Greening the Curricula within Construction Programmes

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Abstract

Improving the knowledge and understanding that construction managers possess of sustainable construction techniques and systems could lead to significant improvements in the environmental performance of the industry. Incorporating environmental issues within the construction education curricula provides an ideal mechanism for achieving this goal. It could be argued that a multi-stakeholder perspective is an effective facet of curriculum development, and that the curriculum be negotiated with interested parties. These parties have been identified as academia, government, industry and industry professional bodies. The perspectives of academia have been reviewed alongside government recommendations, and findings tested for validity via the analysis of primary quantitative data that has been collected.

The data generated has illustrated that there are a number of differences in the approach to curriculum design, and that there is no 'best practice' clearly identifiable. This paper outlines the conclusions formed to date and describes the methodology to be used for the next stage of data collection.

Keywords: Construction Education, Curriculum, Environment**,** Sustainable Construction

Introduction

The research being undertaken was initiated by a review of the construction management undergraduate programme at Liverpool John Moores University. During presentations by final year students, it was evident that knowledge of environmental issues, specifically sustainable construction and design was very superficial. This was worrying because it was assumed by the programme leader that the curriculum promoted an integrated approach to the teaching of environmental issues, which in turn should have led to improved student knowledge.

A thorough review of the curriculum was undertaken, and it was evident that the prescribed curriculum did promote an integrated approach and module leaders were including the topics in their lecture programmes. However this did not appear to promote student learning.

It is intended to review the educational approaches taken by all the professions associated with the Built Environment with regard to environmental issues. It was identified very early on in preliminary investigations that curriculum development involves a number of stakeholders and these could not be excluded from the study. These stakeholders have been identified as the government, the Construction Industry, the Chartered Institute of Building and academia. It is hoped that by involving these parties in the research project, negotiated criteria and concepts for curriculum development can be developed, which could be utilised to inform curricula in order to improve the environmental attitudes of construction professionals of the future. This could have a positive effect on how the construction industry performs, and reduce the damaging impact that construction activity has on the environment.

However very early on in the review process it became apparent that although this exercise would be valuable and offer alternative opinions and views to be evaluated, the process would take much longer than the research funding period. For this reason the strategic decision was taken to limit the research to construction management programmes. Whilst it is acknowledged that the study will not be as wide ranging with the other professions' lack of input, especially those involved with the design process, it is hoped that some of the findings may prove to be of use to the other professions upon completion.

In order to achieve a level of environmental literacy that can change environmental attitudes, the extent of environmental issues in the curricula of construction education programmes needs to be carefully developed. Also due to the vocational nature of construction education, a multi stakeholder perspective of curriculum development is required, with curricula negotiated with the interested parties. International comparison via data collection and analysis will be also be utilised at a later stage in the research programme in an attempt to improve the value of findings.

The ultimate aim of the research is to develop a set of well-developed concepts through statements of relationship that can be used to explain or predict phenomena related to curriculum modelling. These concepts will be derived from data that has been systematically gathered and subsequently analysed and will relate to UK Construction Management curricula, focussing specifically on the area of environmental issues.

Methodology

The initial methodology adopted was the undertaking of a thorough literature review, which focussed on the following topics:

- Defining sustainable construction to identify which elements of sustainability need to be included specifically in construction management programmes, in order to identify what construction management students need to know about environmental issues;

- The impact the construction industry has on the environment, and how the industry can improve on its performance in order to determine what level of environmental literacy is required of construction management students;

- Determination of what environmental education involves and recommendations as to how it can be successfully developed. This was required to try to identify the extent that education influences student learning and attitude formation. It also aimed to identify the barriers that can prevent more environmental focuses being included in the curriculum;

- Approaches to curriculum design and development in order to determine what is considered good practice with regard to developing environmental literacy in students.

The results of the review were analysed and conflicts in the findings were identified. After consideration of the review it was deemed necessary to collect primary data initially from the HE sector and industry in order to confirm or refute the results of the literature review. The initial collection of primary data is classified as the pilot study.

The objectives of the primary data collection for the pilot study were:

1. To gain insight into the present curricular situation concerning the environment, the stakeholders' own evaluation of that situation and to identify principles for greening of curricula.

2. To gain an insight into students' concepts and understanding of the environment.

3. To gain an understanding of how the construction industry has adopted environmental policies and how much importance is placed on protection of the environment from damage caused by the design and construction of buildings.

The pilot study data collection took the form of semi structured interviews undertaken over the telephone with twenty two programme leaders of Construction Management undergraduate courses in the UK. This information was supplemented by the use of a questionnaire sent to final year students on these programmes. Data was collected from Construction Industry representatives via a questionnaire sent to all the Local Authorities in England and Wales.

Analysis of these sets of data led to further gaps in knowledge being identified and the need for richer data to be generated. In order for this to occur, a reduction in the original sample was required and a qualitative approach to data generation developed. Sampling was

undertaken using cluster analysis based on a sampling grid in order to generate a suitable sample. Face to face interviews were undertaken with Construction Management programme leaders at institutions included in the sample. This phase of the research is termed phase 1, and the next planned stage of the research is the analysis of these results in order to generate initial concepts.

Similar interviews are planned in another country to add an international comparison to the research work and after analysis of this, data concepts will be refined. This part of the research project is termed phase 2.

An overview of the methodology to be adopted is shown in figure 1 and the rationale for this approach and further details of the proposed methodology will be detailed later in the paper.
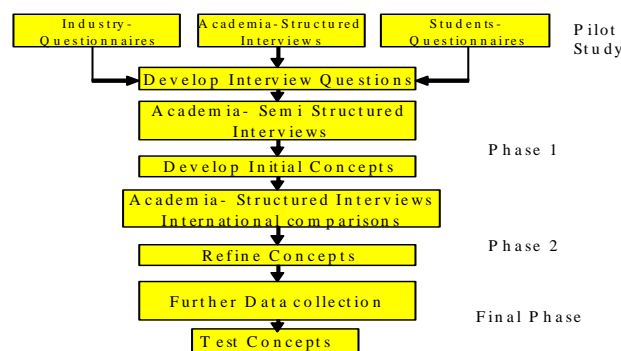

Figure 1 Overview of Methodology

Literature Review

What do construction management students need to know about the environment?

It is virtually unanimously agreed that the Construction Industry has a major impact on the environment through site modification that generally reduces environmental wealth through resource consumption (International Council for Building (CIB), 1999; Edwards, 1999; Webb, 2000; Langston and Dingk, 2001).

However since the Rio Summit in 1992 when Agenda 21 was formulated, although the concepts of sustainability, sustainable development and sustainable construction have slowly penetrated the psyche, the level of comprehension of these terms universally is unclear. Therefore the importance of developing construction management graduates' understanding of these terms is important for an industry that creates so many environmental problems. The aim is to improve the industry performance in the future with regard to environmental protection. In order for this to occur, teaching staff need to understand which elements of the sustainability debate need to be included in which programme of study. For example, one of the questions could be "Is it useful to include elements of environmental design into construction management programmes?" If construction managers are not designers, then teaching them environmental design could be wasting valuable time in the curriculum.

Upon the conclusion of the literature review it was decided that the most relevant aspects of sustainability to construction management students were to develop an understanding of the principles of sustainable construction during the design and construction phases. Developing knowledge of sustainable design is important because many construction management graduates will gain employment with contractors that undertake design and build contracts. They may therefore be in a position to influence designer choice of materials and systems, and also promote more sustainable practices via the design process. An awareness of the environmental impact of a building over its whole life is also very useful, and this is closely linked to the initial design.

After reviewing various definitions of sustainable construction and the framework for sustainability suggested by Mitlin and Satterthwaite (1996), the Actions for Sustainable Construction suggested by Skates and Baird (2001), the assessment of building methods guide devised by Cole (2000), the Building Services Research and Information Association (BSRIA, 1996) definition of sustainable construction and the Van der Ryn and Cowan (1996) ideology of ecological design a set of principles was developed for the purpose of the research.

To achieve the goal of construction work being labelled as sustainable:

- The choice of materials and systems must be considered using an environmental preference method;
- Non-sustainable materials and systems must only be used when there is no feasible alternative;
- Materials must be re-used wherever possible;
- Site run off must be reduced;
- Excavation methods must be carefully considered;
- Waste must be sorted;
- Storm water contained;
- Waste and tipping minimised.

Buildings that are classified as sustainable should:

- Create and allow for the management of a healthy built environment;
- Infuse design with a detailed understanding of the ecology of the area.

These principles can be incorporated into the curriculum for construction management students in order to increase knowledge and change attitudes so that they can make real changes to the industry in the future.

Level of environmental literacy required of construction management students

There is evidence that the construction industry is slowly changing the way that it approaches the environmental debate, but progress is slow. Rethinking Construction, The Egan Report, was published in July 1998 and includes recommendations for improving environmental performance of the construction industry. However, there is still an overriding

belief in the industry that to 'build green' will cost more, and therefore make their companies less competitive. This statement is supported by data that was gathered from Local Authorities in England and Wales that will be discussed later in the paper. It is the belief of the author that the principles of sustainable construction and sustainable design stated earlier, actually form the basis of a good practice management strategy and should lead to cost reductions as opposed to cost increases. This is further supported by Whitelegg (1998) who states that no one expects the construction industry to abandon a profits driven, commercial perspective. The intelligent enterprise will be aware of the need to seek out new market opportunities, reduce costs, innovate and improve its competitive position. Environmental standards drive a continuous process of improvement in quality and identify opportunities and alternatives for doing things in different ways and in ways that will increase market shares and increase profitability.

It is evident from these findings that students need a high level of environmental literacy if they are going to change the nature and practices of the industry when they enter the professions. The concern is that when the student enters industry they may be swayed by industry practices, and effectively ignore the knowledge that they have acquired about environmental damage caused by construction work. Their attitudes and behaviour may begin to conform to existing industry practices.

Environmental education

Many writers have determined that the main aim of environmental education is to change attitudes, that will in turn change behaviour. As long ago as 1976, Ramsey and Rickson identified that it has long been known that the basis for many environmental problems is irresponsible behaviour. Without a doubt, one of the most important influences on behaviour is attitude, that in turn is influenced by education. Campbell Bradley *et al.* (1999) stress the need for trying to change young people's environmental attitudes because young people ultimately will be affected by, and will need to provide, solutions to environmental problems arising from present day actions. As future policymakers, the youth of today will be responsible for 'fixing' the environment and they will be the ones who must be persuaded to act now in order to avoid paying a high price to repair damage to the environment in the future, if indeed it is repairable. Therefore it appears that effective environmental education, which changes the attitudes of young people, is crucial.

The (then) Department for Education (DFE) report, commonly known as the 'Toyne Report' (DFE, 1993), concluded that as education seeks to lead opinion, it will do so more effectively if it keeps in mind the distinctive nature of its mission, which is first and foremost to improve its students' understanding. Their concern may well be awakened as a result; but it must be a properly informed concern. This does not necessarily mean treating the environment as a purely scientific issue, but does mean that the respective roles of science and ethics need to be distinguished, and the complexities of each need to be acknowledged. Failure to do this may lead all too readily to an 'environmentalism' which, by depicting possibilities as certainties, can only discredit itself in the long run and feed the complacency which it seeks to dispel.

McKeown-Ice and Dendinger (2000) have identified the fact that scientific knowledge and political intervention will not solve the environmental problem on their own, thus implying that something additional is required to change behaviour. As has already been discussed, behaviour changes can only occur if attitudes change and this can be achieved through education. As Fien (1997) identifies, environmental education can play a key role by creating awareness, and changing people's values, skills and behaviour.

Introducing environmental elements into the curriculum can therefore be seen as a potentially effective way of transferring knowledge. This should in turn improve attitudes that will lead to improvements in environmental behaviour. Graham (2000) believes that it is crucial that building professionals not only participate in the creation of projects that have low environmental impact, but equally it is important that they learn to conceive, nurture, promote and facilitate the kind of paradigm changes seen as necessary to create a sustainable society.

There are however limitations as to what education can achieve on its own, for as Jucker (2002) believes, if we do not do everything we can to transform our political, economic and social systems into more sustainable structures, we might as well forget the educational part.

Barriers preventing more inclusion of environmental content in the curriculum

The review of the literature justified the need for the research and the re-development of curriculum in order to facilitate the principles stated previously. It also identified the barriers that prevent more inclusion of environmentally focussed material. They include:

The nature and structure of Higher Education in the UK

Dulaimi (1995) believes that the structure and funding of UK HEIs are the main factors that hinder change, but also that change is imperative. The barriers therefore need to be bypassed by HE in order to facilitate adaptation of the curricula. These beliefs were reiterated by Ali Khan (1996) who found that there was considerable indifference to the DFE (1993) report, which recommended that the Higher Education Funding Council for England (HEFCE) should take steps to encourage and reward the adoption of sound environmental practices in institutions. He found that hardly any progress had been made with regard to curriculum greening unless there is an external driver influencing the curriculum, for example a professional body.

Academic indifference and approach to teaching and assessment

Fien and Rawling (1996) found in their research that the professional development of environmental educators as agents of change who have central roles to play in helping create the broad social context necessary for ecologically sustainable development, is essential. However Alabaster and Blair (1996) concluded that academic staff are often ideologically resistant to curriculum changes that emanate from outside the bounds of their discipline. Greening is yet another initiative to accommodate in a workplace that has been flooded with others and is subject to major changes in terms of curriculum design.

Simons (1996) advocates the use of the case-study approach to teaching sustainability because of its capacity for understanding complexity in particular contexts. This is reiterated by Perdan *et al.* (2000) who have identified that more work needs to be done to develop, organise and consolidate case studies and to include them in all inclusive teaching and learning resources, but this again puts pressure on teaching staff.

The curriculum

If a more common approach to the teaching of environmental and sustainability issues is going to be achieved, then curricula need to be more uniform. The construction industry professional bodies are responsible in some instances for curriculum design, but in other instances that is left largely to the University. It is potentially this flexibility that creates non-uniformity.

Student backgrounds

Tikka *et al.* (2000) aimed to identify student attitudes to the environment by comparing students from a variety of educational establishments, as they realised that education is only one of the factors that contribute to learning. They tried to discover whether the educational background and place of education affected attitudes and knowledge. Their research concluded that although student backgrounds did affect attitudes, even very bad attitudes could be changed through education by careful curriculum design which takes into account potential differences in student backgrounds. Dochy *et al.* (2002) support this by stating that if tutors design the curriculum to suit the low prior knowledge student, then this will in turn be most effective in changing pre-conceived ideas in high prior knowledge students.

Lack of communication between industry and academia

One major problem preventing sustainability as a concept in the built environment gaining acceptance, is the reluctance of industry to afford it more consideration than it is receiving at the moment. Leal Filho (1999) believes that sustainability would be better accepted as a concept by industry if the link between the theory and practice of sustainability were fostered better i.e. industry and academia work together to develop workable systems. Therefore any curriculum redesign would need serious input from industry representatives, either at the design stage or at the testing stage.

The literature review has established that education is extremely important in achieving student learning, that can in turn improve attitudes and change behaviour patterns.

Curriculum Development

Learning outcomes v input driven curricula

Wolfe (2001) asks the question "Is there a 'best' approach to incorporating environmental learning into the curriculum?" and answers it by saying no. Courses can be designed around "content inputs" or "expected learning outcomes", and expected learning outcomes can be modular specific, level specific and/or programme specific. However it is sometimes easy to

fall into the trap of assuming the programme has been designed around learning outcomes when in fact the learning outcomes have been written based on the content input. This will usually be based on staff expertise as opposed to what the course team really want as an outcome. One overall aim of the programme should be that students will be environmentally literate on completion of their studies, not just knowledgeable in some aspects of the environment where staff expertise exists.

Huack (1998), Auchey *et al.* (2000) and Wolfe (2001) all believe that an expected learning outcomes approach to curriculum design is the most suitable approach, and this is supported by the Chartered Institute of Building (CIOB, 2002) new educational framework that is also based on learning outcomes. Indeed the trigger for the development of a set of common learning outcomes for construction courses was the Latham Report (1994), which advocated greater teamwork and a better awareness of the roles of other construction professionals. The report led to the Construction Industry Board (CIB) appointing the Construction Industry Council (CIC) as an implementational agency which resulted in the development of a Memorandum of Understanding in 1997. The result was a set of 'common learning outcomes' which all construction professionals can acquire. These common learning outcomes are focussed on transferable skills such as communication, group dynamics and professional awareness. One of the outcomes under professional awareness is: 'Candidates are required to engage in an activity where issues of protection and/or care of the natural and built environment are central to the problem'.

At this time fourteen of the most prominent professional bodies involved in construction are participating in the Memorandum of Understanding, the CIOB being one of them. This illustrates that the industry professional bodies realise not only the importance of students' appreciation of the impact of construction work on the environment, but also that a learning outcomes approach to curriculum development is the most effective.

However there are sceptics, Hussey and Smith (2002) believe that many academics state their learning outcomes only if obliged to do so, that this is seen as a chore, as opposed to a useful exercise. Once the QAA visit is over they will not be looked at again until the next visit is due. They explain this by stating that the fault lies with academics who are reluctant to specify precise and ascertainable outcomes for fear that this will expose their poor teaching. However it could also be because academics are not convinced by the virtues of learning outcomes. As an academic working in higher education the author's opinion is that all three are potentially true with academics falling into each category. However there are mitigating circumstances, pressure of the job itself means that academics do not have sufficient time to detail their learning outcomes as opposed to being just too lazy to produce them. There is also the argument that making learning outcomes too specific prevents changing of the curriculum during the teaching programme if new developments occur in the academic's field. New legislation, government policies or one-off events may require changes to the programme that are not covered by the original learning outcomes, but the programme may benefit from inclusion of these topics. Therefore is it right not to include them because there is no specific learning outcome linked to them? Finally the argument that learning outcomes add no value to a programme could potentially be true, but without learning outcomes there

is no control of the curriculum, and ad hoc changes can occur to such an extent that the programme leader is unaware of course content.

Considering the support of, and reservations to a learning outcomes approach, it is still deemed as most applicable to the re-evaluation and reform of construction management programmes, especially as it is so well supported by construction professional bodies.

Interdisciplinary education

The construction industry is complex and fragmented with many of the decision makers working for different organisations and being of different professions. The ability to design solutions, which reflect a holistic appreciation of the environmental context, requires working closely with other professions. Jucker (2002) supports this idea and believes that we need to overcome the disciplinary straightjacket of current education, which is one of the main reasons for our unsustainable situation because it prevents us from looking beyond one's own narrow field of vision.

Wolfe (2001) also sees the benefit of an interdisciplinary approach to the environment, as greatly improving the programme in many ways, as it will introduce students to the different ways of approaching environmental issues. This is supported by Norberg-Hodge (2000) who believes that we need to actively promote the generalist - the one who sees connections and makes links across different disciplines.

Graham (2000), whose research focussed on increasing environmental literacy through interdisciplinary approaches found that it is important for teachers to explain the role of building professions in relation to each other, in the development of resource aware practices and the procurement of sustainable buildings. One of the goals of his research was to enable students to situate and explain their own environmental perspective using examples appropriate to their professional specialisation. Of course this approach relies on teachers themselves having enough knowledge of other professions in order to explain roles to students. It also requires teachers to be free of excessive bias to their own profession, which may not always be the case in built environment faculties.

There is a consensus of opinion that using interdisciplinary approaches to teaching as much as is possible is a very positive advantage in construction courses. However this must be achieved without students losing the opportunity to develop the skills and acquire the knowledge required for their chosen discipline.

To summarise, Robson *et al.* (1996) define the benefit of this approach as: "by bringing together disciplines and focussing their efforts on a common project, the students prepare to better meet the needs of industry" which has to be of benefit in the long term.

Integration v fragmentation

In most HE institutions a review of the curriculum is carried out on an annual basis, and is to be applauded. However an unfortunate consequence of annual curriculum reform is that new developments are incorporated on an ad hoc basis. They may be included in the teaching of a module where they are not best placed and do not add to the academic rigour

of a module. They may be introduced at the wrong level because there is space in the programme at that level to do so. They may be included in modules where the module leader has no expertise and has no time to develop sufficient understanding of the topic before the module is due to be delivered. If any of these occurs it can lead to fragmentation of a well designed and integrated programme, without the programme leader's knowledge. A fragmented approach is not the best one; Jucker (2002) confirms the limitations of such an approach by stating that we cannot patch on a few environmental courses or a bit of green content here and there if we are to ensure that environmental literacy of students is to be achieved.

Acknowledgment of the student's previous experience of, and attitudes to, all of these activities is important. Mills *et al.* (1996) further state that all information presented in service courses must relate directly to skills being developed in the building construction core major courses, which interpreted means that all modules contributing to the programme must have outcomes that relate directly to the aims and objectives of the overall programme. Generally a learning environment needs to be developed by using authentic study materials and cases, by using forms of co-operative learning and by stressing both knowledge acquisition and problem solving (Dochy *et al.,* 2002).

To summarise the recommendations of the review, it appears that best practice for curriculum development needs to include the following:

- Use of a learning outcomes template;

- Integration of environmental studies into all core modules;

- The utilisation and promotion of high levels of multi disciplinary work that have problem solving emphasis.

Main Findings of the Literature Review

1. Construction Management students need to develop a detailed knowledge of sustainable design and construction, plus develop an understanding of the impact of buildings on the environment during the building life cycle.

2. Education is generally perceived to be the most important factor in forming attitudes.

3. There are a number of barriers in Higher Education that prevent more inclusion of environmental issues in the curriculum.

4. The government is proactively encouraging curriculum greening via a number of reports and proposed strategies, but progress regarding implementation appears to be slow.

5. The construction industry professional bodies appear to be in agreement as to how environmental issues should be incorporated into the curricula of programmes that they accredit.

6. The three main recommendations for curriculum design include integration as opposed to fragmentation, use of multidisciplinary projects and a learning outcomes approach to curriculum design.

7. The starting point for curriculum development is to identify the qualities that environmentally literate professionals need to have, and for teaching staff to build into the curriculum opportunities for students to critically analyse and reflect on preconceived beliefs regarding the environment.*.*

Pilot Study and Phase 1

The Pilot Study Methodology

The methodology for exploring the educational aspects of the study are derived from some of the principles used by Wemmenhove and de Groot (2001), and although there are significant differences between their work and the work of this project, the method produced results that are feasible. Wemmenhove and de Groot (2001) investigated how the curricula of an entire University could be 'greened' as opposed to this study which is investigating how the curricula of a very small number of programmes can be greened.

The pilot study has focussed on the gathering of primary data from the total population of universities based in the United Kingdom that run undergraduate programmes in Construction Management that are accredited by the Chartered Institute of Building under function D of their educational framework. The universities were approached to assess their willingness to participate in the survey. There are 26 Universities which satisfy the criteria, however Liverpool John Moores University (LJMU) was excluded from the sample to be contacted, as the author holds the same position as the programme leaders who were to be interviewed and objectivity is difficult to achieve in one's own HEI.

The total population of final year students in these Universities were the subjects for the student questionnaires; 22 of the 26 programme leaders were interviewed and a total of 178 questionnaires were returned out of a possible 196. LJMU students piloted the student questionnaire, problems with the wording of questions were identified and changes made.

Data from industry was gathered via Local Authorities in England and Wales. The Local Authorities were chosen as a subject for the research as they act as both client and contractor for construction works. They are major clients for publicly funded work and it was assumed that they would have advanced environmental policies and procedures since the adoption of Local Agenda 21 strategies has become prevalent.

Questionnaires were sent out to 102 Local Authorities in England and Wales. Of the 102 questionnaires sent, 73 were returned, indicating a response rate of just under 72%.

Choice of method

The research cannot be classed as education research or construction management research. It falls between the two and is concerned with the education of construction managers. However the authors believe that the methodologies that will achieve the most success are those that are more clearly linked to construction management research. The

pragmatic approach advocated by Raftery *et al.* (1997) state that neither approach is always superior to another, and that researchers in the construction field should conduct research by defining the problem and then applying the most appropriate method chosen from an unconstrained and wide range of possible approaches. These views are supported by Morse (1991), Csete and Albrecht (1994) and Tashakkori and Teddlie (1998). It is therefore deemed appropriate to adopt this pragmatic approach, which accepts the pre-eminence of the research questions as the basis for consideration for designing the research strategy. Adopting this approach allows the authors to explore issues related to the legitimacy of alternative research paradigms. Quantitative research is defined by Creswell (1994) as an inquiry into social or human problems, based on testing a hypothesis or a theory composed of variables, measured with numbers and analysed with statistical procedures in order to determine whether the hypothesis or the theory hold true. The design of the questionnaires sent out to industry and the students were based on findings of the literature review that had enabled a number of hypotheses to be developed that needed testing.

Questionnaire design

Quantitative data collection can also take the form of structured interviews and this was the approach taken for the collection of data from programme leaders via telephone interviews. Dorweiler and Yakhou (1998) utilised a survey in their research into how environmental issues are taught to non-environmental students. The principles they developed were utilised in the design of the structured interview questions but were expanded. Background information was deemed necessary to assess the validity of the interview. The target population was Universities that run accredited CIOB Construction Management programmes and therefore questions were asked about the accreditation status of the programme, and also about the number of students that were studying at the institution on these programmes. The main body of questions related to:

- Course Design, in particular the inclusion of environmental issues;
- Relationship of the curriculum to the CIOB educational framework;
- The amount and level of research undertaken within the department, both environmentally focussed and generic;
- The barriers that prevent more inclusion of environmental features in the curriculum;
- Opinions that academia has about the influence of industry on the curriculum and the extent to which environmental policies within the industry have developed;
- Potential future developments in industry and how these will impact on the curriculum.

The aims of the questions were to:

- Identify common themes, problems and issues in the different institutions;

- Identify issues relating to the particular institution that would allow fields to be developed that would enable categorisation of student questionnaire responses.

The knowledge that students have acquired was investigated by the use of questionnaires issued to final year students studying on relevant courses to assess their understanding of specific issues and their attitudes to the environment. The questions concentrated on drawing out the deep learning that the students have acquired through their studies and were based on the research undertaken by Tikka *et al.* (2000) that aimed to identify student attitudes to the environment by comparing students from a variety of educational establishments. As has already been stated, the questionnaire was piloted at Liverpool JMU and adapted after evaluating the success of the proposed structure.

The main body of questions related to:

- Level of awareness of environmental issues;

- Perception of the amount of environmental content of their programme of study;

- Attitudes to the environment;

- Knowledge of the environmental impact of technologies and procurement strategies;

- Perceptions of how the construction industry has reacted to the environmental debate;

- Factors that the students feel are important in the construction process and those that they believe the industry places most importance on.

The survey data was collected over a period of six months, in semester 2 of the programme. This was the final semester that the students would study at each of the universities.

Pilot study industry questionnaires

The use of questionnaires was deemed valid for the collection of data as there is relatively little competition between Local Authorities and therefore results should not be tainted because of fear of other authorities gaining a competitive advantage if results became public. It was also assumed that a high response rate would be achieved, and a large bank of data would be collected relatively quickly.

The questions were designed to assess whether Local Authorities have a Local Agenda 21 policy; if they do whether it is actually implemented; willingness to pay for improved environmental performance in construction works; the understanding of sustainable construction and also to identify the role that universities can have in the education of Local Authority employees.

The questionnaire was designed to mix dichotomous and scaled questions to allow quantitative analysis. Certain questions allowed for a qualitative reply if the respondent felt they wanted to add anything. The scaled questions used a Likert Scale; this allowed a

qualitative response, a cognitive attitude statement, to be used as a quantitative variable for analysis (Oppenheim, 1992).

Results and Analysis of the Pilot Study

Methods of analysis

For the educational data, both sets were analysed in conjunction with one another. The techniques used for analysis included:

1. Responses standardised, normalised and presented using comparative descriptive statistics.
2. Arithmetic means or mode calculated, along with the standard deviation and constant variable.
3. The Chi-square test has been used for some elements to assess if two or more variables are associated to a significant level, using a 5% level of significance.

Some of the data gathered from the interviews was used to classify groupings of students to enable the statistical analysis to be undertaken. The classifications included:

- Programmes that had specific environmentally focussed expected learning outcomes;
- Institutions where high levels of environmentally focussed research is being undertaken;
- The split between full time, part time and sandwich students.

The analysis of the data collected from industry has been presented using descriptive statistics. As there were not enough variables in the sample to allow for statistical analysis, this was deemed the only method suitable.

Education Sector Findings

Course design

Of the 22 programmes, 10 programme leaders stated that their programme aims had a specific reference to the environment/sustainability, whilst 12 did not. However student perception of how much environmental content was included in their programme showed no statistically significant difference in the awareness of students to environmental issues if the programme has a specific environmentally focussed learning outcome.

Programme leaders were also asked how much of overall assessment has an environmental focus, and the mean figure was 16%. However it was perceived by students to be 32%, which is significantly higher, illustrating discrepancies between programme leader and student perceptions. When programme leaders were asked what they believed was the best assessment approach to develop student understanding of environmental issues, and ultimately the behaviour of the individuals to improve the behaviour of the industry, the clear view is that case study based interdisciplinary group projects were viewed as the most

effective. However the student response to the amount of environmental content of group based projects indicates that this type of project is not utilised fully to develop understanding.

Educational framework

Programme leaders were asked if they believed that the CIOB educational framework put enough emphasis of environmental issues. Four responded yes and 18 responded no. The courses are all validated by the CIOB under the same educational framework and there is a clear statement in the framework of the importance of incorporating environmental issues. It was commented on by a number of programme leaders that although it did state this, there was not enough room in the curriculum to put more environmental content in because of all the other topics that needed to be covered. One institution responded that the accrediting panel had specifically stated that they wanted no more environmental content to be included as it was distracting away from the main theme of the programme. Staff were also asked if they adopted an integrated (which is the way the CIOB framework promotes its delivery) or fragmented approach to teaching environmental issues of the programme. The response was fragmented-13 and integrated-9. Considering that all the programmes are accredited by CIOB under 1994 guidance which clearly states that an integrated approach should be adopted, these figures are surprising, and would indicate that the framework can be interpreted differently by different institutions and different visiting accrediting panels.

Research

Questions were posed to the programme leaders in order to determine two clearly identifiable students groups. The groups were rated as high research where a lot of research is carried out in the institution that has an environmental focus, or low research, which is the opposite. It was assumed that student knowledge would be greater in the high research rated group, but there was no statistically significant difference in the knowledge of both groups.

Student knowledge

84% of the programme leaders stated that modules in their programme have learning outcomes that make specific reference to the environment/ sustainability, and that in the main those modules were technology subjects. It was assumed therefore that the student responses would indicate better knowledge of the impact of particular technologies on the environment, than of the impact of different procurement routes on the environment. Students were asked to rank technologies in order of environmental friendliness and then procurement routes. The analysis of the data identified an average of 38% error in the assumption of students as to the damaging effects of technologies on the environment, and an average of 24% error in the assumption of students as to the most effective procurement routes in promoting sustainable construction.

Comparing the errors for these sets of data it would appear that students are more knowledgeable about management issues in construction as opposed to technical issues, which somewhat contradicts what programme leaders believe to be the case. It also indicates that integration of environmental issues into management subjects is occurring far

more than it is in technology subjects and indicates that integration is a far more subtle approach to teaching than fragmentation, in achieving environmental literacy in students.

Barriers

Programme leaders were asked if there were any reasons that prevented more inclusion of environmental aspects into the curriculum.   The responses corroborated with the findings of the literature review to some extent. The main barriers that the programme leaders highlighted were staff expertise, staff age and interest and lack of time to develop material. These issues illustrate that the recommendations of the DFE Report (1993) have not been widely accepted.

Student attitudes

The student responses were separated into three categories: full time (FT), sandwich (SW), and part time (PT). It was assumed that the sandwich and part time students would have more negative attitudes to the environment as they would have formed opinions in the industry, which was assumed from the literature review to pay little attention to the environment. However the statistical analysis illustrated that potentially there is no significant difference between the responses of FT compared to PT/SW students. The results appear to show that education has more influence on student attitudes than their work experience. The students' perception of the industry is that it ranks cost as the highest priority, followed by time and then health and safety and quality equally, and finally environmental impact. However they personally ranked these elements in a different order as illustrated in figure 2.
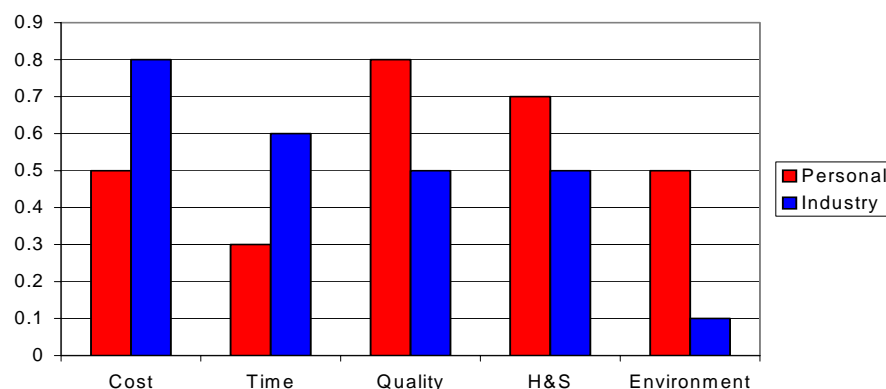

Figure 2 Comparison of students' personal ratings of factors of importance with those they perceive the industry to hold important

Figure 3 illustrates the responses for the whole sample split into part time, full time and sandwich students when asked how important they personally ranked the issues in terms of importance.

All groups ranked health and safety and quality as most important, followed by environment, which appears to illustrate that education has more effect on student attitudes than industrial experience, which was a potential problem highlighted in the literature review. This reiterates the importance of education and the need for good curriculum design.
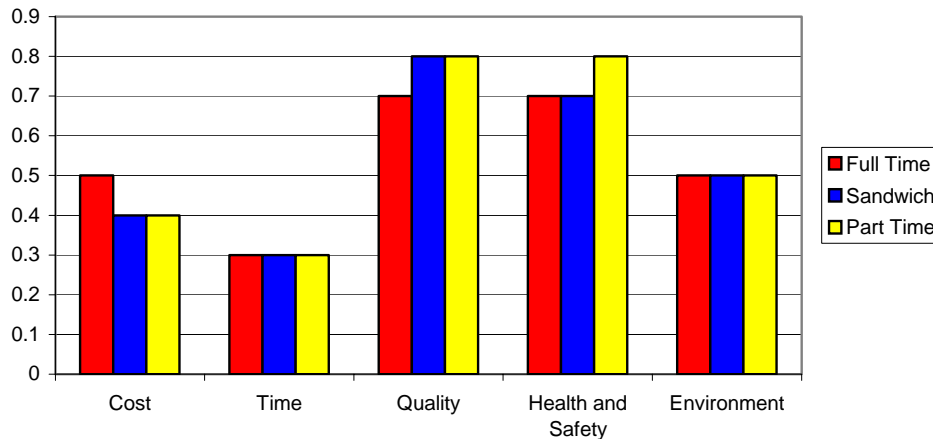

Figure 3 Factors that students perceive as important in the construction process

Industry Findings

The survey was designed to assess whether Local Authorities have a Local Agenda 21 policy; if they do whether it is it implemented in construction; willingness to pay for improved environmental performance in construction works; the understanding of sustainable construction and finally to identify the role that universities can have in the education of Local Authority employees. It was linked closely to test the findings of the literature review. A target date of 1996 was set for all Local Authorities to have adopted a formal Local Agenda 21 (LA21) strategy. However the findings showed that this has not been achieved and 11% of authorities have not achieved this aim. Whilst this is in the minority, which is encouraging, at the time of writing it is six years past the initial target date, which is very discouraging. It was beyond the scope of the research to ascertain why the response has not been 100%, as the decision to implement LA21 policies was outside of the remit of the questionnaire respondents. The implication is that environmental issues may not be as high on the priority list for those Local Authorities as expected. However, 92% of respondents stated that they had an understanding of what is meant by LA21, which indicates that even if the Local Authority does not have a formal policy, staff have become aware of the principles of LA21 themselves. Bearing the above in mind, it is surprising that only 25% of Local Authorities always consider using sustainable construction techniques, with 23% stating that they only consider using them occasionally or never. This indicates that even though the Local Authority has a LA21 policy, it does not filter into construction work practices.

It was assumed from the findings of the literature review that clients (Local Authorities) whose construction work is funded from public sources would identify sustainable construction as a highly important criterion, as opposed to the private sector that would identify cost as the most important. However the findings of the survey contradict this

assumption as 45% of Local Authority respondents stated that cost was the most important criteria and only 6% who stated that sustainability was the most important. Perhaps more importantly 50% stated that sustainability was not important. This is shown in figure 4.
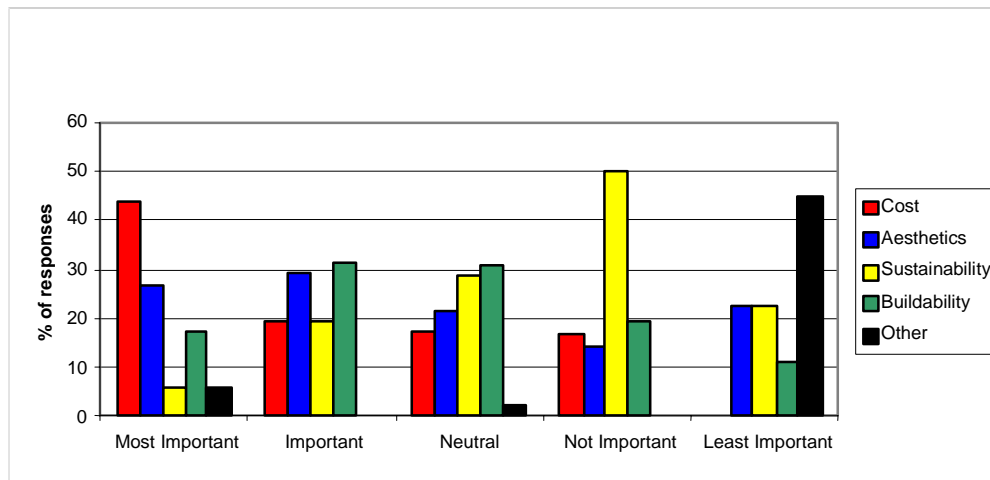

Figure 4 Factors that influence the specification of building materials

By profession the greatest difference in the percentage who stated that sustainability was the most important compared to the least important was the quantity surveying group (9% compared to 62%), and as they are mainly concerned with costs this was a likely outcome. However the professions involved with the design of buildings also indicated big differences. From this information it can be assumed that public accountability of funding is still high on the priority list for Local Authorities, which is understandable and indicates that if the general population were more vociferous in wishing to protect the environment, then this would filter into Local Authority practices. One interesting outcome is that Local Authorities appear to equate sustainable construction with increased cost, and this links to lack of understanding of what sustainable construction is. Most of the principles required to achieve sustainable construction do not cost more, and in fact some can even reduce costs, such as reuse and recycling.

Another contradictory set of data relates to the Landfill Tax. The majority of respondents (84%) stated that they believed that the Landfill Tax was fair or even too low, but only 29% believed that its introduction will help to protect the environment by promoting recycling and reuse. Consequently 50% of respondents stated that tipping off site was still the most common option taken with regard to waste disposal, and only 17% stated that they have a policy to recycle all waste.

Less than half of the respondents believe that environmental issues and the use of sustainable construction techniques will become more important in the future, again this is surprising especially with the April 2002 revision to part L of the Building Regulations, which had far reaching implications for Local Authorities.

The overall conclusions gained from the data generated are:

- The majority of respondents stated that they have a thorough understanding of Agenda 21 and its implications. The later questions identify that this is not

> the case as the benefits of the Landfill Tax are not appreciated and all pointers, including the changes to the Building Regulations would imply that environmental performance of construction in all sectors will have to improve in the future. Also the assumption that 'building green' will cost more identifies a lack of understanding of what sustainable construction actually is.

- The majority of the respondents stated that their Local Authority has a LA21 policy. However it is clear that although the respondents know the policy is in existence, the ethos of these policies is not filtering into practices in the building works departments.

It has been stated in the literature review that Local Authorities should take the lead in promoting the use of sustainable construction methods for all construction works, and by taking the lead become an example to the construction industry generally. However the results of these findings would suggest that this is not the case at this time. Local Authorities may need to review their LA21 policies and ensure that they clearly state the priority that sustainable construction should have in the list of criteria for building work. The respondents were mainly designers and it is they who can have a dramatic effect on the use of more sustainable methods. However, developing a policy is only the first step. The policy has to be communicated to all staff in a way that is understandable. It is evident that there is a lack of knowledge of how building work can be more sustainable, with little or no increase in actual costs. This suggests that education and training are of paramount importance and should perhaps be put high on the agenda for the Local Authorities.

Universities could deliver the expertise required, and as the survey suggest, the majority of respondents believe this to be the case.

Phase 1

Methodology

The initial research illustrated that what programme leaders say they do as far as the curriculum is concerned, appears to be different from the perceptions of the students. It has also been identified that the environmental literacy that the HE sector is developing in students is at a higher level than is required by industry at the moment, but potentially not in the future. Therefore the issues relating to the inclusion of environmental issues into the curriculum needed to be further investigated if concepts relating to curriculum design are to be developed.

The aim of the research project is to develop concepts relating to curriculum design based on the systematic collection and subsequent analysis of data. This approach forms the basis for the development of grounded theory, and therefore the data collection needs to be undertaken in a way that reflects the characteristics of grounded theory which are summarised by Strauss and Corbin (1998) as:

- Situations have been critically analysed upon reflection;
- Bias has been recognised;

- Criticism has been accepted and flexibility incorporated;

- Interpretation of both words and actions have been dealt with sensitively.

To this end the use of interviews has been used as the methodology for phase 1, as they provide richer and more detailed data and allow for the above points to be utilised during analysis. Interviews undertaken were semi-structured; specific questions were identified, but the interviewee was free to respond therefore being unrestricted in scope and flexible in the replies.

There was so much background information that could be gained that implementation problems were envisaged regarding the comparison of how different programme leaders saw these issues. In-depth interviews can generate a large amount of data and allow for immediate follow up questions, clarification of points and exploration of meanings. Therefore although the majority of the interview was exploratory, there were some attitudinal questions. Here the perception of the interviewee was asked for on certain issues, whether they agreed or disagreed and in some instances, they were asked to rank various elements as to the impact they may have on the curriculum. The questions used were designed to encourage the interviewee to answer freely and as little intervention by the author as possible occurred. The interviews were all taped and are being transcribed at this point in the project.

Sample

The nature of this type of data collection relies on quality as opposed to quantity and therefore in order to reduce the original sample size down to a workable number, a cluster analysis, based on a sampling grid was used.

The following questions were identified from the initial pilot study course leader questions as the most relevant to the research:

1. Do they have a programme expected learning outcome that has an environmental focus?

2. Do they have an integrated approach to the teaching of environmental issues?

3. Would you consider increasing the amount of environmental content in your programme?

4. Is the programme viable in the long term?

Questions 1 and 2 are deemed to show that the programme team have considered the inclusion of environmental issues in their programmes already, and therefore these two questions were used as the initial basis for choice as subjects. However as the author wished to determine whether or not there are differences in the programmes and the different approaches that are taken, it was deemed inappropriate to use in the sample all the institutions that stated Yes/Yes to questions 1 and 2 as these will be the institutions that are already proactive and may not represent the true situation. The cluster analysis was therefore prepared by grouping Yes/Yes, Yes/No, No/No, and No/Yes responses to these questions.

The research is focussing on how programmes will change in the future, and therefore willingness to change by the programme leaders is of paramount importance. A Yes response to question 3 was deemed to be necessary. Within the cluster analysis table those institutions that answered yes to question 3 were highlighted. In both the No/Yes and No/No categories there are only two institutions that satisfied the criteria and in order to ensure that the sample was equally balanced, the same number of institutions that answered Yes to question 3 was taken from the Yes/Yes and Yes/No respondents (two from each). In the Yes/No category there were three institutions that satisfied the criteria, and in the Yes/Yes sample as was to be expected, all stated yes to question 3.

There was little to distinguish between these in so far as choice was concerned, as they all have a long tradition of construction management education. Therefore the choice was made by the enthusiasm of the programme leader to be involved in the project.

Conclusions

Summary of main findings of the pilot study

The main conclusions formed from the analysis of the data from the pilot study are:

- The CIOB educational framework is perceived as rigid by programme leaders but is in fact reasonably flexible, so environmental issues could be increased in the curriculum.

- Programme leaders' perception as to how much environmental content there is in their programme is very different from that of students.

- Final level student knowledge of environmental issues in both technology and management subjects is not as good as was expected.

- Student attitudes to the environment are reassuringly positive, and education appears to be the major influence on attitudes, and there is no statistically significant difference in the attitudes of students who have experience of the construction industry as opposed to those who have not.

- The amount of research undertaken by the institution has no identifiable influence on student learning.

- Although the majority of Local Authorities have adopted local Agenda 21 policies they have not implemented the recommendations to any great extent within the construction departments.

- There is a real issue concerning the additional costs that Local Authorities believe employing sustainable construction practices will require. This appears to be the major barrier in preventing more environmentally friendly practices and will impact on the amount of environmental literacy required in graduates.

- However this point reiterates the need for more environmentally literate graduates who will hopefully be able to influence industry practices to a

greater extent in the future, thus demonstrating the need for the HE sector to address these issues.

- Industry practitioners believe that the HE sector has a role to play in providing graduates with the knowledge and attitudes required in order to change industry practices.

Future Proposed Work

Analysis: phase 1

The analysis of the data collected in phase 1 is now being undertaken. Initially analysis by coding was the chosen method, but after extensive work using this method it became apparent that coding distorted the meaning of the wording of the interview transcript. Therefore a different approach to analysis was required. After further research into suitable methodologies the interpretative research paradigm was adopted. The central concern of the interpretative research paradigm is understanding human experiences at a holistic level (Berry, 1998). This method of analysis allows for the interpretation of the complexities embedded in experience, and to seek meanings to illuminate the significance of these experiences. The main failing of this method of analysis is that the reader of the transcribed interviews may lack objectivity when developing interpretations. It is therefore essential that a validity check is undertaken by a different researcher to ensure that misinterpretation and/or opinions formed via the literature review do not taint the analysis.

Phase 2: international comparison

The survey data collected in the pilot study and phase 1 provided valuable information relating to the research topic. However protection of the environment is a global issue and it became apparent during the undertaking of the literature review that a great deal of literature in this area is generated from overseas. Therefore the decision was made to gather data from another country and undertake a comparative study of practices between the UK and another country.

The decision to use Australia for the international comparison was made after initial consideration of all English speaking countries. After conducting a literature review the similarities between the UK and Australia were deemed to be greatest, compared to other English speaking countries. The method of analysis of the data will be identical to that used for the analysis of the phase 1 data to allow for comparisons to be formed.

Final phase

After concepts have been developed they will require testing. The testing will be facilitated using structured group interviews, consisting of stakeholders concerned with curriculum development. It is hoped that the analysis of this final set of data will enable concepts regarding environmental issues in the construction curriculum to be developed that are valid, relevant and useful.

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