals the importance of intangible benefits represented by educational estates as beacons for the community, and also the negative message that can be conveyed by poorly designed or poorly maintained facilities.

Good buildings and estates are shown in some studies to be correlated with student and staff motivation. Recruitment issues, such as the attraction and retention of students and staff, appear to be an important factor in ensuring positive learning outcomes.

The report recommends a set of key questions related to desired outcomes that Colleges and Universities should ask when developing their estate investment and maintenance plans.

The report concludes by providing some illustrative case studies and an extensive set of references.

1. Introduction

The Scottish Funding Council (SFC) is seeking to encourage colleges and universities to give due consideration to educational outcomes when planning their estate-related investment. This initiative comes at a time when a balanced regional infrastructure for the post-16 estate across Scotland is being developed.

The SFC needs to prioritise expenditure between learning institutions to ensure that essential investment continues to be made available. As well as looking at building condition, energy consumption and value for money as key indicators for investment in buildings and infrastructure, the SFC wishes to focus on opportunities to enhance educational outcomes. Due to the recent high level of investment in new educational buildings, the post-16 stock is generally considered to be in good condition and the new capital programme has been significantly reduced recently. The information in this report is therefore targeted on refurbishment and maintenance expenditure, as much as new capital works.

AMA has been invited to summarise research linking expenditure on the built environment with achievement of organisational goals. Educational outcomes in further education are the primary focus as expressed for example in Scottish Government's recent paper *Putting Learners at the Centre: Delivering our Ambitions for Post-16 Education*. The objective of this report is to identify processes that can be used to help each project achieve the best possible educational outcomes relevant to the context.

This report summarises some key findings within the body of research linking buildings and estates to educational outcomes, at schools, colleges and universities. It touches briefly on related findings from other building and organisational types: health and office buildings. The research challenges in identifying a direct causal connection between buildings and outcomes are acknowledged. Several case studies are summarised that illustrate how estate investment was thought to have helped in the attainment of different educational goals. The report concludes by recommending a set of key questions that Colleges and Universities should ask when developing their estate investment and maintenance plans. Appendices contain useful reference material.

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2. Research on building impact - overview

2. 1 Overview

A considerable body of research attempts to link organisational outcomes to the physical environment, and thereby provide guidance on future decisions on investment, design and management of buildings and estates. **The key question in the educational field is: how can the built environment help educational attainment?** In the medical field, this is paralleled by asking: how can the design of medical surgeries, hospitals, and care homes assist in delivering better, or faster, health outcomes? For office buildings, the research enquires: how can the design of office space improve productivity, service delivery and profitability?

While the questions are simple, the answers are often elusive. This is because the built environment is complex, and always operates in a social and cultural milieu, making simple causal relationships unlikely. The type of research that can be conducted is not straightforward. Laboratory experiments conducted under controlled conditions where one element of the building is altered, are not possible. Instead most research is done in the field, for example by comparing outcomes before and after a building change, hoping that other things have not altered at the same time. Research is therefore often based on small data sets and case studies, rarely on long term longitudinal studies. Outcome metrics are often not standardised, or may not be consistently measured. Case study based research have several characteristics:

*   They often reveal common sense conclusions (e.g. the importance of cleanliness, comfort) and anecdotal observations.
*   They may focus more on the 'what' rather than the 'how.' (Bosch, 2003)
*   Correlations in a particular case or cases do not necessarily demonstrate 'causation' which usually cannot be proven.

Common topics within the research literature are summarised in this section, together with a short summary of key findings on outcomes for health buildings and for offices. Section 3 then summarises some seminal work on the outcome of educational buildings.

2.2 Indoor environment and comfort

A vast amount of research has been conducted across all building types on aspects of the indoor environment including air quality, temperature, heating, lighting and acoustics. Findings from such studies are used to prepare standards and legislation on appropriate conditions, such as the rate of fresh air intake, allowable levels of airborne pollutants such as carbon monoxide, carbon dioxide, airborne bacteria and volatile organic compounds. When provision of basic conditions are not met, occupants

tend to feel uncomfortable, cannot concentrate, work or study productively, and may get ill, increasing sickness absence. Numerous studies showing these outcomes have been conducted for office buildings, hospitals, housing and educational environments. More will be said on this in Section 3.

2.3 Energy and carbon

Related to indoor environmental comfort is the question of energy use in buildings, its cost and associated carbon emissions. Goals of efficiency and economy in resource use, and of environmental sustainability, are the reasons for a growing body of research on this topic. Two forms of energy are covered in the literature: embodied energy, that is, the energy that is required to construct a building including energy used in the building materials and their transport to site; and operational energy used to run the facilities. Metrics on this topic are improving with better and more frequent energy metering data, clarification of the different sources of demand for energy, and better translation of those data into carbon dioxide equivalents.

2.4 Mediated outcomes

One of the challenges in research on outcomes is to understand causation, that is, pathways by which attributes of the physical environment affect organisational goals. The role of perception is very important. For example, if students perform better in new buildings, it may be because they perceive that they are valued, and therefore have greater self-confidence which manifests itself through better coursework and examination results. The Hawthorne experiments of the early 19th century gave crucial insights into this process, demonstrating that it was not the actual type of lighting in factories that mattered, but the process of management demonstrating concern for the workforce by bothering to change conditions. Outcomes improved both with the introduction of new lighting, and the re-introduction of former lighting. Social organisation is therefore important, and is often altered at the same time that significant additional investments are made in the physical estate, thus complicating the task of finding 'causes' of improved outcomes.

Management aspects are all-important. People delivering a service, such as teachers and hospital staff, are likely to be more critical to achieving desirable outcomes than any part of the complex equation of physical or environmental factors. Any link between the quality of the environment and the potential for attracting, supporting and retaining high quality staff is therefore an important consideration. It is therefore crucial to understand the impact of a building on service deliverers, in unravelling the multi-factoral interrelationships between the physical environment and outcomes on education, health, productivity or other desired goals.

2.5 Process of change

In deciding to improve estates, there is some evidence that a consultative approach to understanding user needs and future aspirations helps to bring success. Involving users provides several benefits: it reduces the likelihood of investing in aspects that are irrelevant to users, earns commitment to and co-ownership of the investments, and reduces the chance that users do not understand the changes or know how they should then work in the improved facilities. Tools such as the Design Quality Indicator (DQI) (CIC, 2012) have been devised to aid stakeholder involvement at key stages: *foresight* before planning changes; *insight* while changes are being made; and *hindsight*, learning from experience at the end.

Building programmes commonly can take several years to complete, leaving time for a gentle process of organisational change before move-in. In reality, changes are often delayed until the move-in date. Outcomes may take years to establish, however there are few longitudinal studies that track project outcomes years after completion.

Processes such as *Soft Landings* (BSRIA, 2012) have been devised to ensure a gentle transition at the end of a construction process, by reviewing outcomes up to three years after a project is complete, and checking that people using and operating a building know how the designers and engineers intended it to work.

2.6 Health buildings

In health facility research, connections are sought between spatial characteristics and efficiency of the activities carried out. Outcomes investigated include faster discharge and recovery, fewer problems or hospital introduced infections such as MRSA and C-difficil, and fewer falls from beds or use of less analgesics. An extensive review of many studies on the relationship between the designed environment and health care identified, amongst other findings, that patients had fewer falls if they were accommodated in single-bed hospital rooms. The reason appeared to be that family and friends were then able to visit more often and stay longer, hence were often available to help infirm patients getting out of bed, thus preventing falls. (Ulrich et al., 2008) Such findings reveal the complexity of social relationships and physical space. Research on educational environments and their outcomes yield similarly complex inter-relationships.

2.7 Office buildings

Overwhelmingly, the body of research on office buildings covers the basic hygiene questions of indoor air quality, linked to employee comfort, satisfaction and perceived productivity (CABE 2005a). Many studies have investigated whether a complex of minor symptoms referred to as 'sick building syndrome' - including coughs, colds, sore throat, dry and

itchy eyes, headaches and dry skin or rashes - appear to be associated with certain forms of air treatment within buildings. The results have been mixed, presenting an unclear picture that does little to help identify good design.

Another set of research has focussed on office space layout, particularly the outcomes of open versus enclosed layouts, which has parallels in educational space in schools. Solid findings emerge that open plan favours communication and collaboration while enclosed offices benefit concentration and confidentiality. For many people, a balance of both types of conditions and spatial types is needed for them to work effectively. As demands for collaboration, networking and creativity have increased, so more recent research on the office environment has revealed spatial correlations that appear to encourage communication.

A focus on energy efficiency and carbon reduction has led to more recent research on building operations and behavioural change by occupants, to achieve sustainability targets.

3. How estate investment supports educational outcomes

3.1 Literature review

We selected over 40 studies to review, from which we selected outcomes and processes of interest to SFC in guiding estate investment. More of the studies examine schools and higher education facilities rather than the post-16 sector specifically, but still hold important findings for post-16 facilities. The studies mostly explore the link between outcomes and design in the UK, US and Australia, as well as some from France, South Korea and the developing world. We have extracted direct or indirect relationships identified between the design of buildings, the effectiveness of the activity accommodated, and its impact on user performance and experience. These impacts have been converted into several questions for learning institutions to consider when determining investment in estate renewal, refurbishment, and maintenance, shown in Section 4.

Research into what makes a school 'outstanding' educationally rarely considers the quality of the facilities. Nevertheless, buildings are often mentioned as having a supporting or even a 'symbolic' role. (Price et al., 2009). Research into the built environment is often conducted and/or commissioned by the design community[1] with an interest in establishing correlations with building design. This potential bias should be borne in mind when considering the results cited. Much educationally-led research carried out in the last ten years in the UK responds to government investment in educational infrastructure through renewal programmes such as Building Schools for the Future. Some important work in this area has been carried out by international management consultancy organisations, such as KPMG or PricewaterhouseCoopers.

Educational organisations such as CfBT (UK), OECD (based in France but covering many countries) and National Foundation for Education Research (UK) also carry out research, as well as universities whose research is often funded by companies, public bodies or organisations[2]. Some studies appear to be associated with promoting or refuting government policy, or use the research to lobby for funding or investment into building renewal. Others appear to be 'sponsored' as the means of proving a point – for instance, research commissioned by

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[1] These include organisation such as CABE (Commission for Architecture and the Built Environment) (UK), The National Clearinghouse for Educational Facilities (US).

[2] University research groups include University of Newcastle Research Centre for Learning and Teaching, Sheffield Hallam University, University of Georgia (College of Education - School Design and Planning Laboratory).

product manufacturers (e.g. furniture, carpets) helps to sell a product or promote their work.

3.2 Learning outcome metrics

Various metrics are used to indicate a positive (or negative) impact on learning outcomes. Some studies conclude that learning outcomes are correlated with buildings and design in particular cases, but there are few clear causal connections. Correlations with attitudes such as satisfaction, and behaviour, are explored more frequently than attainment and improved test scores. Typical learning outcomes reviewed cover:

- Attendance/ absence
- Test scores (attainment)
- Knowledge retention over time
- Academic level of courses provided
- Student withdrawal/ completion
- Staff recruitment and retention
- Class size
- Student and staff motivation
- Behaviour
- Concentration
- Contact time in classroom
- Continuity of learning time
- Effectiveness
- Employability and earnings

3.3 User experience

A second perspective looks at the psychological impact of the building's design, which is thought to have a significant impact on the user experience – for students, staff and visitors. The research sometimes refers to these aspects as 'intangibles,' meaning that they are difficult to measure, but they could contribute to positive educational outcomes. For instance, the building layout may provide a wide range of spaces allowing pedagogical development.

- Perceived quality of the specialist facilities
- Access to and the quality of inside and outside social spaces
- Use of technology in teaching and learning
- Clarity of circulation and way-finding
- The design of the toilets and lockers (for example to reduce bullying and anti-social behavior)
- Student, parental and community engagement
- Demand for student and teaching positions
- 'Symbolism of environment as device of inspiration' (Price et al., 2009)
- Personal control over the environment such as switching on lights, opening windows, rearranging furniture etc.

3.4   Attributes of buildings and spaces

Attributes of the physical environment that are typically included in research on educational facilities are listed below. They cover aspects that may inhibit good outcomes largely because of basic 'environmental physical' factors (Price et al., 2009).

- Temperature and relative humidity
- Daylight levels and glare
- Ventilation rate
- Air quality including total volatile organics compounds, VOCs
- Acoustics
- Cleanliness and upkeep
- Smell
- Furniture
- Amount of space per person

3.5   The building as a beacon in the educational community

Several articles point to the building as a visible symbol of learning, evocative of the educational ethos or educational specialism. In addition to being a 'device of inspiration' (Price et al., 2009) some research refers to the building as a means of 'social welfare' (Cellini et al., 2010). The school building serves as an advertisement - reaching out to the wider school community, and in particular the parents. These relate to the 'citizen perception' of schools as a representation of community pride, educational investment and increased support. (Young, 2003.) Through its design, the institution has an important role in establishing a visible presence for learning in its community, in raising the perceived value of education, and in strengthening the relationship between educational institutions and the local people, families and businesses that it serves. The ability to attract staff may be positively affected by the beacon concept.

3.6   First impressions

Buildings can have a significant impact on the perception of the learning environment and the quality of the educational service. The construction of new educational buildings, their external appearance (such as the entrance design), the quality of the interior environment and the level of facility maintenance, have all been highlighted in the research as particular aspects which promote a positive student and teacher experience. The desire to go to school and feeling valued are important steps toward academic achievement. A study on teacher retention found that 'as the perceived quality of the school facilities improves, the probability of retention increases' (Buckley et al., 2004). The buildings can provide an opportunity to welcome teachers as well as students.

In addition, the design of the building communicates the pedagogy of the institution and the educational ethos. For example, as one report pointed out, the configuration of the entrance design with elements such as a library has the opportunity to express a 'learning-centred design'. (Price et al., 2009, p28). It is noted that this might not be an aspect that students will consciously recognise, but it does integrate the educational ethos within the spatial experience. Similarly CABE school design assessment reports observed that the position and design of the dining hall promoted alternative uses of this space, such as for breakfast clubs and parent activities. By raising the status of the space in the overall design, food became associated with healthy activities, social learning and a more sustainable use of the facilities. (CABE, 2010.)

Conversely, another study pointed out that some schools have separate entrances for students and visitors, with the student arrivals having a much less inviting experience, often relegated to the 'back door' next to the fire escape. This report points out that 'front of house' parent and visitor facilities may be cleaner or better maintained than those used by students. This gives the impression that the facilities 'discriminate' students from adults, and value the students less. Regarding the impression of poorly maintained facilities, one teacher in Boston noted, 'I think the conditions convey a message to the students: You are not worth the effort of providing and maintaining a good school.' (American Federation of Teachers, 2006). The building design has much to say about inclusion and access, as it does about learning and teaching.

The building's appearance and upkeep can further influence the ability to attract and recruit students and staff. CABE's study *Design with Distinction* (CABE, 2005b) found that approximately 60 per cent of students and staff felt that the building design had a positive impact on their decision to study or work at their chosen university. Specific aspects raised include cleanliness, a feeling of space, bright working areas and the quality of the facilities. Other findings suggest that capital investment can help to attract better teachers in shortage subjects. PricewaterhouseCoopers noted that the 'presence of modern facilities was held by some to be a strong factor in recruiting specialist staff in shortage subjects.' (PricewaterhouseCoopers, 2000, p.25). The building appears to have an important role in marketing the learning institution.

3.7 Student motivation, attendance and behaviour

While there is conflicting data between various studies on student attainment and building investment, some data does appear to support a link between student motivation and building investment. Studies with large datasets, such as those carried out by KPMG, National Foundation for Education Research and the Institute for the Study of Labour, suggest that motivation and attendance are facilitated through the financial investment and physical change in school building. Pupils in schools that were refurbished or rebuilt had, on average, 'significantly less unauthorised absence, when compared to other similar pupils in

similar schools.' (Durbin et al., 2010) KPMG also found similar results in their study, and proposed an explicit link between motivation, attendance and building investment.

A study by IZA in Bonn explores the wider values of school building investment relating school construction to student, teacher and parent *interest* in academic outcomes; the ability to motivate not only students but teachers and parents through building investment seems to be an important outcome. It is recognised that there may be a variety of interrelated factors, for instance implementing fresh teaching practices or 'engagement' workshops that are inspired by the investment and physical changes to the learning environment. Further investigation into the explanation for this link is needed. However the IZA report notes that a survey of school headteachers/principals indicates that student and staff motivation are 'at least as important as direct pedagogical effects for improving academic outcomes' (Neilson, et al., 2011).

Aspects of the building design including the design of the circulation routes, furniture arrangement, the lighting, the use of colour, room temperature, air quality, outside spaces, the acoustics, surveillance (either passive or CCTV,) appear to have an impact on student behaviour. (Fisher, 2002). There is significant scientific evidence to support the link between the quality of lighting, air quality, poor acoustics and temperature, furniture design and student comfort levels. The impact of excessive CO_2 levels negatively affects concentration and behaviour, and increases the chance of students dropping asleep through exposure to stale air. (Schneider, 2002.)

A sense of 'ownership' reinforced through student engagement in relation to the building project or in the finished design itself may also support a change in behaviour, attitude and morale. Other aspects of note are toilets and lockers. Students point out the quality of the toilet provision influences their use, or avoidance. This includes their cleanliness, smell and the lack of fittings such as mirrors. For instance, one study suggests that some children will avoid their use by reducing their drinking water intake. Lockers for personal belongings are an example of another item which students are concerned about. The storage of personal items has been raised in a number of studies, and has an implication on quantity of movement around school, potential back pain, and also the importance and value of personal space among students *(*Price, 2009, p31).

Aspects relating to cleanliness, upkeep and maintenance are covered extensively in the literature. Leaking roofs and graffiti have been associated with poor behaviours though a variety of other factors could be at play (Fisher, 2002). Anecdotal studies indicate that students have a greater level of respect for their new (or renewed) educational facilities. Vandalism, graffiti and 'sticking chewing gum under the desk' appear to be less prevalent than in older facilities. However this may be due to better surveillance rather than pride in the buildings. (Price, 2009, p26.)

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3.8   Staff performance and retention

In a study of UK universities, 'the majority of staff (80 per cent) was of the opinion that the buildings they worked in impacted positively upon their performance' while only half of students considered this to be so (CABE, 2005b). Investment in the physical estate appears to be an important mechanism for improving the perception and confidence in the institution for both students and teachers. Building investment can impact on teachers' motivation as well as students': 'capital investment was seen by headteachers as one of the most powerful levers on teacher motivation, mainly through the boost to morale which teachers get from working in an appropriate and quality physical environment' (PricewaterhouseCoopers, 2000, p19).

The research shows that teachers are most concerned that their buildings are at the very least fit for purpose, and physical environmental issues - such as overcrowding, dilapidation, vandalism and difficulty accessing resources - affect their morale. While the quality of the learning environment has not been considered a priority in terms of legislation, the American Federation of Teachers in the United States points to the poor quality of the internal classroom environment having a 'serious impact on the work environment and effectiveness of school staff.' (American Federation of Teachers, 2006, p8) Reports carried out by national union and regional staff groups in the US emphasise the importance of interior cleanliness, environmental conditions and maintenance of the building fabric as a key staff concern.

In her research Sheila Bosch points to a study carried out by US contractor Heery International linking teacher perception of the learning environment with outcomes. Out of 1500 telephone interviews with teachers in nine metropolitan areas, 'Ninety-nine percent of the respondents considered school design and condition to be important for school safety, and ninety-nine percent also reported that they are important for creating a good learning environment. Similarly, ninety-seven percent believed that they are important for academic achievement, while eighty-eight percent reported them as important for teacher retention.' (Bosch, 2004.)

A 2004 study on teacher retention found that, as the perceived quality of the school facilities improves, the probability of retention increases. Furthermore 'the benefits of facility improvement for retention can be equal to or even greater than those from pay increases' (Buckley et al, 2004). This research references studies in developing countries which found that facility improvement can offset the increase in teacher wages. (Macdonald, 1999.)

3.9 Health, safety and personal wellbeing

Much of the literature focuses on the negative effect of poor building conditions, most notably climate and cleanliness, which has an effect on rates of poor health and absenteeism, morale and staff attrition. Just as environmental comfort is important to students, the literature points out the effect of air quality, thermal comfort, acoustics and lighting on both student and teachers' health and personal wellbeing. Asthma and mould have been pointed out as residual effects from poor ventilation and building maintenance, but also excessive noise and overheating make it difficult to learn and teach effectively and consistently, and can be source of stress. These aspects have an impact on students as well as staff – not only in disrupting their learning time but also in reducing consistency of teaching staff.

Buckley, Schneider and Shang's research also refers to a widely referenced but unpublished study by J.M. Lowe, which found that the best teachers in the US identified that their ability to control the room temperature was central to the performance of students and teachers. (Lowe, 1990.) This finding parallels long-term research into office buildings, where personal control is considered an important aspect in relation to productivity, satisfaction and morale. (Young, 2003.) Both student and staff's control and ownership of their space is considered to be an important issue (Higgins, et al., 2005.)

3.10 Environment, energy and carbon emissions

Clearly there is value in safe, clean and comfortable environmental conditions for teaching and learning. These 'environmental physical' factors have a significant influence on the behaviour and morale of students and staff, and can therefore be an important driver in implementing change. The Zero Carbon Task Force report, *The Road to Zero Carbon*, commissioned by the former Department for Children, Schools and Families (now Department for Education,) found that 'carbon savings can best be achieved where behaviour change is combined with the potential to make low cost savings through retrofit or refurbishment.' (DCSF, 2010.) Just as buildings can have an important influence on people's outcomes, the reverse may also be true.

A BREEAM assessment use a points system to measure a building's expected or actual performance, set against established benchmarks. It is the standard predictor of environmental impact on educational facilities in the UK. The measures are energy and water use, the internal environment (health and well-being), pollution, transport, materials, waste, ecology and management processes.

Despite aspirations to achieve energy efficiency in educational buildings, promoted by UK bodies including HEFCE, the Higher Educational Funding Council of England, and EAUC, the Environmental Association of Universities and Colleges, the energy actually used often far exceeds

predictions. Some seventy educational buildings in the Carbon Buzz dataset exhibit a doubling of energy use between prediction and actual for school buildings and a quadrupling for university buildings. Reasons may include unplanned energy consumption and costs because of increased use of ICT and by people leaving the lights on after hours. Behaviour change is revealed as essential in attaining goals such as those set in *The Road to Zero Carbon* (DCSF, 2010). The growing importance of this area demands that more research be conducted to close the prediction/ performance gap.

Furthermore, sustainability in colleges and universities is 'increasingly expected to provide not only to facilities that are comfortable and cost-effective…but that also affect the learner's understanding of sustainability as part of their wider citizenship learning.' (SFC, 2006, p16.) Environmental performance therefore needs to be understood in the round - as part of the building fabric, the user's experience and the learning itself - to maximise educational outcomes. As changes in IT, sustainability and pedagogy have converged, a spatial response is necessary. (SFC, 2010.)

3.11 Effectiveness of pedagogical delivery

Examples of excellent new approaches to the design and IT in teaching and learning spaces, to encourage a variety of delivery modes, have been identified, and in some cases linked to learning outcomes such as attendance, test scores, long term knowledge retention, as well as to efficient use of staff resources (SFC, 2006). However as major studies such as PricewaterhouseCoopers (2000), KPMG (2009) and National Foundation for Educational Research (2010) point out, it is very difficult to establish a direct correlation between building investment and student attainment. There do seem to be indirect links between test scores and investment, but it is difficult to separate these from extraneous influences, such as increased parental involvement in their children's academic performance.

However, investment in buildings appears to be able to influence the efficiency of educational delivery and the range of learning models required. PricewaterhouseCoopers points out that providing specialist spaces, replacing poor accommodation or reorganising inadequate accommodation increases learning time while reducing time spent moving around the building. PricewaterhouseCoopers refers to time lost and gained by the movement between lessons 'as a key impact on student performance.' (PricewaterhouseCoopers, 2000, p24.) For example, the introduction or positioning of the library, for instance, enables it to be used afterschool hours to benefit both the students and lifelong learning within the wider community. Clearly the design of the building can support educational initiatives such as the extended school,

adult education, the wider community and better engagement with local and regional businesses and industries.

The building appears to have significant impact on the *types* of lessons that can take place in facilities, and the *flexibility* that they enable in terms of spatial usage or the timetable in relation to the curriculum needs. As one teacher pointed out while taking a researcher on a tour of their renewed accommodation, the changes to the National Curriculum have 'meant a change in the way classrooms are used' and 'a need for different spaces.' (Price et al, 2009) The concept of 'educational transformation' formed the basis for Building Schools for the Future in England. The principle was to use capital funding to deliver spaces required for modern methods of learning and teaching. Technology is an essential underpinning to different delivery modes, and can be a useful way to reduce perceived or real barriers to college and university learning. (JISC, 2006.)

The building's organisation in particular appears to make a significant contribution to the *range* of learning styles that can be delivered through the buildings. For instance, the need for a variety of learning settings for group work, presentations, outside learning and individual study framed a 'personalised learning' model. (Fisher, 2005). The current facility design may limit current and future curriculum options, and therefore future-proofing needs to be a major consideration when investing in educational buildings to foresee scenarios whereby some facilities may need to be upgraded or relocated as part of the institution's broader long-term strategy.

At a more detailed level, the quality of finishes and their particular specification can support or inhibit spatial use. For instance, a study of 100 primary schools found that the type of floor covering contributes to noise absorption, safety, and the flexibility of activities, furniture and equipment. (Tanner et al., 2003.)

3.12 Transition to new spaces

An extensive literature review carried out in Australia highlighted a number of gaps in the research linking educational outcomes with learning spaces including the need to understand how new spaces are used post-occupation to support an effective pedagogical 'transition.' The report extends the post-occupancy phase into two parts: 'consolidation' as the teachers start to use the space to teach, and then 'sustainability/ re-evaluation' stage, where there is very little if any research both in terms of learning outcomes and in the buildings themselves. (State of Victoria DEECD, 2011.) This review highlights the need for particular investment in post occupancy evaluation and monitoring over a number of years, which we have included as a key question to ask when matching estate investment to educational outcomes.

4.0 Matching estate investment to educational outcomes: Questions to ask

4.1 Context

SFC already provides Scotland's colleges and universities with various forms of guidance on their estate investment strategies and related financial strategies. To complement that guidance, we propose a checklist of questions to help promote appropriate investment in learning institutions in Section 4.2. The questions are based on themes arising from research covered in the literature review, and our understanding of SFC's criteria for post-16 educational outcomes.

The answers to the questions need to be tested in the round, as part of a comprehensive strategy for investing in institutional buildings and spaces, both within and across the wider educational estate. There is no 'one answer,' but rather colleges and universities should use these questions to formulate a framework for setting priorities, assessing effectiveness, monitoring performance and achieving best value over the long-term.

Within the questions are a number of cross-cutting themes that complement educational outcomes. For instance, sustainability is embedded into almost all questions as it relates to the institution's ability to respond to environmental, social and economic change. Ensuring that the estate, buildings, rooms, furniture and infrastructure are flexible, adaptable, can expand or shrink, and cope with new technologies, will ensure that the investment can respond to future educational changes.

4.2 Questions to ask

How does your investment proposal …

1. **fit** with the long-term strategy for the institution, the region and the country?
2. **support** your students by promoting pride in the institution, encouragement for their studies, attendance, health and wellbeing?
3. **attract**, retain and motivate staff?
4. **support** the ability to teach and learn in different modes?
5. **contribute** to short and long term educational outcomes?
6. **contribute** to the local and regional community?
7. **improve** the efficient and sustainable use of post-16 assets?
8. **provide** for flexibility, adaptability and expansion over time?
9. **enable** the fulfilment of your responsibilities as a place of learning and working?
10. **incorporate** time and resource for consultation, monitoring and feedback?

Subsidiary questions and issues are summarised below for each of the main questions, to help colleges and universities in thinking through the nature of their responses.

1.	Fit with the long term strategy for the institution, the region and the country.

The use of funding must be considered both on a building by building basis and as part of the wider post-16 network – enabling a more effective and integrated use of educational facilities and services. Key issues to consider:

- Can the estate be shared with other post-16 institutions in the vicinity? Will this entail an overall saving in space and staff across the wider college and university network?
- Does the investment include any expensive workshops, laboratories, computers or equipment that could be made available to other colleges and universities nationally? Alternately, could we share an existing facility elsewhere?

2.	Support for students by promoting pride in the institution, encouragement for their studies, attendance, health and wellbeing.

For students, an attractive, accessible, visible, comfortable, clean and well-maintained estate that promotes further education through its visibility is paramount. Additional key issues are:

- Accessibility refers to both transportation and the ease of all users reaching the facilities, as well as the special needs of people with disabilities such as physical, auditory or visual difficulties.
- It must be safe, free from hazards, and provide facilities that aid learning and spending time there, such as social learning and library resources.
- By being clean well managed and well maintained, it can invoke a sense of respect for students, which in turn reinforces their self-worth and confidence in learning.
- By promoting an inclusive environment, the institution will better engage parents, families and external partners into the students' experience, and enable new educational opportunities.

3. Attract, retain and motivate your staff.

For staff, most of the key issues coincide with those for students. Staff usually work in the facilities far longer than students - they attend for more hours every day or week, and ideally remain in a job for several years, while student cohorts come and go. Key issues are:

- The location and accessibility of the institution are fundamental to ensuring that a sufficient pool of educated staff is available.
- Public transportation, as well parking for cars and bicycles is essential. Proximity to a suitable labour pool really matters to attract and retain staff.
- Indoor environmental quality may play a role in the health of staff, possibly reduce absenteeism and may help morale.
- A comfortable, well-equipped office base from which to work, good catering options and a staff room, help to provide a satisfactory working environment that additionally may support collegiality and pride in building up the institution, as well as the exchange of knowledge and experience.

4. Support the ability to teach and learn in different modes.

Given the growing understanding of the different ways in which individuals learn, subjects can be taught, and increased availability of e-learning tools and techniques, estate investment needs to ensure that a suitable richness of provision is encouraged. This might include:

- Collaborative learning opportunities
- Workshops, making and modelling spaces, and simulation laboratories
- Adaptability and expansion of space
- Social and peer to peer learning spaces and student facilities
- Places that readily accommodate personal learning and small group teaching
- E-learning infrastructure, fast wi-fi broadband, AV equipment, help desks
- Furniture that is mobile, stackable and reconfigurable, can aid in using rooms in different teaching modes, for example teacher at front, groupwork in clusters, solo work aided by roving staff, shared presentations.
- Managing a booking system that allows many variations in timetabling of lessons.
- Particular consideration of timetabled versus nontimetabled learning spaces.

5. Contribute to short and long term educational outcomes.

Typical short-term outcome measures include:
- Test and coursework scores – their level and improvement
- Completion and drop-out rates
- Self-esteem of students
- Student perceptions of their studies, staff, facilities

Longer term outcomes to be sought include:

- Retention of knowledge and skills after leaving college or university
- Improved career prospects
- Increased employability and earning potential
- Building confidence and leadership skills

6. Contribute to the local and regional community.

Key issues are the way in which the investment:

- Provides the skills needed within the local, regional and national economy, and supports growth and regeneration.
- Address social issues and long-term intergenerational challenges
- Strengthens and increases employment opportunities
- Welcomes the community to use the facilities particularly during evenings, weekends and term breaks.
- Helps to engage parents and families of students and staff
- Helps to forge strong links with businesses and industry, for example by allowing hiring of specialist facilities, or encouraging industry to sponsor students, attend events, or fund part of the estate.
- Promotes lifelong learning

7. Improve the efficient and sustainable use of post-16 assets.

Important concepts and strategies here are the need for investment in order to save over the long term life of the estate. Spatial usage and environmental performance need to be equally considered. For example, improvements may be needed in order to:

- make more effective and rational use of space
- improve staff efficiency by larger class sizes where appropriate
- provide off-site learning resources
- share space more for example between departments, through improvement in timetabling systems and room bookings
- use technology and other resources more effectively
- introduce more effective facility management and maintenance regimes
- reduce energy consumption through passive design, well insulated buildings, improved lighting, systems, equipment and management
- encourage low-energy behaviours for students and staff
- conserve and reuse water for example by dual flush wcs, rainwater recycling on site for wc flushing or for landscaping irrigation
- purchase renewable energy from the grid, and consideration of the benefits of local generation - solar, wind or geothermal
- increase recycling rates

- Use the estate as an exemplar site for student and community understanding of energy efficiency and carbon reduction
- Select hardy, native plants for landscaping.

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8.   Provide for flexibility, adaptability time.

Educational estates are subject to many changes from within, such as expanded or reduced student numbers, new subjects and pedagogy, or from external circumstances such as political decisions to alter funding of post-16 education, changing demographics, and changes in local workforce demand. The estate needs to be able to adapt readily to new circumstances. Flexibility can be provided for example:

- At estate level, by preparing in advance for ways in which the estate can be expanded or can shrink through subdivision.
- At building level, growth can be handled by adding new wings, filling in courtyards, adding floors, or inserting a mezzanine. If there is a need to shrink, possibilities for an additional entrance, separate circulation and sub-divisible services such as boilers, should be considered.
- At room level, opportunities for removing or adding walls, adding a mezzanine, and for changing heating, lighting, power, audio-visual and computing infrastructure is important.

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9.   Enable the fulfilment of your responsibilities as a place of learning and working.

Important issues here are the need to ensure that estates and facilities comply with legislation and regulation to achieve minimum standards of design and operation. Typically this covers:

- Health and safety
- Building regulations
- Access for people with disabilities
- Energy savings and carbon reduction commitments
- Recycling and waste
- Hazardous and deleterious materials such as asbestos
- Adherence to planning controls and historic building guidance.

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10.   Incorporate time and resource for consulting with users, monitoring and feedback to evaluate success.

To ensure an appropriate set of investments, staff and students should be consulted on their priorities, For a process of continuous improvement, it is imperative that investment reviews are conducted, to

learn from positive examples and to avoid problems that arose in negative cases. Allowance should be made to:

- Consult with staff and students when determining investments to ensure their priorities are considered
- Conduct post-project reviews and record lessons on the project procurement process, and its delivery to time and budget
- Conduct and publicise post-occupancy evaluations to learn if aspirations were met, what works well, where immediate improvements can be made, and what lessons might apply to other investments
- Install monitoring equipment and systems to record items such as occupancy, energy use, temperature, relative humidity and lighting levels as an indicator of comfort and carbon.
- Allow time and allocate responsibilities to analyse and report on the results, and then to publicise and act on the findings.
- Invest in monitoring the project on a long-term basis, and consider lessons learnt in relation to the wider estate.

5.0 Case studies of good outcomes

We have selected case studies to illustrate some of the different themes raised. While none may be identical to projects that colleges or universities wish to undertake, they offer a range of ideas to review with a project team on which to build shared understanding of goals and opportunities.

5.1. SFC *Building Ambition*

This document has identified, for individual case study college buildings, a number of desirable educational outcomes. This is a good resource to see how specific colleges have met particular educational outcome goals relevant to the Scottish situation. As such they are an important reference point when establishing the type of outcomes that a project may seek. In the different cases, building projects in colleges:

- Brought a larger student community together and so can improve the learning offerings;
- Embedded sustainability into learner programmes and the whole curriculum;
- Provided teaching spaces that allow student to learn in 'real' work environments;
- Increased full-time enrolment by 25% - providing improved opportunities for people in the region;
- Increased the range of vocational and core skills on offer;
- Provided more support for students such as child care, disability support, as well as innovative tools such as interactive whiteboards to open new avenues for students;
- Created high quality specialist, industry-relevant learning environments;
- Provided a gateway for local people to access community services – arts, culture, leisure, heath and skills, and learning;
- Contribution to Scotland's economic and cultural life;
- Improved retention and achievement rates – to make students confident, motivated and highly employable;
- Provided a sophisticated Learning Resource Centre, thus offering an up to date educational environment suited to current pedagogical thinking and the direction of the college.

5.2 Waingels College - delivering personalised learning

Waingels College is a state secondary school in Wokingham, England serving children ages 11-18 years old. The school was accommodated in a campus of buildings dating from the 1960s and 70s, but its disjointed arrangement prevented the school from delivering a personalised learning approach. The buildings were holding back the school staff from teaching in the way they needed to. The layout resulted in lengthy journeys, hidden corners and distractions that undermined the staff and student experience.

Through a carefully considered refurbishment and extension project, the school was reorganised into a coherent campus arranged around a

central 'village green.' Retained buildings were extended using a prefabricated system to create four smaller 'schools in a school.' The proportions and floor heights were carefully considered to tie into the existing infrastructure while promoting well daylit, well ventilated classrooms that provide good acoustics, and promote openness and flexibility within the smaller 'schools.' By reducing time on site (and associated disruption during construction) investment was directed into the creation of a series of high quality learning spaces and a new dining and assembly hall that enabled the school to successfully deliver its desired curriculum and pastoral learning. The new buildings are inspiring, accessible and comfortable – and attractive to students, teachers and parents from the local community and beyond.

• http://viewpictures.co.uk/Building.aspx?ID=27740
• http://www.architectsjournal.co.uk/

5.3 University of Warwick – International Digital Library

When designing a new university building, Edward Cullinan Architects used the Design Quality Indicator (DQI) assessment tool to meet the requirements of a complex multi-stakeholder organisation. The building was designed for Warwick Manufacturing Group to 'develop digital technologies for learning and innovation in digital manufacturing through virtual product testing, research and education programmes.' The DQI process helped stakeholders to agree priorities and aspirations for the design. It helped the group to have a 'structured and measurable conversation' about their existing space. These conversations helped to refine the brief and to draw out unforeseen opportunities, such as informal and collaborative spaces, the reception area, the marketing strategy and detailed flexibility for technology. The DQI briefing session showed how individual requirements affected the other stakeholders, and helped to align the briefing aspirations with the budget and other practicalities.

• http://webarchive.nationalarchives.gov.uk/20110118095356/http://www.cabe.org.uk/case-studies/international-digital-laboratory

5.4. Engaging pupils' views on quality of the learning environment

A group of researchers at Sheffield Hallam University carried out a study on the quality of school facilities by working with the pupils in two secondary schools in Sheffield. One of the schools was in a state of disrepair, and the other had been rebuilt as part of a PFI initiative. They asked students to lead tours of their school to identify 'features that they liked or disliked.' These tours provided a series of parameters for pupil questionnaires for the wider school to understand student satisfaction and perception of their school facilities. In the school that was in a state of disrepair, students mentioned the facilities management and cleanliness. Pupils felt it was 'harder to feel like trying in such poor space.' Both schools felt that there was a lack of social networking space, which the students rated as 'at least as important as classroom

space.' Pupils in one school pointed out that the dining space was only used at mealtimes, which the researcher noted was convenient for facilities maintenance regimes, but not necessarily for learning and socialising opportunities. While this study has a limited dataset, it does indicate the potential importance of the students' voice in analysing the impact of the learning environment on the educational experience. (Price et al., 2009).

5.5 The influence of the building environment on health outcomes
An example from the health building area demonstrates two important aspects relevant to learning institutions:
- improvement in the environment needs to be looked at as a whole (not elementally)
- the focus cannot be only on learners but on improving their relationship with the educational community as a whole.

Dr. Roger Ulrich, a professor at Texas A+M University and colleagues carried out extensive research reviewing the relationship between the building environment and its impact on clinical outcomes. They found that the design of the physical environment had a significant influence on patient outcomes. These outcomes related to patient recovery and wellbeing, as well as staff performance (which in turn had an indirect impact on the patients.) Ulrich and colleagues reviewed physical environmental factors such as cleanliness, building legibility and circulation, room occupancy, noise, lighting ventilation, privacy views, and access to the outdoors, and their measurable impact on patient infection, pain, depression, safety and satisfaction.

They attribute a number of positive outcomes to various aspects of the quality of the environment. They emphasise that some improvements are linked strongly to an improved staff environment and visitor experience, rather than to an improved patient environment. Outcome measures that improved were:
- Faster recovery rates
- Lower stress levels for patients and staff
- Better staff performance - reduced injuries and increased preventative measures
- Higher standard of care - better sanitary practices, such as handwashing, better patient access to staff help - either visually or in terms of adjacencies.
- Better overall experience through a greater level of comfort
- More respect between and for patients and staff members
- Encouragement of visitors presence, which had a knock-on impact on patient morale and indirect supervision and assistance.

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