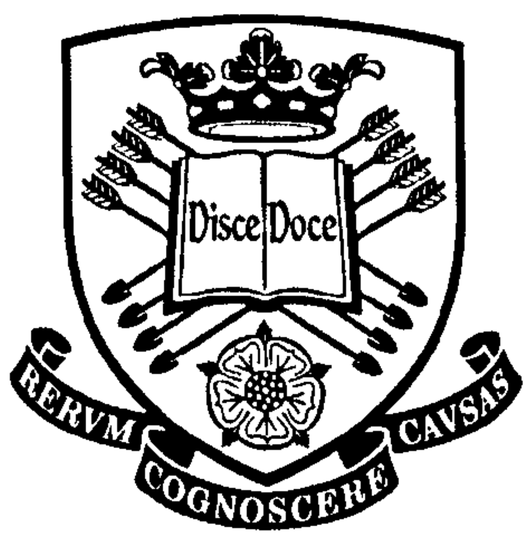
# A COMMUNICATION PLATFORM TO FACILITATE KNOWLEDGE TRANSFER BETWEEN DIFFERENT STAKEHOLDER GROUPS IN SUSTAINABLE STUDENT ACCOMMODATION DESIGN

## VOLUME II

**BING CHEN**

A THESIS SUBMITTED FOR THE FULFILMENT OF THE DEGREE OF DOCTOR OF PHILOSOPHY IN ARCHITECTURE

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Great achievements are not born from a single vision but from the combination of many distinctive viewpoints. Diversity challenges assumptions, open minds and unlocks our potential to solve any problems we may face.

– *Source ... Corporate Impressions Communications*

# CHAPTER 6

# CONSULTATION RESPONSES FROM THE OCCUPANT GROUP

## 6.1 CHAPTER OUTLINE

The second part of this thesis, including Chapter 6, Chapter 7, Chapter 8, Chapter 9 and Chapter 10, further explores the priority variance within and between different stakeholder groups. Further, based on consultation responses from the Occupant Group, the Client Group and the Designer Group, the Code (or the communication platform) for Sustainable Student Accommodation (CSSA) will be designed and evaluated.

This chapter describes data collection and analysis from the Occupant Group (student residents). Self-completion questionnaires are used to collect both quantitative and qualitative information. Then SPSS is applied to analyse the quantitative data and make correlational and causal-comparative studies. To have a full picture of students' awareness of sustainable living issues, a follow-up investigation is carried out later with another student sample to collect more data and make comparative studies. In this research phase, data collection and analysis is conducted in tandem, repeatedly referring to each other. Detailed consultation procedures are described in the following sections, though it is mainly focused on the quantitative approach.

## 6.2 AIMS AND METHODS IN THIS RESEARCH STAGE

In the pilot investigation (see 5.5), it was argued that the application of housing environmental assessment methods (i.e. EcoHomes) could probably provide temporary solutions for the housing market, but it was peoples' awareness of sustainable living that decided how far the campaign against climate change would progress. As housing occupants with relatively more specialist knowledge, architectural students have been considered as the key stakeholders to get the message across. Their awareness of sustainable living issues and willingness to encourage other stakeholders to participate in tackling climate change should be particularly addressed as the first step to change. However, as found in the pilot investigation (see Chapter 5), in the real world, high-level architectural students in the target group were likely to see themselves as housing designers rather than housing occupants. A close consensus could not even be achieved within the same group of people when they evaluated interrelated housing environmental issues from different perspectives, as designers and as occupants. Further, neither of these two viewpoints corresponded with the one used in EcoHomes (or to some extent, the viewpoint of regulators and experts).

To alleviate the conflicts, it is important to educate these key stakeholders about their new duties in the design decision-making processes. Besides embracing genuinely collaborative

roles, they should be trained to see themselves as campaigners who contribute to problems rather than just alternative solutions. This objective is expected to be achieved through sustainability-related education programmes. In this research stage, the palette of housing environmental issues being addressed in EcoHomes are used again as appraisal standard to investigate knowledge transfer in current architectural education, mainly concentrating on its effect on students' living manners and lifestyle choices.

This investigation was carried out between 2005 and 2007 on the basis of previous studies. Based on the convenience sampling[xl] method, student samples were drawn from Faculty of Architecture (including School of Architecture, Department of Landscape, and Town and Regional Planning) in the University of Sheffield, including undergraduate students from first year to final year and postgraduate students. The self-completion questionnaire was designed on the basis of certain techniques, such as tick boxes and open-ended questions, to gather both quantitative and qualitative data. A statistical analysis programme, SPSS, was then used to make statistical analysis for the quantitative data available. Detailed consultation procedures are described in the following sections, followed up with discussions related to generalisation issues.

## 6.3 CONSULTATION PROCEDURE AND RESPONSES – DESCRIPTIVE STATISTICS

Based on experience from the pilot investigation, similar but stricter consultation procedures were carried out in the Faculty of Architecture, University of Sheffield. The self-completion questionnaires (*Questionnaire to the Occupant Group*, see Appendix 2.3) were issued, completed and collected at the end of the students' sustainability-related courses, under the researcher's supervision. With support from the course tutors, all surveys were administered in exam-like conditions, with talking strongly discouraged and no overlooking of others' questionnaires. This aimed to ensure that all questions were answered independently by participants. It was a convenience sample because the target students were selected purposefully rather than randomly and absentees from classes were unavailable to answer the questionnaires. On the other hand, because of the way questionnaires were administered, responses from the target students were good in quantity and quality and could be used for

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[xl] 'A convenience sample is one that is simple available to the researcher by virtue of its accessibility. ... Certainly, in the field of organisation studies it has been noted that convenience samples are very common and indeed are more prominent than are samples based on probability sampling.' (Bryman 2004: 100) Convenience sampling is a type of *non-probability sampling* method (see Chapter 3).

statistical analysis.

In the following sections, the response for each questionnaire section is given a breakdown in detail, followed with related descriptive and statistical analysis.

### 6.3.1 RESPONSE RATE (QA)

As argued above, because of the convenience sampling method, there was a very high rate of responses[xli] among those students to whom the questionnaires were administered. Except 12 questionnaires that were missed, in total there were 471 formal responses from the Faculty of Architecture. 4 questionnaires were considered invalid due to large sections being missed, thus leaving a sample of 467 (the response rate is 96.7%).

Of these, 269 respondents came from the School of Architecture, 106 respondents came from the Department of Landscape, and the rest (92) came from the Department of Town and Regional Planning (TRP), as shown in Table 6.1 (QA). In order to make correlational and causal-comparative studies, students doing dual courses were coded and computed according to their major subjects, and taught masters students were merged with students at an equal level, as shown in Figure 6.1.

**Table 6.1: Aggregated Responses from students in the Faculty of Architecture**

| | Architecture | Landscape | TRP | Total |
|---|---|---|---|---|
| 1st year | 110 | 20 | | 130 |
| 2nd year | 63 | 33 | 40 | 136 |
| 3rd year | 79 | 13 | 35 | 127 |
| 4th year | 3 | | 9 | 74 |
| 5th year | | 17 | | |
| MA | 14 | 23 | 8 | |
| Total | 269 | 106 | 92 | 467 |

[xli] Response rate: 'the percentage of a sample that does, in fact, agree to participate. However, the calculation of a response rate is a little more complicated than this. First, not everyone who replies will be included: if a large number of questions are not answered by a respondent or if there are clear indications that he or she has not taken the interview or questionnaire seriously, it is better to employ only the number of usable interviews or questionnaires as the numerator. Similarly, it also tends to occur that not everyone in a sample turns out to be a suitable or appropriate respondent or can be contacted. Thus the response rate is calculated as follows: Number of usable questionnaires / (total sample – unsuitable or incontestable members of the sample) * 100%' (Bryman 2004: 98)

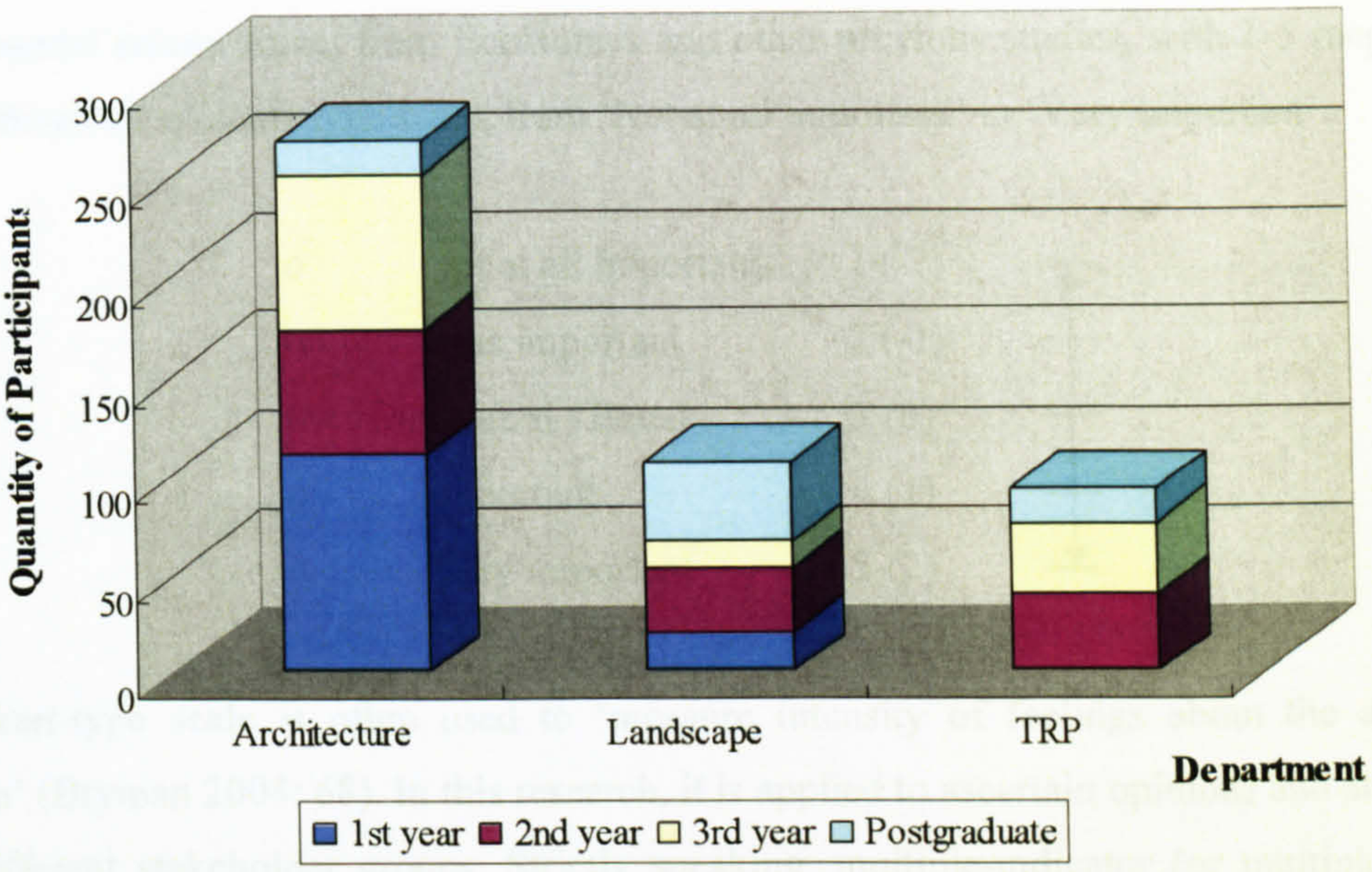


**Figure 6.1: Responses from the Faculty of Architecture**

### 6.3.2 ACCOMMODATION TYPES & RELATIVE IMPORTANCE OF HOUSING ENVIRONMENTAL ISSUES (QC)

As shown in Figure 6.2 (QC1), 'flat' was considered by students in the target group as the most suitable accommodation type. However, other accommodation types were also welcomed to contribute to the community-oriented development.

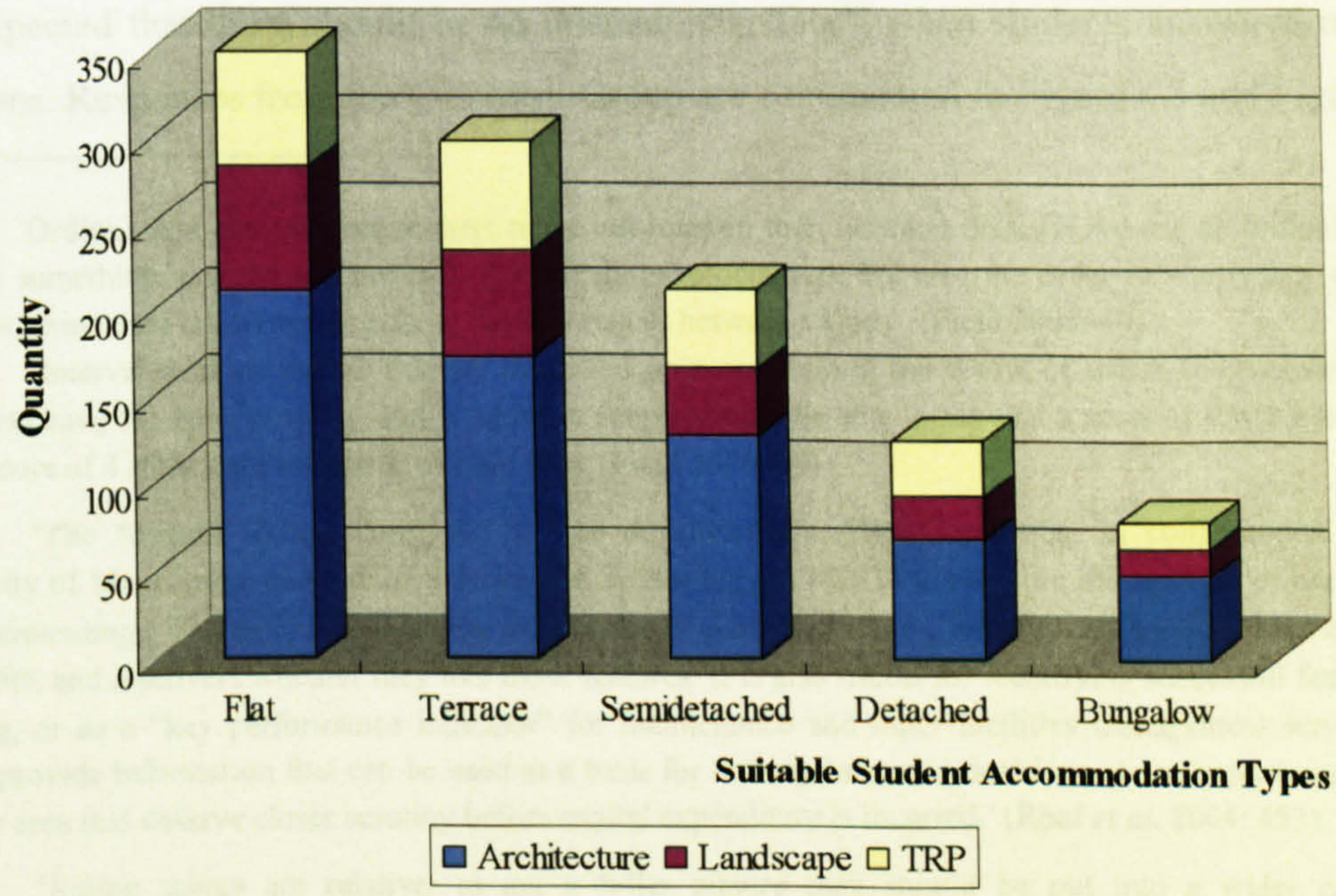


**Figure 6.2: Most suitable student accommodation types**

Students were then asked to evaluate the relative importance of a range of housing environmental issues drawn from EcoHomes and other previous studies, with 1-5 range-of-opinion based on a Likert-type scale, from 'Not at all important' to 'Very important'.

- Not at all important 1 (-2)
- Less important 2 (-1)
- Neutral / Equal 3 (0)
- Important 4 (1)
- Very important 5 (2)

The Likert-type scale is often used to 'measure intensity of feelings about the area in question' (Bryman 2004: 68). In this research, it is applied to ascertain opinions and attitudes from different stakeholder groups. Strictly speaking, multiple-indicator (or multiple-item) measures of concepts, such as Likert scales, produce *ordinal*[xlii] variables (see comparable studies by Dejesus 2002, Parnell 2003a and so on). However, many scholars argue that 'they can be treated as though they produce *interval/ratio*[xliii] variables, because of the relatively large number of categories they generate' (Bryman 2004: 226). In this study, it is important to note that all issues related to evaluation of the relative importance were designed to be measured ***at regular intervals***, which means that the increase in relative importance represented by a change from -1 to 0 along the scale should be the same as the change from 0 to 1. To some extent, Likert-type scale used in this research can be seen as a combination of the conventional Likert scale and the prospective overall liking score (OLS)[xliv]. The method of measurement was clearly explained to participants as part of the instructions. Therefore, it was expected that there should be no misunderstanding[xlv] when students answered relevant questions. Responses from the Occupant Group are summarised in Figure 6.3 and Figure 6.4.

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[xlii] Ordinal data can give researchers more information than nominal data. 'If we use an ordinal scale to measure something, we can tell not only that things have occurred, but also the order in which they occurred. However, these data tell us nothing about the differences between values.' (Field 2005: 49)

[xliii] 'Interval data are scores that are measured on a scale along the whole of which intervals are equal.' Ratio data have the same property, but in addition people should be able to say that a score of 8 was twice bigger than a score of 4 if they are measured as ratio data. (Field 2005: 49)

[xliv] 'The "overall liking score" (OLS) was developed by ABS Consulting, in collaboration with the University of Manchester Institute of Science and Technology (UMIST) to measure the reaction of occupants to their surroundings. The technique rates the importance of particular issues, features and services for the building occupants, and discovers whether they like those features. It is also useful for identifying successful features of a building, or as a "key performance indicator" for maintenance and other facilities management services. The results provide information that can be used as a basis for making informed decisions about improvements, or to identify area that deserve closer scrutiny before capital expenditure is incurred.' (Roaf *et al.* 2004: 453)

[xlv] 'Rating scores are relative: to get a fuller picture they should be put into a wider context by benchmarking individual cases within a bigger data set and by explaining individual circumstances as clearly as possible so that the reader can judge where importance and risk lies' (Leaman and Bordass 2007: 672).

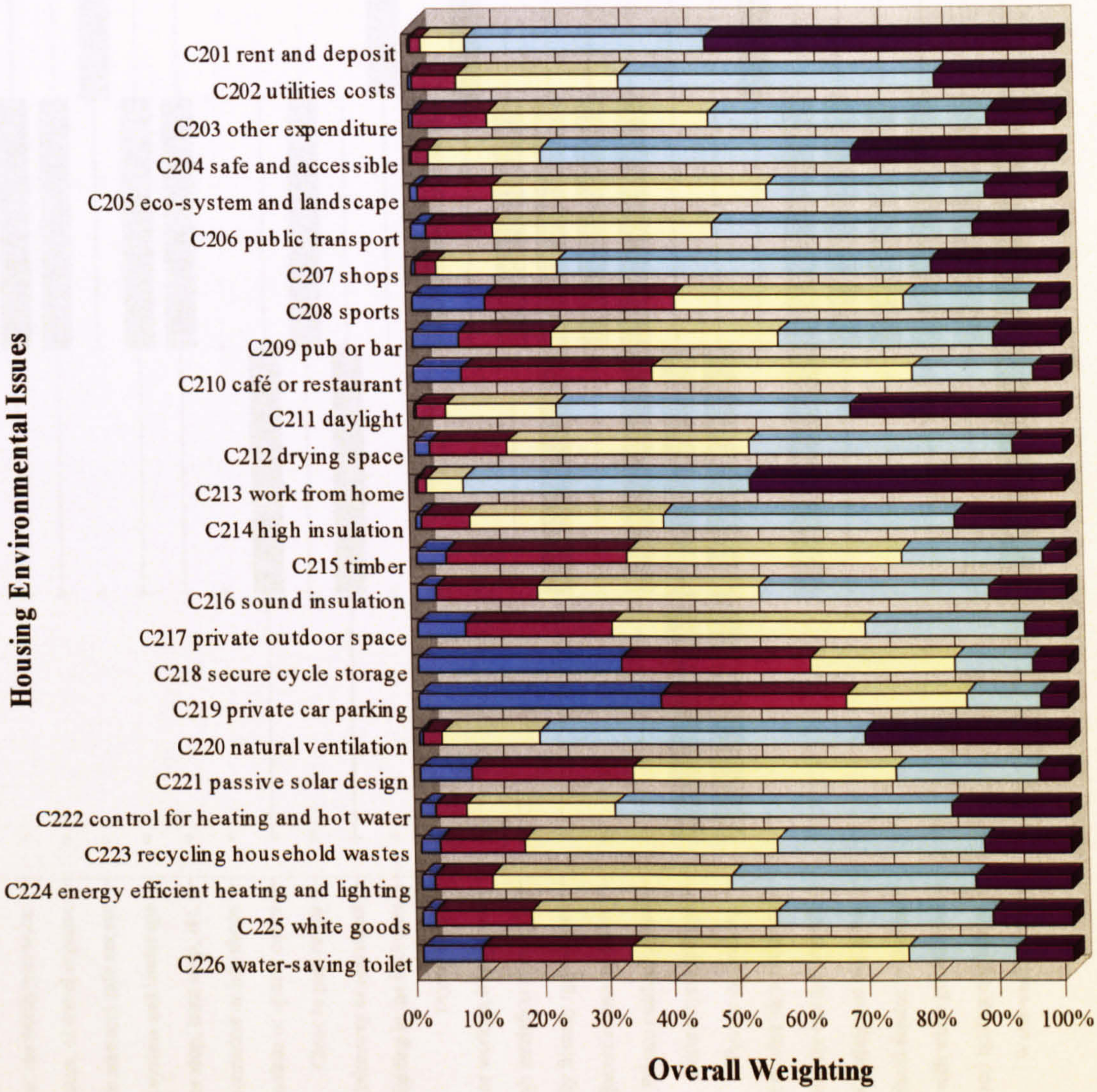


**Figure 6.3: Relative importance of different housing environmental issues – rated by the target students (as the Occupant Group) based on a Likert-type scale, from 'Not at all important' to 'Very important'.**

Aggregated results of the consultation in the target students group are shown in this figure. A bar on the graph's Y-axis represents the variety of housing environmental issues encountered in the accommodation seeking processes (drawn from EcoHomes and previous studies). The relative importance of different issues are summarised as a percentage of the total response; comparing the length of segments shows the degree of consensus on the relative importance of a particular issue between participants in the target student group.

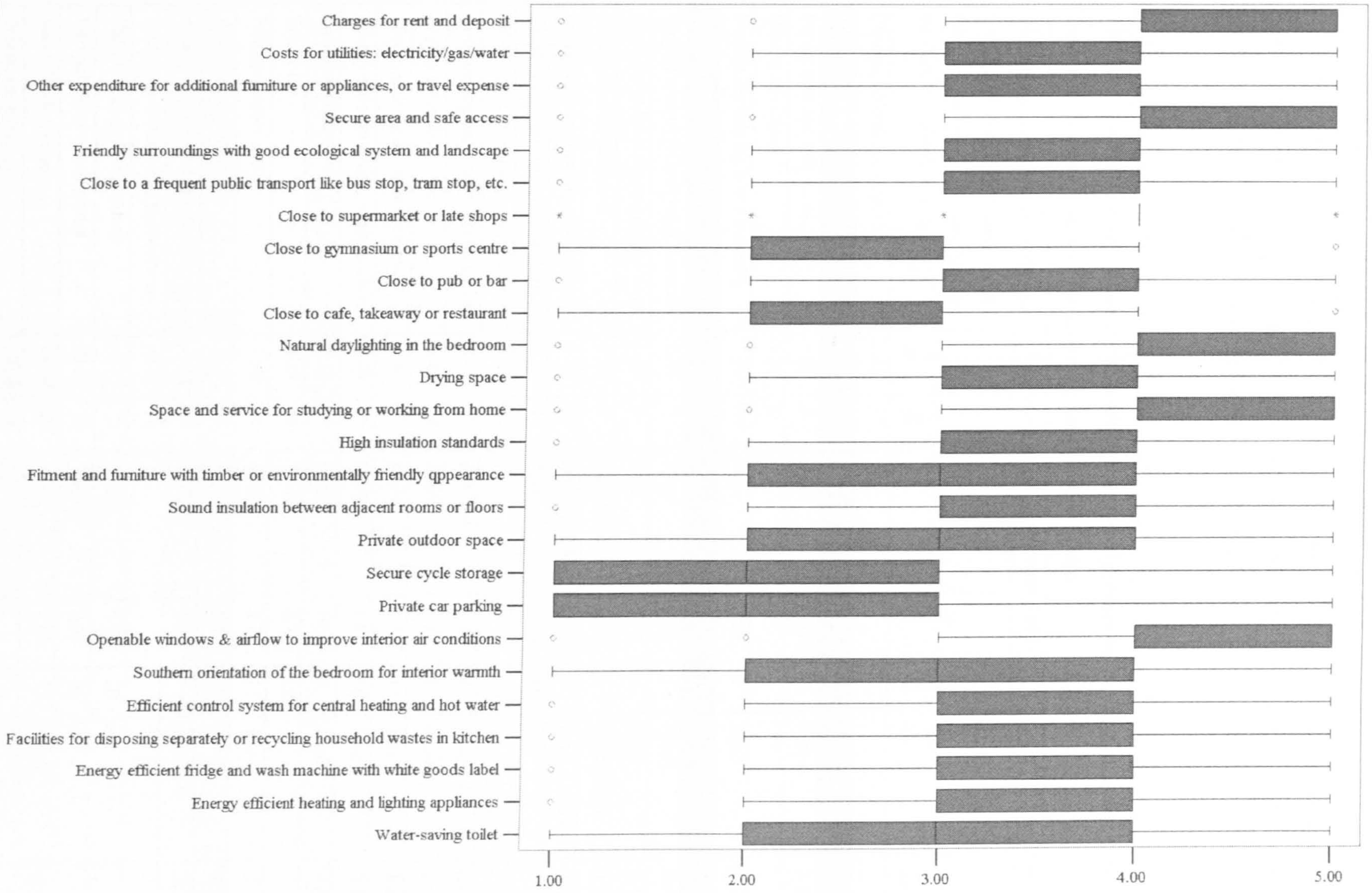


**Figure 6.4: Boxplots of the relative importance of different housing environmental issues – rated by the target students (as the Occupant Group) based on a Likert-type scale, from 'Not at all important' (1) to 'Very important' (5)**

Obviously, there was a certain degree of consensus between students in the target group on the relative importance of the palette of housing environmental issues. To understand students' priorities in their housing seeking processes better, the mean value is used to rank these housing environmental issues, as shown in Table 6.2.

**Table 6.2: Comparison of different ranks for housing environmental issues by the Occupant Group, EcoHomes 2006 and the Code for Sustainable Homes**

| Comparison of different ranks for housing environmental issues by the Occupant Group, EcoHomes 2006 and the Code for Sustainable Homes | Students | | EcoHomes 2006 | | | The Code | | |
|---|---|---|---|---|---|---|---|---|
| | Mean | ***Rank*** | Category | Credits | ***Rank*** | Category | Credits | ***Rank*** |
| Charges for rent and deposit | 1.43 | 1 | | | | | | |
| Study and work from home | 1.39 | 2 | Tra4 | 1.00 | 16 | Ene9 | 1.26 | 14 |
| Secure area and safe access | 1.09 | 3 | Man4 | 2.00 | 11 | Man4 | 2.20 | 13 |
| Natural ventilation | 1.09 | 4 | | | | | | |
| Natural daylighting in the bedroom | 1.06 | 5 | Hea1 | 5.25 | 5 | Hea1 | 3.50 | 6 |
| Supermarket or late shops | 0.93 | 6 | Tra3/4 | 0.75 | 19 | | | |
| Control system for heating & hot water | 0.79 | 7 | Man1 | 3.00 | 7 | Man1 | 3.30 | 7 |
| Costs for utilities: electricity/gas/water | 0.78 | 8 | Pol4 | 2.73 | 9 | Ene7 | 2.51 | 10 |
| High insulation standards | 0.70 | 9 | Ene2&Pol1 | 2.74 | 8 | Ene2&Pol1 | 3.21 | 8 |
| Energy efficient heating and lighting | 0.54 | 10 | Ene1,5,6&Pol2 | 20.14 | 1 | Ene1,3,6&Pol2 | 25.95 | 1 |
| Close to a frequent public transport | 0.52 | 11 | Tra1 | 2.00 | 12 | | | |
| Other expenditure, like travel expense | 0.52 | 12 | | | | | | |
| Good ecological system and landscape | 0.42 | 13 | Eco2&4 | 6.66 | 4 | Eco2&4 | 6.66 | 3 |
| Drying space for clothes | 0.40 | 14 | Ene3 | 0.92 | 17 | Ene4 | 1.26 | 15 |
| Facilities for house waste recycling | 0.40 | 15 | Mat4 | 2.71 | 10 | Was1 | 3.66 | 5 |
| Energy efficient fridge, wash machine | 0.39 | 16 | Ene4 | 1.83 | 14 | Ene5 | 2.51 | 12 |
| Sound insulation | 0.38 | 17 | Hea2 | 7.00 | 3 | Hea2 | 4.67 | 4 |
| Pub or bar | 0.25 | 18 | Tra3/4 | 0.75 | 18 | | | |
| Private outdoor space | 0.00 | 19 | Hea3 | 1.75 | 15 | Hea3 | 1.17 | 16 |
| Water-saving toilet | -0.07 | 20 | Wat1 | 8.33 | 2 | Wat1 | 7.50 | 2 |
| Timber for fitment and furniture | -0.08 | 21 | Mat2&3 | 4.06 | 6 | Mat2&3 | 2.70 | 9 |
| Southern orientation of the bedroom | -0.09 | 22 | | | | | | |
| Café, takeaway or restaurant | -0.17 | 23 | Tra3/4 | 0.75 | 20 | | | |
| Gymnasium or sports centre | -0.23 | 24 | Tra3/4 | 0.75 | 21 | | | |
| Secure cycle storage | -0.69 | 25 | Tra2 | 2.00 | 13 | Ene8 | 2.51 | 11 |
| Private car parking | -0.84 | 26 | | | | | | |
| | | | | | | | | |
| Some housing environmental issues have been considered to be *more* important by the Occupant Group | | | | | | | | |
| Other housing environmental issues have been considered to be *less* important by the Occupant Group | | | | | | | | |

Compared with the system for value judgement used by EcoHomes or the Code to address the causal issues, the one used by students in the target group to address the consequent issues is different. As shown in Table 6.2, some issues were considered to be more important by target students, such as 'space and service for studying or working from home' (related to Tra4 in EcoHomes), 'close to local accessible amenities (supermarket or late shops)' (related to Tra3) and so on. Other issues were considered to be less important, such as 'sound insulation between adjacent rooms or floors' (related to Hea2 in EcoHomes), 'water-saving toilet' (related to Wat1) and 'fitment and furniture with timber or environmentally friendly appearance' (related to Mat2&3) and so on. Another important issue that was addressed by students in the target group for student accommodation design, but missed from the questionnaire, was that student accommodation should be 'close to university and some university facilities (e.g. library)'.

Further, it is important to note that the average scores of some issues were very close to each other based on the 5-point measurement, for instance 'secure area and safe access' and 'natural ventilation' were both given an average score of 1.09, 'close to a frequent public transport' and 'other expenditure' were both given an average score of 0.52, and so on. However, since the sample size is relatively large, the maximum variation of the given phenomena, the relative importance of the palette of housing environmental issues from a student occupant's perspective, is still expected to be explored. This will be further discussed in 6.4.

### 6.3.3 KNOWLEDGE OF LIVING ISSUES (QD)

Students' knowledge of living issues related to their daily lifestyles was much less than expected. As shown in Figure 6.5 and Figure 6.6, more than half or almost half of target students admitted that their knowledge of 'the difference between energy suppliers' (64%), 'low energy lighting appliance' (49%) and 'Ecological Footprint' (60%) were poor (being rated as either 'poor' or 'very poor'). Their understanding of 'cost of utility bills' (44%), 'control or setting of heating system' (32%) and 'recycling household waste' (33%) was also less than expected. Even for the issue of 'the distance and frequency of service at the nearest public transport', which was rated by target students with better understanding, there were still 14% of them who considered their knowledge of this issue was less than neutral.

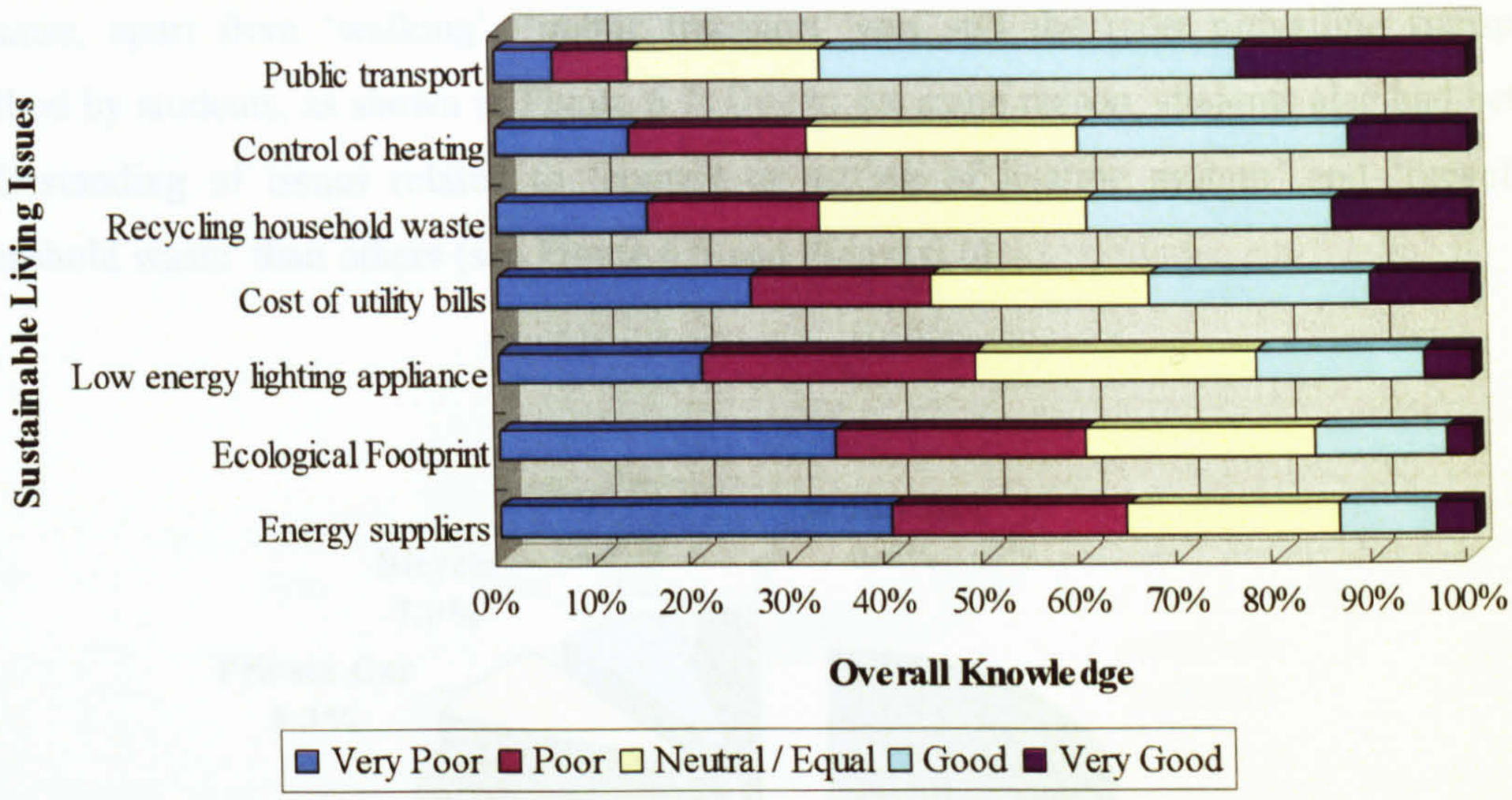


**Figure 6.5: Relative knowledge of different living issues – rated by the target students (as the Occupant Group) based on a Likert-type scale, from 'Very poor' to 'Very good'**

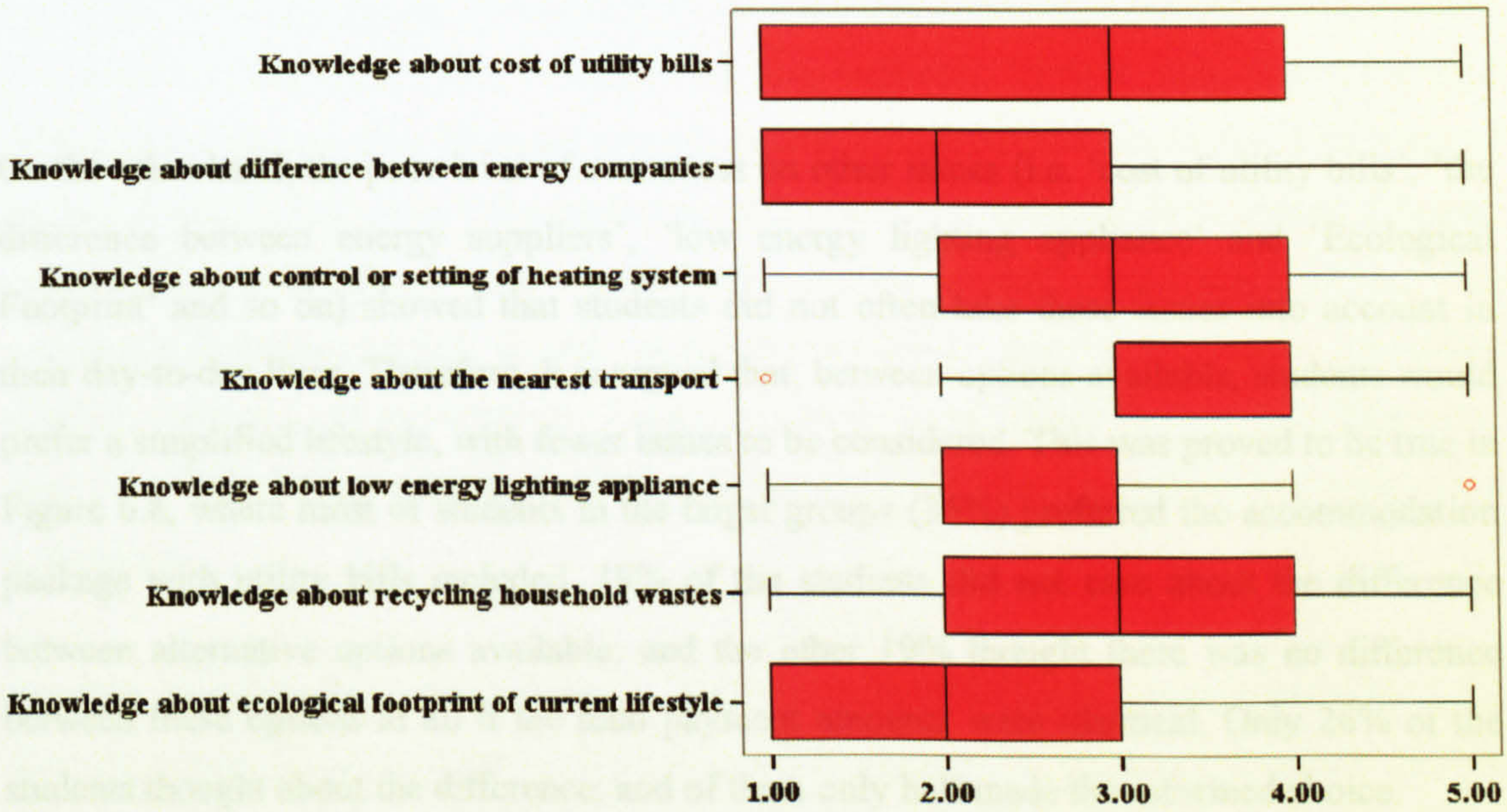


**Figure 6.6: Boxplots of the relative knowledge of different living issues – rated by the target students (as the Occupant Group) based on a Likert-type scale, from 'Very poor' (1) to 'Very good' (5)**

Obviously, students' knowledge of these issues needs to be improved as these issues are related to energy saving, carbon reductions and waste recycling in the operational phase of accommodation occupation. It is believed that students often have better understanding of issues confronted frequently in their everyday lives. In this case, for example, students in the target group had more knowledge of transport-related issues than others. This was mainly

because, apart from 'walking', 'public transport' was still the most prevailing transport method by students, as shown in Figure 6.7. Due to the same reason, students also had better understanding of issues related to 'control or setting of heating system' and 'recycling household waste' than others (see Figure 6.5 and Figure 6.6).

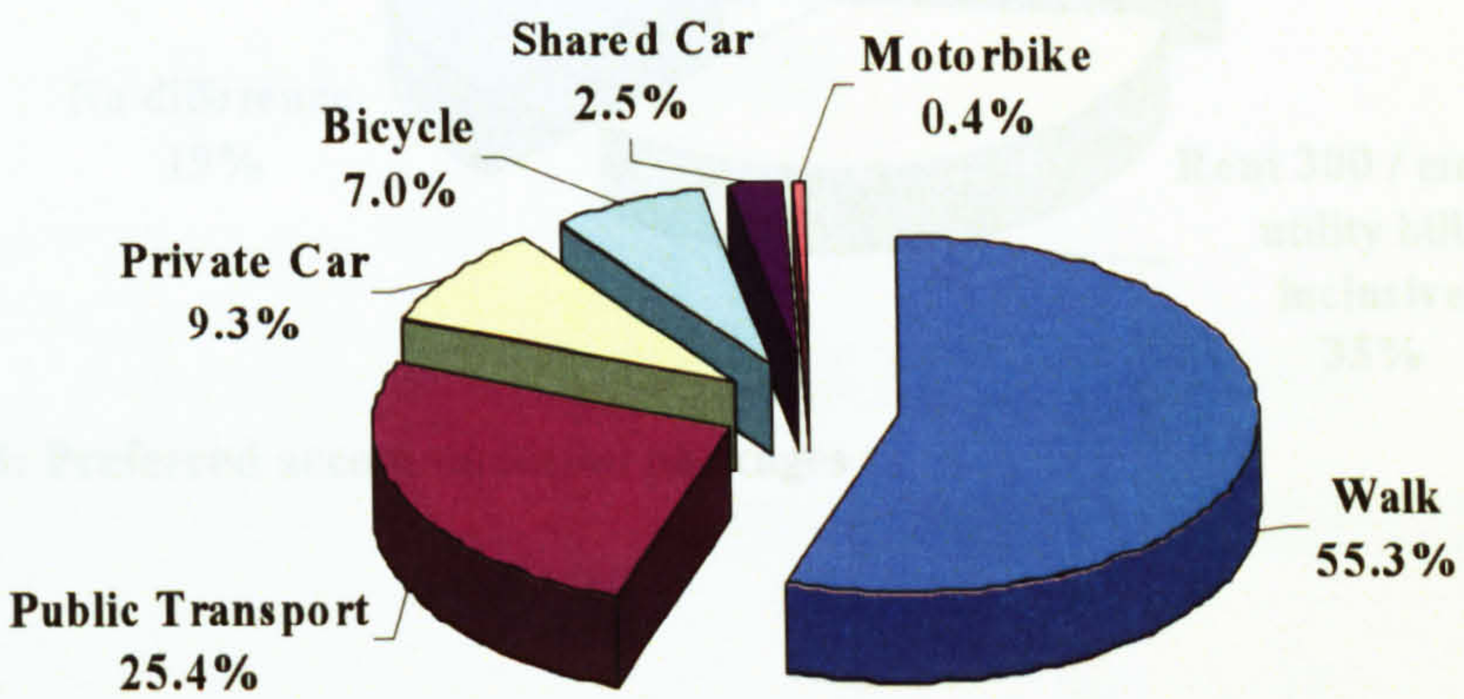


**Figure 6.7: Transport methods generally used by students (the Occupant Group)**

On the other hand, the poor level of awareness on other issues (i.e. 'cost of utility bills', 'the difference between energy suppliers', 'low energy lighting appliance' and 'Ecological Footprint' and so on) showed that students did not often take these issues into account in their day-to-day lives. Therefore, it is argued that, between options available, students would prefer a simplified lifestyle, with fewer issues to be considered. This was proved to be true in Figure 6.8, where most of students in the target groups (36%) preferred the accommodation package with utility bills included. 19% of the students did not care about the difference between alternative options available; and the other 19% thought there was no difference between these options at all if the total payment amounts were identical. Only 26% of the students thought about the difference; and of them only half made the informed choice.

As argued earlier, lifestyle choice was about peoples' voluntary, rather than compulsory, decision between alternative options available. Based on results above, therefore, it was reasonable to believe that students in the target group were not likely to relate alternative lifestyles to environmental impacts and showed little interest to whether the change of their lifestyles could make things different. This was proved to be true in the following question, where only half of the target students (57%) would look for information about living in a more sustainable way.

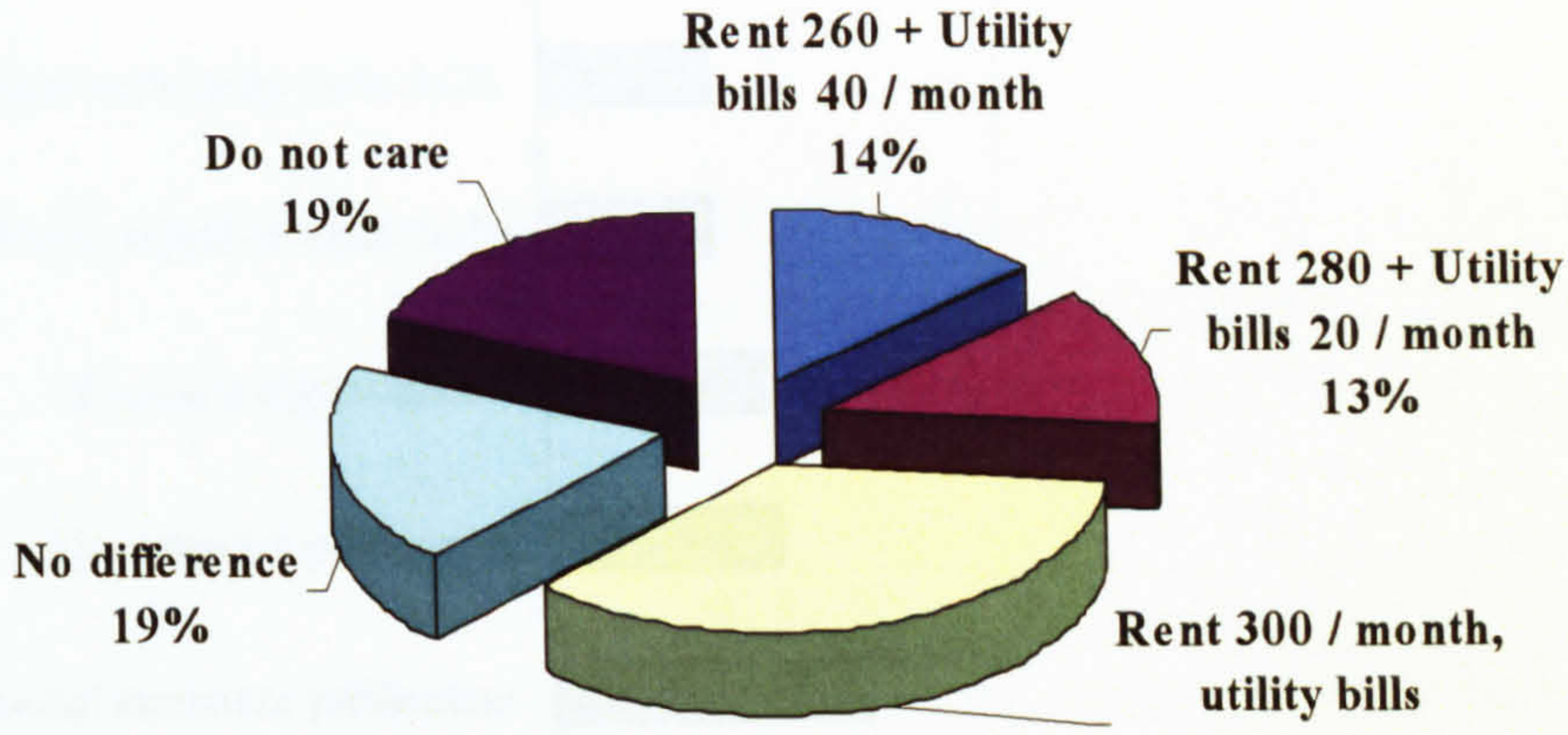


**Figure 6.8: Preferred accommodation packages**

To summarise, in current education, architectural students' knowledge of some issues, which are related to energy saving, carbon reductions and waste recycling in the operational phase of accommodation occupation, is much less than expected. Further, they also show less willingness to change their lifestyles towards greater environmental sensitivity. This leads to an open question that, even if the student accommodation is designed to be energy efficient and low carbon dioxide emitted, whether these student residents will truly appreciate the sustainable features and will be able to run the facilities properly. Obviously, university students' awareness of sustainability issues, especially those related to their daily lifestyles, need to be improved as soon as possible as it lags far behind the development of sustainable technology.

For those students who were looking for information about living in a more sustainable way, they often received the information from 'general media like TV, radio or newspaper' (33%), 'friends, colleagues or tutors' (27%), 'professional journal or publication' (12%) and so on, as shown in Figure 6.9. In addition, 'internet', as a general media, was addressed by target students in particular as an important information source for sustainable living. It was interesting to see that 'information booklet from university Accommodation and Campus Services (ACS)' (6%) was considered the least effective way to get the message across, although it was supposed to be most related to students' lives in accommodation.

To explore the maximum variation of the given phenomena, students' knowledge of lifestyle issues should be further examined based on statistical analysis. This will be discussed in 6.4.

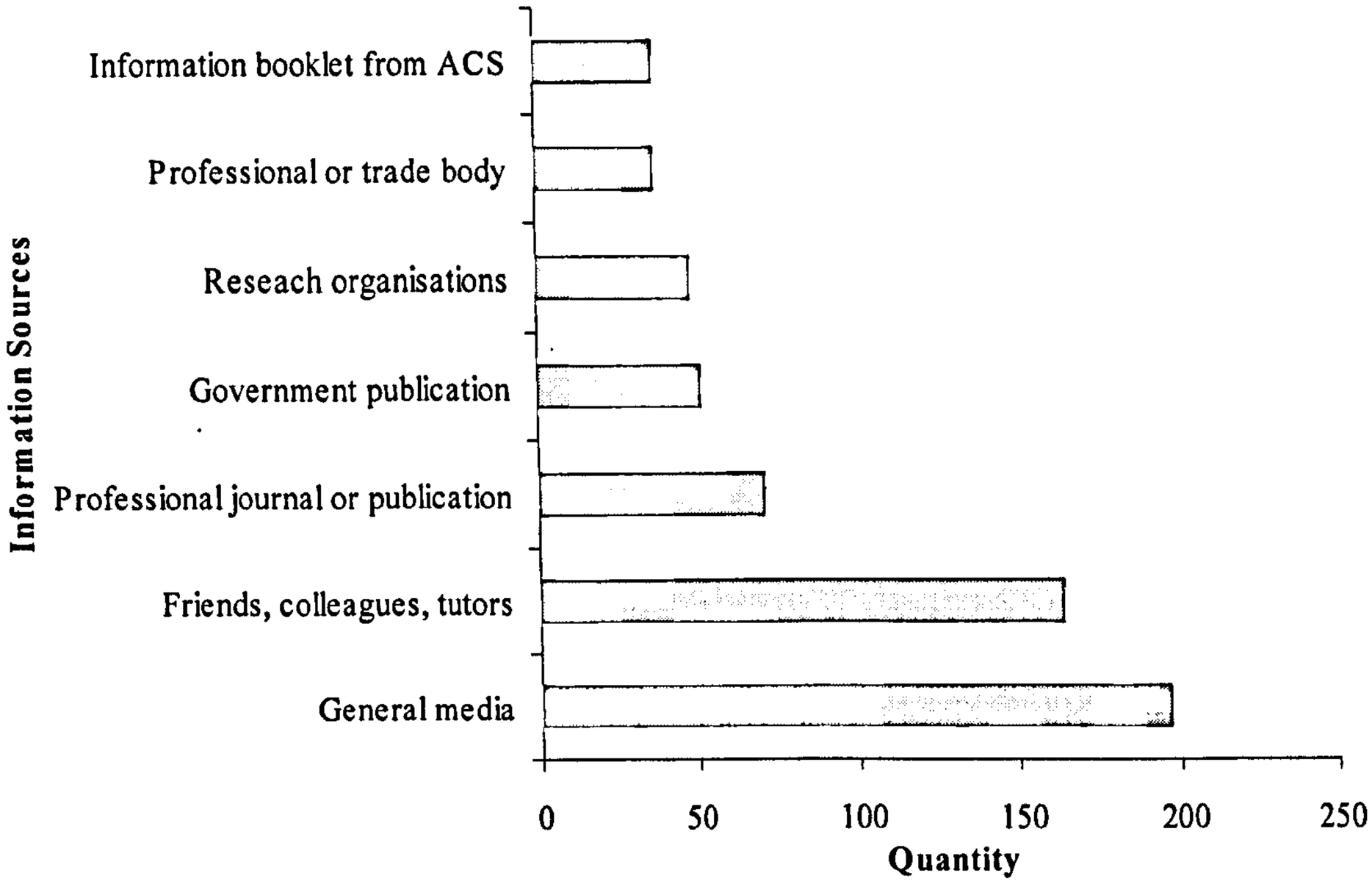


**Figure 6.9: Information sources for living in a more sustainable way**

### 6.3.4 OPEN QUESTIONS (QE)

In the section of open questions, students were asked, as students from the Faculty of Architecture, whether they would have any special interests when looking for a new accommodation. Qualitative data was coded and analysed based on techniques drawn from the grounded theory, though the procedures were not followed rigidly (for further information about the grounded theory, see 7.2). Although some students argued that they were concerned with issues relating to household waste recycling, high standard insulation (i.e. double glazing) and energy efficient heating systems and so on, more attention was paid to issues relating to the convenient circumstance for study and living (e.g. large interior space for studying at home). To some extent, this feedback corresponded with students' priorities of relevant issues (responses of QC in 6.3.2). Some interesting feedback from the target students are summarised in the following sections:

'I think, as a student, things such as cutting down on electricity use etc are not done with mind on sustainability, but more on cost.' – from a first year architectural student

'Yes. I am much more concerned with energy saving than my housemates. Actually in university accommodation, questions related to bills, energy

suppliers, control systems will be N/A.' – from a first year architectural student

'I would like to live more sustainably. Sometimes I act in a way that is unsustainable because I know that it is easier than the alternative. I think my housemates are less sustainably-minded than me.' – from a third year architectural student

'All the issues addressed in the questionnaire are important but you cannot find a student accommodation with all these issues being considered from an integrated perspective; or if you can, you often cannot afford it.' – from a third year architectural student

'Ability to recycle. The major things preventing this currently are distance to recycling facilities (especially those for plastic or glass recycling).' – from a second year landscape student

Although some students believed that this kind of survey would help them increase their awareness of relevant issues, but the proportion was very small.

'Be able to positively affect my housemate's footprints as well as my own.' – from a second year architectural student

'Become more energy efficient.' – from a third year landscape student

Furthermore, some students argued against the hypothesis of this research and said that,

'Architectural students (alas) are not necessarily more aware or ready to change than other people, in my opinion.' – from a third year architectural student

Some qualitative responses from the open questions above provided further hypotheses for later quantitative studies. To better understand maximum variation of the given phenomena, a statistical analysis programme is used to make correlational and causal-comparative studies in the following sections.

## 6.4 STATISTICAL ANALYSIS BASED ON SPSS

As argued in Chapter 2, there were many factors that jointly decide the energy consumption and carbon dioxide emissions during the operational phase of accommodation occupation. Recently some trans-disciplinary studies have been carried out. Researchers start to use statistical methods to explore variation of the given phenomena. For instance, a Bayesian Belief Networks (BBN)[xlvi] model is proposed by CaRB team (Shipworth 2005) to support the design decision-making, as shown in Figure 6.10. Based on this model, this research simplifies the variables by setting a particular social group (university students studying architecture or built environment related disciplines) as the main research scenario.

In the process of focusing down, the centre of gravity of this research was transferred to explore the interrelationship between 'education' and its effects over 'environmental awareness' and 'social desirability' to this 'social group'. Actually, as shown in Figure 6.10, issues relating to 'education' and its effects on 'environmental awareness' and 'social desirability' were addressed as the most important factors that contributed to the bottom line of the BBN model. Some factors related to 'education' and 'social group', such as gender, major subject, academic year and cultural background[xlvii] (issues addressed in QA), were used to group feedback from variables and divide them into sub-groups for further studies, as shown in Figure 6.11.

The statistical analysis programme SPSS (Figure 6.12) was then used to make correlational and causal-comparative studies. Different analysis methods were applied according to their specific features, assumptions, functions and the desired outcomes. Further details are described in the following sections, focusing on issues with significant findings in particular.

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xlvi 'Bayesian Belief Networks (BBNs) are an intuitive method for reasoning under uncertainty, combining different data types, and learning from new observations as they become available (Jensen 1999).' ... 'In Bayesian Methods: A social and behavioural science approach Gill (2002) lists advantages of Bayesian methods as including: the ability to learn as new information is received or population variables change; the capacity to systematically integrate a wide variety of data types and any prior available knowledge; overt and clear model assumptions and straightforward sensitivity testing.' ... 'The interest in applied Bayesian Belief Networks lies principally in their use as decision support systems. They are offer the opportunity to capture expert knowledge in the field as well as structure this in a way supports programme development and implementation. Their capacity to integrate data of varying quality and type, as well as synthesising relevant factors in social, economic, ecological and technical fields, makes them particularly useful in the complex socio-economic/socio-technical environments of sustainable development.' (Shipworth 2005)

xlvii In this particularly focused social group, factors based on which the variables are grouped have been significantly simplified. Some private or sensitive issues, such as age, income, occupation, education background and so on, are not necessary to be taken into account as they are similar to participants in the focus group.

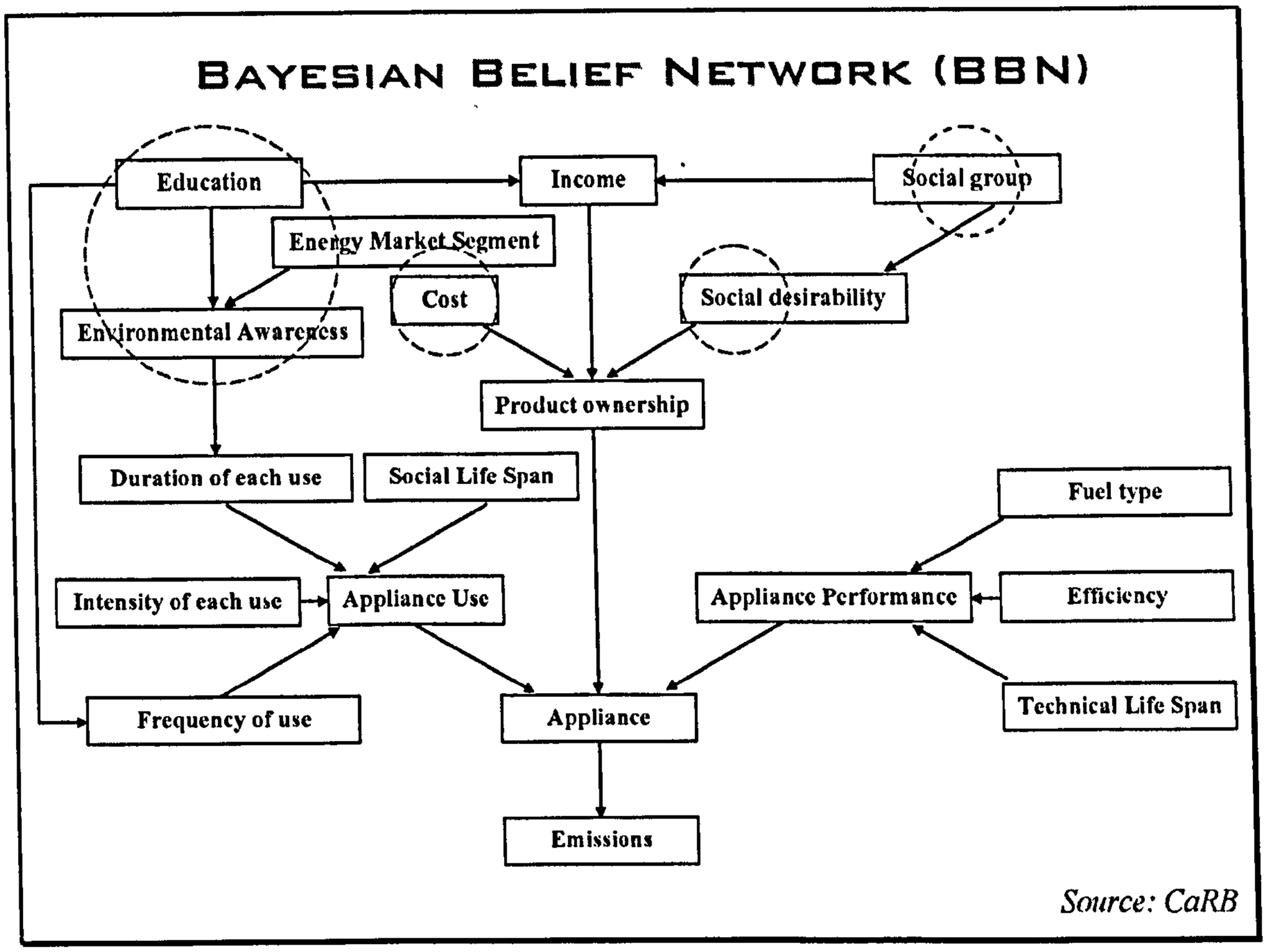


**Figure 6.10: Proposed Bayesian Belief Network (BBN) model by CaRB** (Shipworth 2005)

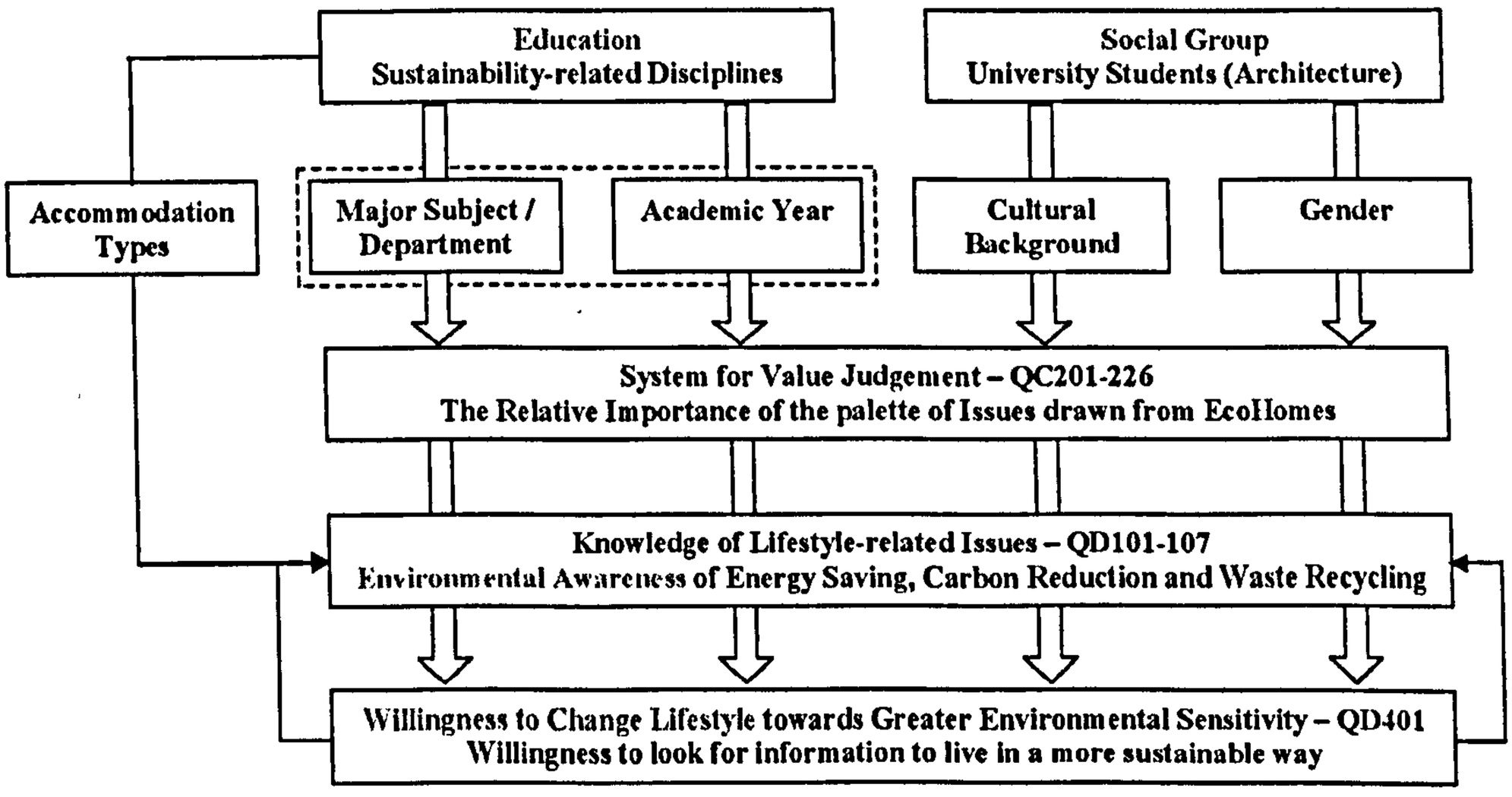


**Figure 6.11: Research framework in this stage based on the Bayesian Belief Network**

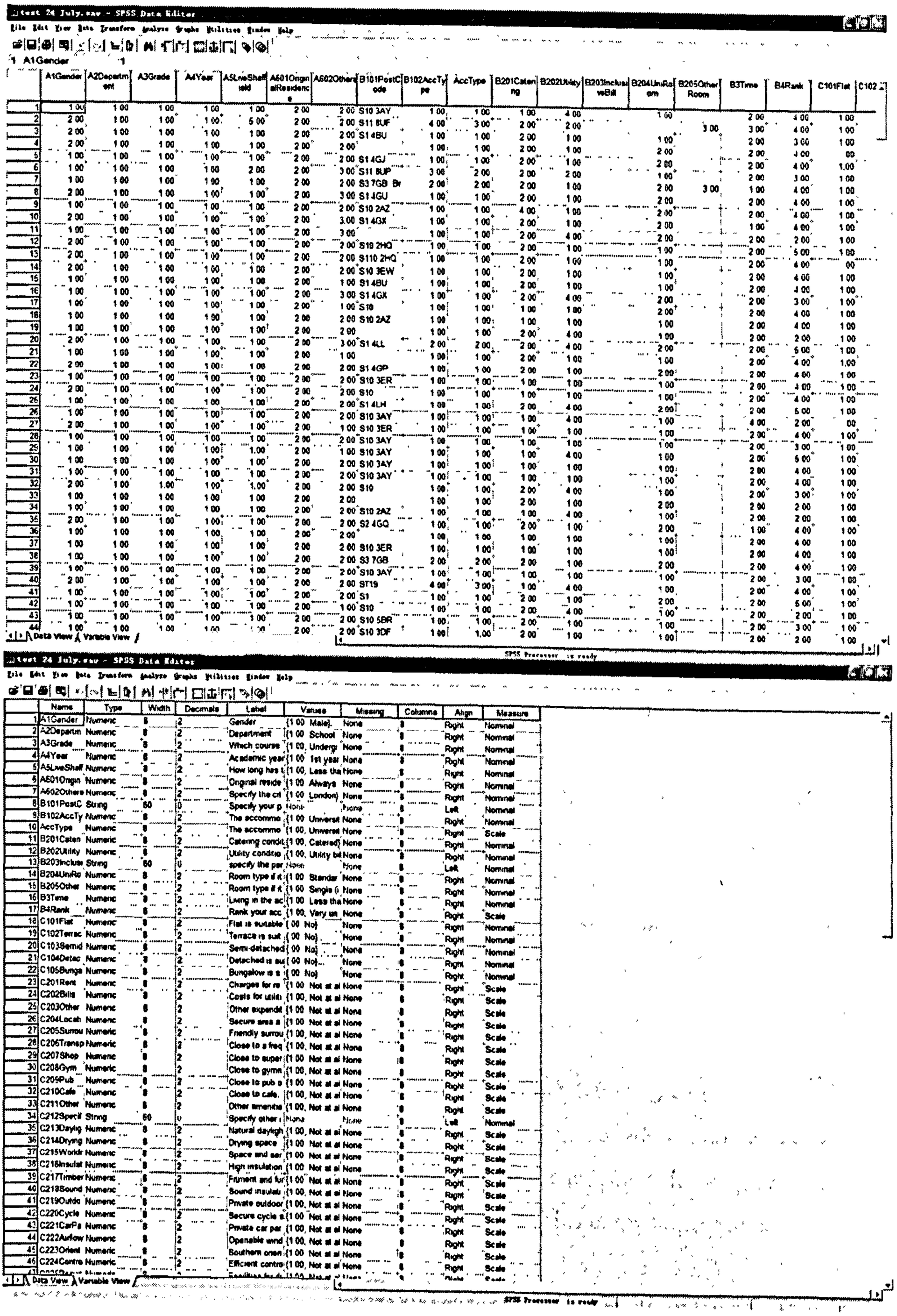


**Figure 6.12: SPSS Windows Version 13**

It is important to note that, in the statistic analysis, asterisks * and ** were used to indicate different levels of significant difference, normally with * representing $p < .05$ and ** representing $p < .01$ unless a stricter alpha level was specified.

### 6.4.1 GROUP FACTORS (QA) * HOUSING ENVIRONMENTAL ISSUES DRAWN FROM ECOHOMES (QC2)

This section explores the priority variances within the target group of students according to their group factors (i.e. gender, major subject, academic year and cultural background). As argued earlier (see 6.3.2), the relative importance of a range of housing environmental issues drawn from EcoHomes (QC201-226) were designed to be evaluated based on a 5-point Likert-type scale, from 'Not at all important' to 'Very important' measured at regular intervals. In the processes of statistical analysis, the parametric tests (such as t-tests and ANOVA) could be applied to explore the significant differences if assumptions were not violated, for instance the distribution of the underlying population from which the sample had been drawn was normal.

Nevertheless, it was still arguable whether the multiple-indicator (or multiple-item) measures of concepts, such as 5-point Likert-type scales in this case, could produce interval or ratio variables besides ordinal variables. In terms of analysis, therefore, statistical methods drawn from both ***parametric*** and ***non-parametric*** techniques were applied in parallel to explore the variation and to supplement each other. Since parametric statistics tended to be more sensitive and powerful than non-parametric statistics (Field 2005: 533; Pallant 2007: 210), results from parametric statistics were taken into account as the main research findings, whereas results from non-parametric statistics were used to verify the significant findings based on parametric statistics. The procedures of data analysis are described in the following sections and some details can be found in Appendix 1.

- ***Gender * QC201-226 – Independent T test & Mann-Whitney U test***

The independent t-test (*Independent Samples T test* underneath *Compare Means*) was conducted to compare the means, on the evaluation of the palette of housing environmental issues (from QC201 to QC226), for male and female students in the target group.

As shown in Table 6.3 and Table 6.4, aggregated results of the consultations showed that male and female students' opinions were significantly different ($p < .05$) on six environmental issues, which were QC202, QC204, QC206, QC209, QC214 and QC218. For the evaluation of the rest of issues, there were no significant differences ($p > .05$) between male and female students in the target group. Further details can be found in Appendix 1.1.

**Table 6.3: Group Statistics – Described by Gender**

| | Gender | N | Mean | Std. Deviation | Std. Error Mean |
|---|---|---|---|---|---|
| QC201 | Male | 247 | 4.3846 | .73932 | .04704 |
| | Female | 220 | 4.4818 | .68556 | .04622 |
| QC202 | Male | 247 | 3.6842 | .85864 | .05463 |
| | Female | 220 | 3.8909 | .81477 | .05493 |
| QC203 | Male | 247 | 3.4453 | .85305 | .05428 |
| | Female | 220 | 3.6000 | .85154 | .05741 |
| QC204 | Male | 247 | 3.9514 | .77935 | .04959 |
| | Female | 220 | 4.2409 | .75317 | .05078 |
| QC205 | Male | 247 | 3.4130 | .84073 | .05349 |
| | Female | 220 | 3.4364 | .91189 | .06148 |
| QC206 | Male | 247 | 3.3522 | .92031 | .05856 |
| | Female | 220 | 3.7136 | .88869 | .05992 |
| QC207 | Male | 247 | 3.8745 | .75199 | .04785 |
| | Female | 220 | 3.9955 | .74330 | .05011 |
| QC208 | Male | 247 | 2.7571 | 1.07716 | .06854 |
| | Female | 220 | 2.7864 | .98611 | .06648 |
| QC209 | Male | 247 | 3.3725 | 1.05486 | .06712 |
| | Female | 220 | 3.1227 | 1.04179 | .07024 |
| QC210 | Male | 247 | 2.8381 | 1.03892 | .06611 |
| | Female | 220 | 2.8182 | .86728 | .05847 |
| QC211 | Male | 247 | 4.0486 | .81004 | .05154 |
| | Female | 220 | 4.0682 | .86001 | .05798 |
| QC212 | Male | 247 | 3.4211 | .88394 | .05624 |
| | Female | 220 | 3.3727 | .87439 | .05895 |
| QC213 | Male | 247 | 4.3522 | .72794 | .04632 |
| | Female | 220 | 4.4318 | .63382 | .04273 |
| QC214 | Male | 247 | 3.5911 | .86884 | .05528 |
| | Female | 220 | 3.8136 | .85303 | .05751 |
| QC215 | Male | 247 | 2.9312 | .85499 | .05440 |
| | Female | 220 | 2.9000 | .95037 | .06407 |
| QC216 | Male | 247 | 3.3927 | 1.00184 | .06375 |
| | Female | 220 | 3.3636 | .94822 | .06393 |
| QC217 | Male | 247 | 3.0040 | 1.00607 | .06401 |
| | Female | 220 | 2.9955 | 1.01809 | .06864 |
| QC218 | Male | 247 | 2.4170 | 1.22648 | .07804 |
| | Female | 220 | 2.1864 | 1.12943 | .07615 |
| QC219 | Male | 247 | 2.2308 | 1.24588 | .07927 |
| | Female | 220 | 2.0864 | 1.07133 | .07223 |
| QC220 | Male | 247 | 4.0648 | .76765 | .04884 |
| | Female | 220 | 4.1136 | .80568 | .05432 |
| QC221 | Male | 247 | 2.8502 | .96157 | .06118 |
| | Female | 220 | 2.9682 | 1.00405 | .06769 |
| QC222 | Male | 247 | 3.7530 | .84086 | .05350 |
| | Female | 220 | 3.8318 | .90351 | .06091 |
| QC223 | Male | 247 | 3.3684 | .96161 | .06119 |
| | Female | 220 | 3.4318 | .97451 | .06570 |
| QC224 | Male | 247 | 3.4858 | .90099 | .05733 |
| | Female | 220 | 3.6091 | .92253 | .06220 |
| QC225 | Male | 247 | 3.3158 | .93567 | .05954 |
| | Female | 220 | 3.4727 | .95285 | .06424 |
| QC226 | Male | 247 | 2.8826 | 1.06610 | .06783 |
| | Female | 220 | 2.9727 | 1.02889 | .06937 |

**Table 6.4: Independent Samples T Test**

| | | Levene's Test for Equality of Variances | | t-test for Equality of Means | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | 95% Confidence Interval of the Difference | |
| | Equal variances | F | Sig. | t | df | Sig. (2-tailed) | Mean Difference | Lower | Upper |
| QC201 | assumed | .521 | .471 | -1.467 | 465 | .143 | -.09720 | -.22736 | .03296 |
| | not assumed | | | -1.474 | 464.238 | .141 | -.09720 | -.22680 | .03239 |
| QC202 | assumed | 4.692 | .031 | -2.660 | 465 | .008 | -.20670 | -.35941 | -.05399 |
| | not assumed | | | -2.668 | 463.127 | .008(**) | -.20670 | -.35894 | -.05445 |
| QC203 | assumed | .225 | .635 | -1.957 | 465 | .051 | -.15466 | -.30993 | .00061 |
| | not assumed | | | -1.957 | 459.003 | .051 | -.15466 | -.30992 | .00060 |
| QC204 | assumed | 3.411 | .065 | -4.071 | 465 | .000(**) | -.28949 | -.42924 | -.14974 |
| | not assumed | | | -4.079 | 461.901 | .000 | -.28949 | -.42897 | -.15002 |
| QC205 | assumed | 1.633 | .202 | -.289 | 465 | .773 | -.02341 | -.18280 | .13598 |
| | not assumed | | | -.287 | 447.689 | .774 | -.02341 | -.18357 | .13675 |
| QC206 | assumed | .261 | .610 | -4.305 | 465 | .000(**) | -.36141 | -.52638 | -.19644 |
| | not assumed | | | -4.314 | 461.961 | .000 | -.36141 | -.52604 | -.19677 |
| QC207 | assumed | .278 | .598 | -1.745 | 465 | .082 | -.12096 | -.25721 | .01529 |
| | not assumed | | | -1.746 | 459.980 | .082 | -.12096 | -.25712 | .01520 |
| QC208 | assumed | 2.930 | .088 | -.305 | 465 | .760 | -.02928 | -.21788 | .15932 |
| | not assumed | | | -.307 | 464.644 | .759 | -.02928 | -.21692 | .15836 |
| QC209 | assumed | .832 | .362 | 2.569 | 465 | .011(*) | .24974 | .05870 | .44079 |
| | not assumed | | | 2.571 | 460.060 | .010 | .24974 | .05883 | .44066 |
| QC210 | assumed | 6.506 | .011 | .223 | 465 | .824 | .01987 | -.15536 | .19511 |
| | not assumed | | | .225 | 463.096 | .822 | .01987 | -.15355 | .19330 |
| QC211 | assumed | 1.247 | .265 | -.254 | 465 | .800 | -.01960 | -.17152 | .13232 |
| | not assumed | | | -.253 | 451.096 | .801 | -.01960 | -.17206 | .13286 |
| QC212 | assumed | .100 | .752 | .593 | 465 | .554 | .04833 | -.11188 | .20854 |
| | not assumed | | | .593 | 459.908 | .553 | .04833 | -.11179 | .20844 |
| QC213 | assumed | 1.569 | .211 | -1.253 | 465 | .211 | -.07959 | -.20442 | .04524 |
| | not assumed | | | -1.263 | 464.767 | .207 | -.07959 | -.20343 | .04425 |
| QC214 | assumed | 1.342 | .247 | -2.787 | 465 | .006(**) | -.22254 | -.37947 | -.06562 |
| | not assumed | | | -2.790 | 460.601 | .005 | -.22254 | -.37931 | -.06578 |
| QC215 | assumed | 2.489 | .115 | .373 | 465 | .709 | .03117 | -.13299 | .19534 |
| | not assumed | | | .371 | 443.417 | .711 | .03117 | -.13402 | .19637 |
| QC216 | assumed | 1.033 | .310 | .321 | 465 | .748 | .02908 | -.14890 | .20705 |
| | not assumed | | | .322 | 463.274 | .748 | .02908 | -.14833 | .20648 |
| QC217 | assumed | .022 | .882 | .092 | 465 | .927 | .00859 | -.17572 | .19291 |
| | not assumed | | | .092 | 457.513 | .927 | .00859 | -.17585 | .19304 |
| QC218 | assumed | 5.144 | .024 | 2.105 | 465 | .036 | .23064 | .01536 | .44592 |
| | not assumed | | | 2.115 | 464.477 | .035(*) | .23064 | .01638 | .44490 |
| QC219 | assumed | 12.911 | .000 | 1.335 | 465 | .183 | .14441 | -.06818 | .35699 |
| | not assumed | | | 1.347 | 464.438 | .179 | .14441 | -.06634 | .35515 |
| QC220 | assumed | 1.777 | .183 | -.671 | 465 | .503 | -.04886 | -.19201 | .09429 |
| | not assumed | | | -.669 | 452.794 | .504 | -.04886 | -.19242 | .09470 |
| QC221 | assumed | .037 | .848 | -1.296 | 465 | .196 | -.11798 | -.29684 | .06088 |
| | not assumed | | | -1.293 | 453.521 | .197 | -.11798 | -.29730 | .06134 |
| QC222 | assumed | .139 | .710 | -.976 | 465 | .330 | -.07878 | -.23744 | .07988 |
| | not assumed | | | -.972 | 449.224 | .332 | -.07878 | -.23812 | .08055 |
| QC223 | assumed | .006 | .938 | -.707 | 465 | .480 | -.06340 | -.23968 | .11289 |
| | not assumed | | | -.706 | 457.346 | .480 | -.06340 | -.23983 | .11303 |
| QC224 | assumed | .005 | .942 | -1.459 | 465 | .145 | -.12326 | -.28925 | .04273 |
| | not assumed | | | -1.457 | 456.109 | .146 | -.12326 | -.28949 | .04297 |
| QC225 | assumed | .403 | .526 | -1.794 | 465 | .074 | -.15694 | -.32887 | .01500 |
| | not assumed | | | -1.792 | 456.771 | .074 | -.15694 | -.32906 | .01518 |
| QC226 | assumed | 1.254 | .263 | -.927 | 465 | .354 | -.09014 | -.28119 | .10091 |
| | not assumed | | | -.929 | 462.002 | .353 | -.09014 | -.28080 | .10052 |

(*) significant difference at level of $p < .05$

(**) significant difference at level of $p < .01$

The results showed that, in the target group, male and female students had a general consensus on the relative importance of most of the housing environmental issues addressed in the questionnaire (QC201-226). Although their opinions might vary from issue to issue, the magnitudes of the differences were relatively small (see Appendix 1.1 for their effect sizes). However, there were six exceptions which had been described above. From a further study based on the interpretation of the statistic results, it was found that, in the target group, female students were more likely to pay attention to some environmental issues in their housing seeking processes, such as 'costs for utility bills' (related to Pol4 in EcoHomes), 'secure area and safe access' (Man4), 'close to frequent public transport' (Tra1) and 'high insulation standards' (Ene2 and Pol1). While for male students, they were more concerned with issues relating to leisure activities, such as 'close to pub or bar' (related to Tra3 in EcoHomes) and 'secure cycle storage' (Tra2).

To encourage students to take part in the campaign against climate change, therefore, the same palette of housing environmental issues should be addressed from different perspectives. For female students, it is important to relate the issues to money saving, safety and security, and convenient lifestyle and so on. On the other hand, for male students, it is important to let them know how these changes will lead their lifestyles to a more interesting and exciting future.

Some people may argue against the method of using independent t-test to see the variance between different groups of variables in this case by insisting that the data were measured on ordinal (ranking) scales rather than on interval scales. According to them, non-parametric technique, the Mann-Whitney U test, might be more suitable and should be used instead. To see the difference, therefore, the *2 Independent Samples* (test) underneath *Nonparametric Tests* was used to re-analyse the data and the results were reported in Table 6.5. It was found that male and female students in the target group had significant differences ($p < .05$) in QC202, QC203, QC204, QC206, QC209, QC214 and QC218. Most findings corresponded with those from the independent t-test, except QC203 ('other expenditure') which had been found to have significant differences between male and female students by the Mann-Whitney U test but not by its parametric counterpart (independent t-test).

Since non-parametric statistics tended to be less sensitive and powerful than parametric statistics (Field 2005: 533; Pallant 2007: 210), results from the parametric statistics (independent t-test) were taken into account as the main research findings.

**Table 6.5: Mann-Whitney U test [a]**

| | Mann-Whitney U | Wilcoxon W | Z | Asymnp. Sig. (2-tailed) |
|---|---|---|---|---|
| QC201 | 25243.000 | 55871.000 | -1.489 | .137 |
| QC202 | 23667.500 | 54295.500 | -2.593 | .010(*) |
| QC203 | 24346.000 | 54974.000 | -2.071 | .038(*) |
| QC204 | 21619.500 | 52247.500 | -4.131 | .000(**) |
| QC205 | 26436.000 | 57064.000 | -.537 | .591 |
| QC206 | 21543.000 | 52171.000 | -4.093 | .000(**) |
| QC207 | 25003.500 | 55631.500 | -1.670 | .095 |
| QC208 | 26715.000 | 57343.000 | -.326 | .745 |
| QC209 | 23444.500 | 47754.500 | -2.673 | .008(**) |
| QC210 | 26911.500 | 51301.500 | -.129 | .897 |
| QC211 | 26545.000 | 57173.000 | -.461 | .644 |
| QC212 | 26319.000 | 50629.000 | -.623 | .533 |
| QC213 | 25968.500 | 56596.500 | -.922 | .356 |
| QC214 | 23464.500 | 54092.500 | -2.717 | .007(**) |
| QC215 | 26405.500 | 50715.500 | -.556 | .578 |
| QC216 | 26513.500 | 50823.500 | -.473 | .636 |
| QC217 | 26807.000 | 51117.000 | -.261 | .794 |
| QC218 | 24381.000 | 48691.000 | -1.985 | .047(*) |
| QC219 | 26031.000 | 50341.000 | -.817 | .414 |
| QC220 | 26086.000 | 56714.000 | -.812 | .417 |
| QC221 | 25542.000 | 56170.000 | -1.175 | .240 |
| QC222 | 25503.000 | 56131.000 | -1.247 | .212 |
| QC223 | 26278.000 | 56906.000 | -.645 | .519 |
| QC224 | 24813.500 | 55441.500 | -1.714 | .087 |
| QC225 | 24682.000 | 55310.000 | -1.798 | .072 |
| QC226 | 25986.500 | 56614.500 | -.855 | .393 |

(*) significant difference at level of $p < .05$

(**) significant difference at level of $p < .01$

a. Grouping Variable: Gender

- ***Major Subject (Department) and Academic Year * QC201-226 – Two-way Independent Analysis of Variance (ANOVA)***

The two-way between-groups analysis of variance (independent ANOVA) was conducted to explore the impact of education, particularly focusing on 'major subject' (department) and 'academic year', on students' evaluation of the palette of housing environmental issues (from QC201 to QC226). To make comparisons, students in the target group were divided into several sub-groups according to their departments and academic years, as shown in Table 6.6.

**Table 6.6: Aggregated responses according to students' departments & academic years**

| | Architecture | Landscape | TRP | Total N |
|---|---|---|---|---|
| 1st year | 110 | 20 | | 130 |
| 2nd year | 63 | 33 | 40 | 136 |
| 3rd year | 79 | 13 | 35 | 127 |
| MA | 17 | 40 | 17 | 74 |
| Total N | 269 | 106 | 92 | 467 |

As shown in Table 6.7 and Table 6.8, it was found that the effects, including both main effects and interaction effects, of independent variables (major subject and academic year) on students' attitudes varied from issue to issue. The interaction effects between department and academic year on students' evaluation of the relative importance of QC209, QC214 and QC216 were statistically significant, $p < .05$. There were statistically significant main effects for students' department on their evaluation of QC205 and QC212, $p < .05$; and on their evaluation of QC209, QC210, QC211, QC217, QC218 and QC220, $p < .01$. Likewise, there were also statistically significant main effects for students' academic year on students' evaluation of QC206, $p < .05$, and QC209, $p < .01$. Further details can be found in Appendix 1.1.

**Table 6.7: Descriptive Statistics by Department and Academic Year**

| Issues drawn from EcoHomes | Year | Mean (M) / Standard Diversion (SD) | | |
|---|---|---|---|---|
| | | Architecture | Landscape | TRP |
| QC201 Charges for rent and deposit | 1st year | 4.3455 / .69647 | 4.0000 / .79472 | |
| | 2nd year | 4.6508 / .51302 | 4.4242 / .75126 | 4.5250 / .67889 |
| | 3rd year | 4.3038 / .88222 | 4.6154 / .50637 | 4.7143 / .57248 |
| | MA | 4.2353 / .75245 | 4.4500 / .67748 | 4.4706 / .62426 |
| QC202 Costs for utilities: electricity / gas / water | 1st year | 3.8273 / .84440 | 3.8000 / .83351 | |
| | 2nd year | 3.7460 / .78223 | 3.8788 / .78093 | 3.8500 / .89299 |
| | 3rd year | 3.7595 / .85057 | 3.6923 / .75107 | 3.8857 / .96319 |
| | MA | 3.7647 / .66421 | 3.7500 / .80861 | 3.2941 / 1.1048 |
| QC203 Other expenditure, like travel expense | 1st year | 3.3636 / .86446 | 3.5000 / 1.0000 | |
| | 2nd year | 3.5079 / .87755 | 3.5152 / .66714 | 3.6500 / .86380 |
| | 3rd year | 3.5570 / .87335 | 3.3077 / .75107 | 3.5714 / .94824 |
| | MA | 3.5294 / .51450 | 3.8750 / .72280 | 3.2941 / 1.0467 |
| QC204 Secure area and safe access | 1st year | 4.0000 / .75419 | 4.1000 / .64072 | |
| | 2nd year | 4.0952 / .75593 | 4.1515 / .79535 | 4.2000 / .82275 |
| | 3rd year | 4.0506 / .76626 | 3.8462 / .55470 | 4.0571 / .83817 |
| | MA | 4.3529 / .70189 | 4.2250 / .94699 | 4.0588 / .82694 |
| QC205 Good ecological system and landscape | 1st year | 3.3727 / .81115 | 3.7500 / .71635 | |
| | 2nd year | 3.3492 / .78614 | 3.6364 / .92932 | 3.4750 / .84694 |
| | 3rd year | 3.2911 / .80307 | 3.2308 / .83205 | 3.5143 / .95090 |
| | MA | 3.1765 / 1.07444 | 3.6750 / 1.0225 | 3.3529 / 1.16946 |
| QC206 Close to a frequent public transport | 1st year | 3.4455 / .81933 | 3.6000 / .88258 | |
| | 2nd year | 3.2857 / .92333 | 3.6667 / .95743 | 3.5500 / .814920 |
| | 3rd year | 3.4304 / .91545 | 3.1538 / .80064 | 3.5429 / 1.12047 |
| | MA | 3.7647 / .97014 | 4.0000 / .81650 | 3.7647 / 1.25147 |
| QC207 Supermarket or late shops | 1st year | 3.9455 / .64731 | 3.6500 / 1.08942 | |
| | 2nd year | 3.7143 / .79166 | 4.1515 / .66714 | 4.0250 / .73336 |
| | 3rd year | 3.8354 / .72378 | 3.8462 / .68874 | 4.0000 / .80440 |
| | MA | 4.1765 / .72761 | 4.0250 / .73336 | 4.2353 / .83137 |
| QC208 Gymnasium or sports centre | 1st year | 2.7818 / 1.01712 | 2.9000 / 1.25237 | |
| | 2nd year | 2.7778 / 1.12801 | 2.7576 / .96922 | 2.9500 / 1.01147 |
| | 3rd year | 2.5949 / .92707 | 2.5385 / 1.1266 | 2.7714 / 1.1137 |
| | MA | 2.3529 / 1.05719 | 2.8750 / .96576 | 3.2941 / .98518 |
| QC209 Pub or bar | 1st year | 3.3091 / 1.06440 | 3.4000 / 1.0463 | |
| | 2nd year | 3.2222 / 1.03868 | 3.4545 / 1.09233 | 3.7250 / .93336 |
| | 3rd year | 3.1139 / .86213 | 3.3077 / .48038 | 3.5143 / 1.12122 |
| | MA | 1.9412 / .89935 | 2.8750 / 1.09046 | 3.6471 / 1.11474 |

| | | | | |
|---|---|---|---|---|
| QC210 Café, takeaway or restaurant | 1st year | 2.6364 / .90592 | 3.2000 / .83351 | |
| | 2nd year | 2.6825 / 1.05991 | 3.0909 / 1.07132 | 3.2000 / .88289 |
| | 3rd year | 2.8608 / .87316 | 2.5385 / .66023 | 2.8571 / .97446 |
| | MA | 2.5882 / .71229 | 2.7500 / 1.03155 | 3.2353 / 1.20049 |
| QC211 Natural daylighting in the bedroom | 1st year | 4.1545 / .79201 | 3.7000 / .80131 | |
| | 2nd year | 4.1270 / .77235 | 4.2424 / .96922 | 3.5500 / .84580 |
| | 3rd year | 4.1899 / .71747 | 4.1538 / .68874 | 3.8571 / .97446 |
| | MA | 4.1765 / .80896 | 4.1750 / .78078 | 3.7647 / .97014 |
| QC212 Drying space for clothes | 1st year | 3.3091 / .92613 | 3.6000 / .68056 | |
| | 2nd year | 3.3333 / .86136 | 3.7879 / .73983 | 3.1000 / .90014 |
| | 3rd year | 3.3797 / .85190 | 3.6154 / .76795 | 3.4857 / .88688 |
| | MA | 3.2941 / .77174 | 3.5750 / .87376 | 3.3529 / 1.11474 |
| QC213 Study and work from home | 1st year | 4.5727 / .66992 | 4.3500 / .58714 | |
| | 2nd year | 4.4127 / .58571 | 4.4848 / .56575 | 4.0750 / .85896 |
| | 3rd year | 4.3418 / .67721 | 4.2308 / .83205 | 4.3429 / .80231 |
| | MA | 4.4118 / .61835 | 4.3250 / .65584 | 4.2941 / .58787 |
| QC214 High insulation standards | 1st year | 3.5818 / .88184 | 3.6500 / .58714 | |
| | 2nd year | 3.6984 / .87316 | 3.7576 / .75126 | 3.5750 / .98417 |
| | 3rd year | 3.7975 / .83788 | 3.2308 / .92681 | 3.9143 / .78108 |
| | MA | 4.2353 / .66421 | 3.7250 / .93336 | 3.4706 / 1.00733 |
| QC215 Timber for fitment and furniture | 1st year | 2.7545 / .84795 | 3.1000 / .91191 | |
| | 2nd year | 2.8730 / 1.09974 | 3.2121 / .78093 | 3.0500 / .78283 |
| | 3rd year | 2.9367 / .80609 | 2.5385 / .77625 | 3.0571 / 1.02736 |
| | MA | 2.8824 / .92752 | 3.0750 / .91672 | 2.5882 / .87026 |
| QC216 Sound insulation | 1st year | 3.4182 / .97097 | 3.1500 / 1.22582 | |
| | 2nd year | 3.2857 / 1.11339 | 3.3939 / 1.08799 | 3.4750 / .93336 |
| | 3rd year | 3.4937 / .79861 | 2.9231 / .75955 | 3.3714 / .97274 |
| | MA | 3.7059 / .84887 | 3.4500 / .90441 | 2.8235 / 1.07444 |
| QC217 Private outdoor space | 1st year | 3.0909 / 1.00042 | 3.3000 / .92338 | |
| | 2nd year | 2.8413 / 1.06569 | 3.0909 / 1.07132 | 2.9250 / .91672 |
| | 3rd year | 2.8228 / .99691 | 3.2308 / .72501 | 2.9143 / 1.09468 |
| | MA | 2.6471 / .86177 | 3.4250 / .93060 | 2.8235 / 1.18508 |
| QC218 Secure cycle storage | 1st year | 2.3091 / 1.22471 | 3.0500 / .99868 | |
| | 2nd year | 1.9683 / 1.17732 | 2.7273 / 1.23168 | 2.1000 / 1.05733 |
| | 3rd year | 1.9114 / .96330 | 3.0000 / 1.08012 | 1.9429 / 1.0831 |
| | MA | 2.7059 / .91956 | 3.0250 / 1.31046 | 2.3529 / .99632 |
| QC219 Private car parking | 1st year | 2.1364 / 1.08769 | 2.6000 / 1.09545 | |
| | 2nd year | 2.2222 / 1.22401 | 2.3636 / 1.05529 | 2.0250 / .89120 |
| | 3rd year | 1.9873 / 1.28596 | 1.6154 / .65044 | 1.9429 / 1.13611 |
| | MA | 2.0588 / 1.24853 | 2.4250 / 1.31826 | 2.7059 / 1.40378 |
| QC220 Natural ventilation | 1st year | 4.1909 / .74803 | 4.0500 / .82558 | |
| | 2nd year | 4.2063 / .65152 | 4.3030 / .63663 | 3.7250 / .93336 |
| | 3rd year | 4.0886 / .75430 | 3.7692 / .59914 | 3.9143 / .78108 |
| | MA | 4.2941 / .77174 | 4.1750 / .84391 | 3.6471 / 1.05719 |
| QC221 Southern orientation of the bedroom | 1st year | 2.9818 / .91853 | 3.1500 / .87509 | |
| | 2nd year | 3.0476 / .90569 | 2.6970 / 1.07485 | 2.4750 / .93336 |
| | 3rd year | 2.9747 / .86194 | 2.7692 / .43853 | 2.6571 / 1.0831 |
| | MA | 3.5882 / 1.00367 | 3.0000 / 1.1767 | 2.4118 / 1.22774 |
| QC222 Control system for heating & hot water | 1st year | 3.6818 / .86663 | 4.1000 / .64072 | |
| | 2nd year | 3.8889 / .72091 | 3.7576 / .96922 | 3.7750 / .76753 |
| | 3rd year | 3.8228 / .78052 | 3.4615 / .66023 | 3.7429 / 1.09391 |
| | MA | 4.2941 / .68599 | 3.8000 / 1.04268 | 3.5294 / 1.23073 |
| QC223 Facilities for waste recycling | 1st year | 3.3545 / .95386 | 3.4000 / .88258 | |
| | 2nd year | 3.3810 / 1.06904 | 3.4545 / .93845 | 3.1750 / .93060 |
| | 3rd year | 3.5823 / .79433 | 3.1538 / .80064 | 3.4571 / 1.03875 |
| | MA | 3.2353 / 1.09141 | 3.6500 / 1.05125 | 2.9412 / 1.14404 |
| QC224 Energy efficient heating and lighting | 1st year | 3.6000 / .89031 | 3.8000 / .76777 | |
| | 2nd year | 3.5873 / .89145 | 3.7576 / .90244 | 3.2750 / .78406 |
| | 3rd year | 3.4557 / .97135 | 3.3846 / .76795 | 3.4571 / 1.01003 |
| | MA | 3.7059 / .91956 | 3.6500 / 1.02657 | 3.2353 / .83137 |
| QC225 Energy efficient fridge, wash machine | 1st year | 3.4818 / .88548 | 3.6000 / 1.0463 | |
| | 2nd year | 3.3175 / .96429 | 3.6061 / 1.05887 | 3.2000 / .72324 |
| | 3rd year | 3.2658 / .95688 | 3.3077 / .75107 | 3.3714 / 1.05957 |
| | MA | 3.3529 / .99632 | 3.4750 / 1.08575 | 3.3529 / .86177 |
| QC226 Water-saving toilet | 1st year | 2.9909 / .97204 | 3.1500 / 1.1821 | |
| | 2nd year | 2.6984 / 1.01019 | 3.2424 / 1.17341 | 2.9000 / .84124 |
| | 3rd year | 2.6456 / 1.0258 | 3.0000 / .8165 | 3.0286 / 1.12422 |
| | MA | 3.1765 / .95101 | 3.2250 / 1.29075 | 2.5882 / .93934 |

**Table 6.8: The impact of 'department' and 'academic year' on students' evaluation of the relative importance of housing environmental issues (from QC201 to QC226) – ANOVA**

| Q | Main Effect | | | | | | Interaction Effect | | |
|---|---|---|---|---|---|---|---|---|---|
| | Department | | | Academic Year | | | Department * Academic Year | | |
| | F | Sig. | Partial Eta Squared | F | Sig. | Partial Eta Squared | F | Sig. | Partial Eta Squared |
| QC201 | .829 | .437 | .004 | 3.355 | .019 | .022 | 2.806 | .017 | .030 |
| QC202 | .296 | .744 | .001 | 1.009 | .389 | .007 | .972 | .434 | .011 |
| QC203 | .194 | .824 | .001 | .512 | .674 | .003 | 1.491 | .191 | .016 |
| QC204 | .108 | .898 | .000 | 1.287 | .278 | .008 | .548 | .740 | .006 |
| QC205 | 3.128 | .045(*) | .014 | .923 | .430 | .006 | .678 | .641 | .007 |
| QC206 | .751 | .473 | .003 | 3.240 | .022(*) | .021 | .913 | .472 | .010 |
| QC207 | .816 | .443 | .004 | 2.123 | .097 | .014 | 2.095 | .065 | .022 |
| QC208 | 4.047 | .018 | .017 | 1.128 | .337 | .007 | .887 | .490 | .010 |
| QC209 | 16.070 | .000(**) | .066 | 7.397 | .000(**) | .046 | 2.414 | .035(*) | .026 |
| QC210 | 5.409 | .005(**) | .023 | 1.380 | .248 | .009 | 2.191 | .054 | .023 |
| QC211 | 9.180 | .000(**) | .039 | 1.613 | .186 | .010 | 1.370 | .234 | .015 |
| QC212 | 4.568 | .011(*) | .020 | .204 | .894 | .001 | .768 | .573 | .008 |
| QC213 | 1.626 | .198 | .007 | .341 | .796 | .002 | 1.308 | .259 | .014 |
| QC214 | 2.655 | .071 | .012 | .786 | .502 | .005 | 2.573 | .026(*) | .027 |
| QC215 | .517 | .597 | .002 | 1.102 | .348 | .007 | 1.749 | .122 | .019 |
| QC216 | 2.766 | .064 | .012 | .446 | .720 | .003 | 2.413 | .036(*) | .026 |
| QC217 | 4.997 | .007(**) | .021 | .605 | .612 | .004 | .648 | .663 | .007 |
| QC218 | 14.412 | .000(**) | .059 | 2.523 | .057 | .016 | .608 | .694 | .007 |
| QC219 | .813 | .444 | .004 | 3.417 | .017 | .022 | 1.415 | .217 | .015 |
| QC220 | 7.648 | .001(**) | .032 | .675 | .568 | .004 | 1.423 | .215 | .015 |
| QC221 | 9.910 | .000 | .042 | 1.132 | .336 | .007 | 1.627 | .151 | .018 |
| QC222 | 1.822 | .163 | .008 | .699 | .553 | .005 | 2.375 | .038 | .025 |
| QC223 | 1.382 | .252 | .006 | .202 | .895 | .001 | 1.335 | .248 | .014 |
| QC224 | 2.366 | .095 | .010 | .432 | .730 | .003 | .729 | .602 | .008 |
| QC225 | .774 | .462 | .003 | .494 | .687 | .003 | .369 | .870 | .004 |
| QC226 | 2.461 | .087 | .011 | .194 | .901 | .001 | 1.388 | .227 | .015 |

- For QC201, QC207, QC219, QC221, QC222 and QC226, the assumption of equal variances was violated.
- For QC208, The main effect of 'department' did not reach statistical significance in the *post hoc* tests ($p > .05$)

(*) significant difference at level of $p < .05$
(**) significant difference at level of $p < .01$

Findings from this two-way between-groups ANOVA showed that the impacts of education, focusing on 'major subject' (department) and 'academic year' in particular, on students' evaluation of housing environmental issues (from QC201 to QC226) were not always linear (see Appendix 1.1). Therefore, attention should be paid to the specific issues in the design processes according to the alternative priorities from different groups of student residents. Further, between these two education-related factors, it seemed that 'major subject' (course setting in different departments) had more impact on students' system for value judgement than 'academic year' (length of time of study). In other words, although it can be a long lasting lesson to educate students and encourage them to change their living habits towards greater environmental sensitivity, the target should be set at the very beginning and better be related to their courses. This should be envisaged in future research.

Since there is no alternative non-parametric technique which can be used to verify the findings from the two-way between-groups ANOVA, results reported above from the parametric statistics are taken into account as the main research findings.

- ***Cultural Background (Original Residence Places) * QC201-226 – One-way Independent Analysis of Variance (ANOVA) and the Kruskal-Wallis test***

The one-way between-groups analysis of variance (independent ANOVA) was conducted to explore the impact of students' cultural background ('students' residence places') on their evaluation of the palette of housing environmental issues (from QC201 to QC226). This survey was initially designed to see whether local students (always living in Sheffield) might have more sense of belonging and then might be more concerned with the relevant local environmental issues than others. However, the sample size of local students (11 out of 467) was relatively too small to be considered as a sub-group. Therefore, as shown in Table 6.9, students in the target group were divided into three sub-groups ultimately according to their original residence places to make comparisons.

**Table 6.9: Grouped aggregated responses according to students' cultural background**

| Residence Place | Total N |
|---|---|
| London | 62 |
| Other cities in the UK | 334 |
| Other countries (international students) | 71 |
| **Total N** | 467 |

As shown in Table 6.10 and Table 6.11, it was found that the effects of students' cultural background ('original residence places') on their systems for value judgement varied from issue to issue. The effects of students' cultural background ('original residence places') on their evaluation of the relative importance of QC206, QC211 and QC215 were statistically significant at the level of $p < .05$; and on their evaluation of the relative importance of QC209, QC221, QC224 and QC226 were statistically significant at the level of $p < .01$. Further details can be found in Appendix 1.1.

**Table 6.10: Descriptive Statistics by Cultural Background (Original Residence Places)**

| Issues drawn from EcoHomes | Original Residence Places | N | Mean (M) | Standard Diversion (SD) |
|---|---|---|---|---|
| QC201 Charges for rent and deposit | London | 62 | 4.5484 | .61876 |
| | Other cities in the UK | 334 | 4.4371 | .72737 |
| | Other countries | 71 | 4.2958 | .72495 |
| QC202 Costs for utilities: electricity / gas / water | London | 62 | 3.9677 | .80912 |
| | Other cities in the UK | 334 | 3.7335 | .86522 |
| | Other countries | 71 | 3.8451 | .74925 |
| QC203 Other expenditure, like travel expense | London | 62 | 3.6613 | .88602 |
| | Other cities in the UK | 334 | 3.4641 | .86484 |
| | Other countries | 71 | 3.6479 | .75779 |
| QC204 Secure area and safe access | London | 62 | 4.1613 | .81369 |
| | Other cities in the UK | 334 | 4.0449 | .77562 |
| | Other countries | 71 | 4.2254 | .75965 |
| QC205 Good ecological system and landscape | London | 62 | 3.6129 | .77576 |
| | Other cities in the UK | 334 | 3.3772 | .90123 |
| | Total | 467 | 3.4240 | .87410 |
| QC206 Close to a frequent public transport | London | 62 | 3.5484 | .86228 |
| | Other cities in the UK | 334 | 3.4671 | .96038 |
| | Other countries | 71 | 3.7606 | .74575 |
| QC207 Supermarket or late shops | London | 62 | 3.9839 | .68931 |
| | Other cities in the UK | 334 | 3.9042 | .77679 |
| | Other countries | 71 | 4.0141 | .66532 |
| QC208 Gymnasium or sports centre | London | 62 | 2.7097 | .93013 |
| | Other cities in the UK | 334 | 2.7455 | 1.07297 |
| | Other countries | 71 | 2.9437 | .92408 |
| QC209 Pub or bar | London | 62 | 3.3226 | 1.05231 |
| | Other cities in the UK | 334 | 3.4162 | .99722 |
| | Other countries | 71 | 2.4366 | .95218 |
| QC210 Café, takeaway or restaurant | London | 62 | 2.7097 | .94760 |
| | Other cities in the UK | 334 | 2.8862 | .98590 |
| | Other countries | 71 | 2.6620 | .82711 |
| QC211 Natural daylighting in the bedroom | London | 62 | 4.3065 | .80141 |
| | Other cities in the UK | 334 | 4.0150 | .85762 |
| | Other countries | 71 | 4.0423 | .70583 |
| QC212 Drying space for clothes | London | 62 | 3.4839 | .74089 |
| | Other cities in the UK | 334 | 3.3743 | .94316 |
| | Other countries | 71 | 3.4366 | .64879 |
| QC213 Study and work from home | London | 62 | 4.4677 | .69466 |
| | Other cities in the UK | 334 | 4.3623 | .69999 |
| | Other countries | 71 | 4.4507 | .60448 |
| QC214 High insulation standards | London | 62 | 3.6935 | .87943 |
| | Other cities in the UK | 334 | 3.6826 | .86708 |
| | Other countries | 71 | 3.7606 | .86956 |
| QC215 Timber for fitment and furniture | London | 62 | 2.8710 | .91408 |
| | Other cities in the UK | 334 | 2.8713 | .91281 |
| | Other countries | 71 | 3.1690 | .79257 |
| QC216 Sound insulation | London | 62 | 3.4355 | 1.08069 |
| | Other cities in the UK | 334 | 3.3204 | .96597 |
| | Other countries | 71 | 3.6056 | .90204 |
| QC217 Private outdoor space | London | 62 | 3.1290 | 1.04777 |
| | Other cities in the UK | 334 | 3.0240 | 1.03947 |
| | Other countries | 71 | 2.7746 | .79637 |
| QC218 Secure cycle storage | London | 62 | 2.4839 | 1.32742 |
| | Other cities in the UK | 334 | 2.2395 | 1.17128 |
| | Other countries | 71 | 2.4789 | 1.10659 |
| QC219 Private car parking | London | 62 | 2.1290 | 1.12328 |
| | Other cities in the UK | 334 | 2.2246 | 1.19579 |
| | Other countries | 71 | 1.9014 | 1.04410 |
| QC220 Natural ventilation | London | 62 | 4.2742 | .60515 |
| | Other cities in the UK | 334 | 4.0689 | .79680 |
| | Other countries | 71 | 4.0141 | .85345 |
| QC221 Southern orientation of the bedroom | London | 62 | 2.9677 | .90477 |
| | Other cities in the UK | 334 | 2.7754 | .97746 |
| | Other countries | 71 | 3.4648 | .87556 |
| QC222 Control system for heating & hot water | London | 62 | 3.9355 | .80716 |
| | Other cities in the UK | 334 | 3.7335 | .87213 |

| | | | | |
|---|---|---|---|---|
| | Other countries | 71 | 3.9296 | .89959 |
| QC223 Facilities for waste recycling | London | 62 | 3.6129 | .96419 |
| | Other cities in the UK | 334 | 3.3383 | .99363 |
| | Other countries | 71 | 3.4930 | .80841 |
| QC224 Energy efficient heating and lighting | London | 62 | 3.6935 | .93368 |
| | Other cities in the UK | 334 | 3.4551 | .92484 |
| | Other countries | 71 | 3.8310 | .75566 |
| QC225 Energy efficient fridge, wash machine | London | 62 | 3.4355 | 1.00198 |
| | Other cities in the UK | 334 | 3.3413 | .96343 |
| | Other countries | 71 | 3.5775 | .78671 |
| QC226 Water-saving toilet | London | 62 | 3.1774 | 1.06393 |
| | Other cities in the UK | 334 | 2.8263 | 1.05114 |
| | Other countries | 71 | 3.1690 | .95597 |

**Table 6.11: The impact of cultural background ('original residence places') on students' evaluation of the relative importance of housing environmental issues (from QC201 to QC226) – ANOVA**

| | F | Sig. | Eta Squared |
|---|---|---|---|
| QC201 | 2.125 | .121 | .009 |
| QC202 | 2.264 | .105 | .010 |
| QC203 | 2.369 | .095 | .010 |
| QC204 | 1.892 | .152 | .010 |
| QC205 | 2.075 | .127 | .010 |
| QC206 | 3.018 | .020(*) | .013 |
| QC207 | .803 | .448 | .003 |
| QC208 | 1.201 | .238 | .005 |
| QC209 | 28.368 | .000(**) | .122 |
| QC210 | 2.153 | .117 | .009 |
| QC211 | 3.246 | .040(*) | .014 |
| QC212 | .485 | .548 | .002 |
| QC213 | .950 | .388 | .004 |
| QC214 | .236 | .790 | .001 |
| QC215 | 3.326 | .037(*) | .014 |
| QC216 | 2.639 | .072 | .011 |
| QC217 | 2.378 | .094 | .010 |
| QC218 | 1.983 | .139 | .009 |
| QC219 | 2.284 | .103 | .010 |
| QC220 | 2.167 | .116 | .009 |
| QC221 | 15.456 | .000(**) | .067 |
| QC222 | 2.495 | .084 | .011 |
| QC223 | 2.525 | .081 | .011 |
| QC224 | 6.061 | .003(**) | .026 |
| QC225 | 1.915 | .148 | .008 |
| QC226 | 5.293 | .005(**) | .023 |

- For QC209, QC211, QC215, QC221 and QC226, the assumption of homogeneity of variances was not violated, so the results were reported with ANOVA Sig.
- For QC206 and QC224, the assumption of homogeneity of variances was violated, so the results were reported with Welch or Brown-Forsythe Sig.

(*) The mean difference is significant at the .05 level
(**) The mean difference is significant at the .01 level

Obviously cultural background had a significant impact on target students' priorities to some housing environmental issues. Most of the differences could be well interpreted based on the method of priori reasoning. For instance, due to the cultural features, students in the UK (including both students from London and from other cities in the UK) were more likely to

have a pub or bar close to their accommodation (QC209), compared with international students. However, more attention should be paid to the related design issues, such as how to accommodate these priority differences and reach a compromise between different groups of student residents in the stakeholder-oriented decision-making processes.

Again, the alternative non-parametric technique of one-way independent ANOVA, the Kruskal-Wallis test, was applied to verify the findings from parametric statistics. The *K Independent Samples* (test) underneath *Nonparametric Tests* was conducted to re-analyse the data and the results were reported in Table 6.12. It was found that there were statistically significant effects of students' cultural background ('original residence places') on their evaluation of the relative importance of QC211 and QC215, $p < .05$; and on their evaluation of the relative importance of QC209, QC221, QC224 and QC226, $p < .01$. Most findings corresponded with those from the one-way independent ANOVA, except QC206 ('close to a frequent public transport') which has been found to have significant differences by the one-way independent ANOVA but not by its non-parametric counterpart (the Kruskal-Wallis test).

**Table 6.12: The impact of cultural background ('original residence places') on students' evaluation of the relative importance of housing environmental issues (from QC201 to QC226) – Kruskal-Wallis test [a, b]**

| | Chi-Square | df | Asymp. Sig. |
|---|---|---|---|
| QC201 | 4.398 | 2 | .111 |
| QC202 | 3.779 | 2 | .151 |
| QC203 | 5.360 | 2 | .069 |
| QC204 | 4.453 | 2 | .108 |
| QC205 | 3.911 | 2 | .141 |
| QC206 | 4.698 | 2 | .095 |
| QC207 | .921 | 2 | .631 |
| QC208 | 2.427 | 2 | .297 |
| QC209 | 50.307 | 2 | .000(**) |
| QC210 | 3.501 | 2 | .174 |
| QC211 | 7.455 | 2 | .024(*) |
| QC212 | .665 | 2 | .717 |
| QC213 | 1.971 | 2 | .373 |
| QC214 | .196 | 2 | .906 |
| QC215 | 7.572 | 2 | .023(*) |
| QC216 | 5.895 | 2 | .052 |
| QC217 | 5.512 | 2 | .076 |
| QC218 | 4.246 | 2 | .120 |
| QC219 | 4.239 | 2 | .120 |
| QC220 | 3.315 | 2 | .191 |
| QC221 | 29.327 | 2 | .000(**) |
| QC222 | 5.904 | 2 | .052 |
| QC223 | 4.718 | 2 | .095 |
| QC224 | 11.204 | 2 | .004(**) |
| QC225 | 3.506 | 2 | .173 |
| QC226 | 10.374 | 2 | .006(**) |

(*) significant difference at level of p < .05
(**) significant difference at level of p < .01
a. Kruskal Wallis Test
b. Grouping Variable: City/country where you were living before Sheffield.

Since non-parametric statistics tended to be less sensitive and powerful than parametric statistics (Field 2005: 533; Pallant 2007: 210), results from the parametric statistics (one-way independent ANOVA) were taken into account as the main research findings.

- ***Summary: Group Factors (QA) * Housing Environmental Issues drawn from EcoHomes (QC2)***

In 6.4.1, a variety of statistical techniques were applied to study the impacts of students' 'education' and 'social group', including factors related to gender, major subject (department), academic year and cultural background (original residence places), on their evaluation of the relative importance of a palette of housing environmental issues drawn from EcoHomes. Findings can be used to inform the related education programmes and the design processes of student accommodation. To allow the findings to be fed back into the key decision-points in terms of information flow efficiently, issues with significant findings are summarised, as shown in Table 6.13. Some findings can also be used to modify the existing model of Bayesian Belief Networks (BBN) by giving the causal issues (such as 'education' and its effects over 'environmental awareness' and 'social desirability') with different weighing factors for a focus social group (for instance university students in this case). This idea should be further developed in future research.

It is also important to note that, although all the discussions in 6.4.1 were focused on issues with significant findings, the housing environmental issues without significant findings were meaningful to the decision-making processes as they could help architects reduce the matters that need to be taken into account in the student accommodation design. More specifically, as shown in Table 6.13, since a *close consensus* is achieved on students' evaluation of some housing environmental issues drawn from EcoHomes, these issues can be evaluated based on relatively small-size samples in future collaborative design decision-making processes. These issues are 'QC207 close to a supermarket or late shops' (related to Tra3 in EcoHomes), 'QC208 close to gymnasium or sports centre' (Tra3), 'QC213 study and work from home' (Tra4), 'QC222 control system for heating and hot water' (Man1), 'QC223 facilities for house waste recycling' (Mat4) and 'QC225 energy efficient fridge, wash machine' (Ene4); and their relative importance in this case (University of Sheffield) have been summarised in Table 6.2. However, the generalisation of this finding needs to be further validated. This will be discussed in 6.5.1.

**Table 6.13: Summary of the impacts of students' 'education' and 'social group' on their evaluation of the relative importance of the housing environmental issues drawn from EcoHomes**

| Some Housing Environmental Issues drawn from EcoHomes | Gender | Department | Academic Year | Department * Academic Year | Cultural Background | Related to EcoHomes |
|---|---|---|---|---|---|---|
| QC201 Charges for rent and deposit | | | | | | |
| QC202 Costs for utilities: electricity/gas/water | | | | | | Pol4 |
| QC203 Other expenditure, like travel expense | | | | | | |
| QC204 Secure area and safe access | | | | | | Man4 |
| QC205 Good ecological system and landscape | | | | | | Eco2&4 |
| QC206 Close to a frequent public transport | | | | | | Tra1 |
| QC207 Supermarket or late shops | | | | | | Tra3/4 |
| QC208 Gymnasium or sports centre | | | | | | Tra3/4 |
| QC209 Pub or bar | | | | | | Tra3/4 |
| QC210 Café, takeaway or restaurant | | | | | | Tra3/4 |
| QC211 Natural daylighting in the bedroom | | | | | | Hea1 |
| QC212 Drying space for clothes | | | | | | Ene3 |
| QC213 Study and work from home | | | | | | Tra4 |
| QC214 High insulation standards | | | | | | Ene2&Pol1 |
| QC215 Timber for fitment and furniture | | | | | | Mat2&3 |
| QC216 Sound insulation | | | | | | Hea2 |
| QC217 Private outdoor space | | | | | | Hea3 |
| QC218 Secure cycle storage | | | | | | Tra2 |
| QC219 Private car parking | | | | | | |
| QC220 Natural ventilation | | | | | | |
| QC221 Southern orientation of the bedroom | | | | | | |
| QC222 Control system for heating & hot water | | | | | | Man1 |
| QC223 Facilities for house waste recycling | | | | | | Mat4 |
| QC224 Energy efficient heating and lighting | | | | | | Ene1,5,6&Pol2 |
| QC225 Energy efficient fridge, wash machine | | | | | | Ene4 |
| QC226 Water-saving toilet | | | | | | Wat1 |

| | |
|---|---|
| significant difference at level of $p < .05$ | |
| significant difference at level of $p < .01$ | |

### 6.4.2 GROUP FACTORS (QA AND QB) * KNOWLEDGE OF LIFESTYLE ISSUES (QD)

This section will explore the knowledge variation within the target group of students according to their group factors (i.e. gender, major subject, academic year and cultural background). As argued earlier, occupants' consciousness of and attitude for sustainable lifestyle played an important role for energy saving and carbon reductions during the operational phase of house occupation. In this research, therefore, students' knowledge of some living issues (QD101-107) were designed to be evaluated based on the 5-point Likert scale, from 'Very poor' to 'Very good'. However, it is important to note that students' knowledge was measured ***on ordinal***[xlii] ***(ranked) scales*** this time rather than on interval[xliii] scales. Thus, non-parametric techniques (such as the Mann-Whitney U test and the Kruskal-Wallis test) were applied to make the statistical analysis as they were ideal for the analysis of the data that was measured on nominal (categorical) and ordinal (ranked) scales (Field 2005: 521; Pallant 2007: 210).

The procedures of data analysis are described in detail in the following sections. Any issue from QC101-107 with data missing was considered to be due to the student having 'very poor' knowledge of it.

- ***Gender * QD101-107 – Mann-Whitney U test***

The Mann-Whitney U test (*2 Independent Samples* underneath *Nonparametric Tests*) was conducted to compare the differences between male and female students' knowledge of some living issues (QD101-107).

As shown in Table 6.14, aggregated results of the consultations showed that male and female students' knowledge was significantly different on QD104 ($p < .05$) and QD106 ($p < .01$). For the rest of the issues, there were no significant differences ($p > .05$) between male and female students in the target group. Further details can be found in Appendix 1.2.

Specifically, female students in the target group had better understanding of issues related to public transport (QD104) and waste recycling (QD106) than male students, though the relative magnitude of the differences were very small and only represented small size effects (see Appendix 1.2 for their effect sizes). However, their knowledge of other living issues addressed in QD1 was similar.

**Table 6.14: Knowledge difference between male and female students in the target group – Mann-Whitney U test [a]**

| | Mann-Whitney U | Wilcoxon W | Z | Asymnp. Sig. (2-tailed) |
|---|---|---|---|---|
| QD101 | 24638.500 | 48948.500 | -1.782 | .075 |
| QD102 | 26418.500 | 50728.500 | -.541 | .588 |
| QD103 | 24903.500 | 49213.500 | -1.601 | .109 |
| QD104 | 23711.000 | 54339.000 | -2.505 | .012(*) |
| QD105 | 25747.000 | 50057.000 | -1.009 | .313 |
| QD106 | 23508.000 | 54136.000 | -2.580 | .010(**) |
| QD107 | 25530.500 | 56158.500 | -1.170 | .242 |

(*) significant difference at level of $p < .05$
(**) significant difference at level of $p < .01$
a. Grouping Variable: Gender

- ***Major Subject (Department) * QD101-107 – The Kruskal-Wallis Test***

As the non-parametric counterpart of one-way ANOVA, the Kruskal-Wallis test (*K Independent Samples* underneath *Nonparametric Tests*) was conducted to explore the impact of students' 'department' on their knowledge of the palette of living issues (QD101-107).

As shown in Table 6.15, aggregated results of the consultations showed that there were statistically significant differences between students from different departments on QD101, QD102 and QD105 at the level of $p < .01$ and on QD103 at the level of $p < .05$. Further details can be found in Appendix1.2.

**Table 6.15: Impact of 'department' on students' knowledge of some living issues – Kruskal-Wallis Test Statistics [a, b]**

| | Chi-Square | df | Asymp. Sig. |
|---|---|---|---|
| QD101 | 27.004 | 2 | .000(**) |
| QD102 | 26.642 | 2 | .000(**) |
| QD103 | 8.122 | 2 | .017(*) |
| QD104 | .206 | 2 | .902 |
| QD105 | 14.257 | 2 | .001(**) |
| QD106 | 2.104 | 2 | .349 |
| QD107 | 3.741 | 2 | .154 |

* significant difference at level of $p < .05$
** significant difference at level of $p < .01$
a. Kruskal Wallis Test
b. Grouping Variable: Department

It was interesting to see that, within the Faculty of Architecture, architectural students clearly had less knowledge of some living issues than students from the other two departments, such

as energy consumption (QD101), energy supplier (QD102), control for energy saving (QD103) and energy saving lighting (QD105). This finding somewhat corresponded with the earlier argument (see 5.4) that architectural students did not realise that they contributed to not only solutions but also problems in tackling climate change.

- ***Academic Year * QD101-107 – The Kruskal-Wallis Test***

Similar work, the Kruskal-Wallis test (*K Independent Samples* underneath *Nonparametric Tests*), was also conducted to explore the impact of students' 'academic year' on their knowledge of some living issues (QD101-107).

As shown in Table 6.16, aggregated results of the consultations showed that there were statistically significant differences between students from different academic years on all issues from QD101 to QD107 ($p < .01$). Further details can be found in Appendix 1.2.

**Table 6.16: Impact of 'academic year' on students' knowledge of some living issues – Kruskal-Wallis Test Statistics [a, b]**

| | Chi-Square | df | Asymp. Sig. |
|---|---|---|---|
| QD101 | 108.460 | 3 | .000(**) |
| QD102 | 90.259 | 3 | .000(**) |
| QD103 | 49.342 | 3 | .000(**) |
| QD104 | 23.275 | 3 | .000(**) |
| QD105 | 37.063 | 3 | .000(**) |
| QD106 | 28.941 | 3 | .000(**) |
| QD107 | 15.724 | 3 | .001(**) |

* significant difference at level of $p < .05$

** significant difference at level of $p < .01$

a. Kruskal Wallis Test

b. Grouping Variable: Academic Year

Specifically, there was a trend that students in higher level might have better understanding of the palette of living issues addressed in QD (QD101-107) though the tendency was not very powerful or always linear. However, there was one exception, QD104, which might be led by the fact that new students were often more likely to travel around by public transport and then knew this issue better than others. To a great extent, therefore, it was believed that education (or experience of living independently) might have a latent effect on students' knowledge of some important living issues that related to energy saving, carbon reductions and waste recycling in the operational phase of house occupation. This should be further addressed in future education programmes.

- ***Cultural Background (Original Residence Places) * QD101-107 – The Kruskal-Wallis Test***

The Kruskal-Wallis test (*K Independent Samples* underneath *Nonparametric Tests*) was also conducted to explore the impact of students' cultural background (according to their 'original residence places') on their knowledge of some living issues (QD101-107).

As shown in Table 6.17, it was very interesting to see that there was no statistically significant difference between students from different cultural backgrounds on their knowledge of any issue from QD101 to QD107 ($p > .05$). This finding did not correspond with the assumptions that one might make on the basis of the conventional understanding or the comparable researches (for instance, examples given by Kang (2007) showed that cultural difference had a significant effect on peoples' acceptable noise levels).

**Table 6.17: Impact of cultural background ('original residence places') on students' knowledge of some living issues – Kruskal-Wallis Test Statistics [a, b]**

| | Chi-Square | df | Asymp. Sig. |
|---|---|---|---|
| QD101 | .527 | 2 | .768 |
| QD102 | .196 | 2 | .907 |
| QD103 | .182 | 2 | .913 |
| QD104 | 3.278 | 2 | .194 |
| QD105 | .637 | 2 | .727 |
| QD106 | 5.148 | 2 | .076 |
| QD107 | .999 | 2 | .607 |

* significant difference at level of $p < .05$

a. Kruskal Wallis Test

b. Grouping Variable: Original Residence Places

- ***Accommodation Types * QD101-107 – The Kruskal-Wallis Test***

As argued earlier (see 2.7.2), students' lifestyle choice would be affected not only by their undertaking education programmes but also by their current living patterns in the student accommodation. Therefore, the Kruskal-Wallis test (*K Independent Samples* underneath *Nonparametric Tests*) was conducted to explore the relationship between students' 'accommodation types' and their knowledge of some living issues (QD101-107).

As shown in Table 6.18, aggregated results of the consultations showed that there were statistically significant differences between students living in different accommodation types on issues from QD101 to QD106 ($p < .01$). Further details can be found in Appendix 1.2.

**Table 6.18: Relationship between students' 'accommodation types' and their knowledge of some living issues – Kruskal-Wallis Test Statistics [a, b]**

| | Chi-Square | df | Asymp. Sig. |
|---|---|---|---|
| QD101 | 76.959 | 2 | .000(**) |
| QD102 | 61.967 | 2 | .000(**) |
| QD103 | 24.814 | 2 | .000(**) |
| QD104 | 13.945 | 2 | .001(**) |
| QD105 | 24.974 | 2 | .000(**) |
| QD106 | 15.659 | 2 | .000(**) |
| QD107 | .781 | 2 | .677 |

* significant difference at level of p < .05
** significant difference at level of p < .01
a. Kruskal Wallis Test
b. Grouping Variable: Accommodation Types

Specifically, students living in 'private rented properties' or 'the personally owned properties' often had more knowledge of the palette of living issues, which were related to energy saving, carbon reductions and waste recycling (QD101-107), than those living in 'the university or university partnership properties'. This finding validated the earlier hypothesis that, generally speaking, there was a trend that students often had better understanding of issues confronted frequently in their everyday lives. In other words, the more independently students lived, the better understanding of the relevant living issues they would have. In this case, students living in 'private rented properties' or 'the personally owned properties' often paid more attention to these living issues as they needed to deal with them in their day-to-day lives. However, for students living in 'the university or university partnership properties', they rarely knew about these issues as many of them, such as utility bills, energy suppliers, control systems, energy-saving lighting appliances and household waste recycling and so on, had been taken into account by the University Accommodation and Campus Services (ACS – the Client Group). Although this kind of centralised control intended to reduce occupant-related errors, it was an open question whether it would truly lead to energy saving and carbon reductions in the operational phase of house occupation, or instil good citizenship practices from a longer-term perspective. At least, it did not provide the opportunities to help student residents improve their understanding of issues related to sustainable living.

### 6.4.3 GROUP FACTORS (QA) * WILLINGNESS TO LIFESTYLE CHANGE (QD401)

Besides investigating target students' knowledge of some living issues, this survey aimed to explore students' willingness to change their lifestyle towards greater environmental

sensitivity (QD401). ***Nominal data***[xlviii] was collected to see whether students in the target group looked for information about living in a more sustainable way. Then *chi-square test* was applied to see whether there was any relationship between categorical variables, in this case the relationship between students' group factors (related to 'education' (department and academic year) and 'social group' (gender and cultural background)) and their willingness to make lifestyle changes (QD401).

For the chi-square test for independence, there are two important assumptions: 'it is imperative that each person, item or entity contributes to only one cell of the contingency table' and 'the expected frequencies should be greater than 5' (Field 2005: 686). Once the two assumptions are not violated, *Crosstabs* underneath the *Descriptive Statistics* can then be used to summarise data that fall into categories and produce the chi-square test. Further, besides *Chi-square test*, *Contingency coefficient*, *Phi and Cramer's V* and *Lambda*[xlix] in the Statistics were selected according to their features.

For 2 by 2 tables, the most commonly used effect size is the phi coefficient, 'which is a correlation coefficient and can range from 0 to 1, with higher values indicating a stronger association between the two variables' (Pallant 2007: 217). According to Cohen (1988, cited in Pallant 2007:217), the criteria of effect sizes are .10 for small effect, .30 for medium effect and .50 for large effect.

For tables larger than 2 by 2, the value to report is Cramer's V (Field 2005: 689, Pallant 2007: 217) as it takes into account the degrees of freedom. As argued by Pallant (2007: 217), the criteria for judging the effect size of larger tables can be determined by the following procedure: 'first subtract 1 from the number of categories in the row variable (R-1), and then

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[xlviii] As the lowest level for data measurement (compared with ordinal and interval/ratio data), the nominal data are merely labels, or categories into which the variables can be filled. (Field 2005:49)

[xlix] 'Chi-square: this performs the basic Pearson chi-square test. The chi-square test detects whether there is a significant association between two categorical variables. However, it does not say anything about how strong that associate might be.

Phi and Cramer's V: these are measures of the strength of association between two categorical variables. Phi is used with 2*2 contingency tables (tables in which you have two categorical variables and each variable has only two categories). Phi is calculated by taking the chi-square value and dividing it by the sample size and then taking the square root of this value. If one of the two categorical variables contains more than two categories then Cramer's V is preferred to phi because phi fails to reach its minimum value of zero (indicating no association) in these circumstances

Lambda: Goodman and Kruskal's λ measures the proportional reduction in error that is achieved when membership of a category of one variable is used to predict category membership on the other variable. A value of 1 means that one variable perfectly predicts the other, whereas a value of 0 indicates that one variable in no way predicts the other.' (Field 2005: 689)

subtract 1 from the number of categories in the column variable (C-1), then pick whichever of these values is smaller'.

- For R-1 or C-1 equal to 1 (two categories): small = .01, medium = .30, large = .50
- For R-1 or C-1 equal to 2 (three categories): small = .07, medium = .21, large = .35
- For R-1 or C-1 equal to 3 (four categories): small = .06, medium = .17, large = .29

The procedures of data analysis are described in detail in the following sections and any case with data missing was considered to be due to the student *not* looking for information about living in a more sustainable way.

- ***Gender * QD401 – Chi-square test for independence***

As shown in Table 6.19 and Table 6.20, there was not a significant association between the gender of students and whether or not the students were likely to look for information towards greater environmental sensitivity, $\chi^2(1) = 2.33$, $p > .05$. However, the proportion of female students (60.5%) in the target group who were likely to look for information about living in a more sustainable way was more than male students (53.4%).

**Table 6.19: Gender * Looking for information about living in a more sustainable way Crosstabulation**

| | | | Looking for information about living in a more sustainable way | | Total |
|---|---|---|---|---|---|
| | | | No | Yes | |
| Gender | Male | Count | 115 | 132 | 247 |
| | | Expected Count | 106.8 | 140.2 | 247.0 |
| | | % within Gender | 46.6% | 53.4% | 100.0% |
| | | % within Looking for information | 56.9% | 49.8% | 52.9% |
| | | % of Total | 24.6% | 28.3% | 52.9% |
| | Female | Count | 87 | 133 | 220 |
| | | Expected Count | 95.2 | 124.8 | 220.0 |
| | | % within Gender | 39.5% | 60.5% | 100.0% |
| | | % within Looking for information | 43.1% | 50.2% | 47.1% |
| | | % of Total | 18.6% | 28.5% | 47.1% |
| Total | | Count | 202 | 265 | 467 |
| | | Expected Count | 202.0 | 265.0 | 467.0 |
| | | % within Gender | 43.3% | 56.7% | 100.0% |
| | | % within Looking for information | 100.0% | 100.0% | 100.0% |
| | | % of Total | 43.3% | 56.7% | 100.0% |

**Table 6.20: Chi-Square Tests**

| | Value | df | Asymp. Sig. (2-sided) | Exact Sig. (2-sided) | Exact Sig. (1-sided) |
|---|---|---|---|---|---|
| Pearson Chi-Square | 2.332(b) | 1 | .127 | | |
| Continuity Correction(a) | 2.055 | 1 | .152 | | |
| Likelihood Ratio | 2.336 | 1 | .126 | | |
| Fisher's Exact Test | | | | .135 | .076 |
| Linear-by-Linear Association | 2.327 | 1 | .127 | | |
| N of Valid Cases | 467 | | | | |

a Computed only for a 2x2 table

b 0 cells (.0%) have expected count less than 5. The minimum expected count is 95.16.

- ***Major Subject (Department) * QD401 – Chi-square test for independence***

As shown in Table 6.21 and Table 6.22, there was not a significant association between the department of students and whether or not the students were likely to look for information towards greater environmental sensitivity, $\chi^2(2) = 1.60$, $p > .05$. However, the proportion of architectural students (57.6%) and landscape students (59.4%) in the target group who were likely to look for information about living in a more sustainable way was more than TRP students (51.1%).

**Table 6.21: Department * Looking for information about living in a more sustainable way Crosstabulation**

| | | | Looking for information about living in a more sustainable way | | Total |
|---|---|---|---|---|---|
| | | | No | Yes | |
| Department | Architecture | Count | 114 | 155 | 269 |
| | | Expected Count | 116.4 | 152.6 | 269.0 |
| | | % within Department | 42.4% | 57.6% | 100.0% |
| | | % within Looking for information | 56.4% | 58.5% | 57.6% |
| | | % of Total | 24.4% | 33.2% | 57.6% |
| | Landscape | Count | 43 | 63 | 106 |
| | | Expected Count | 45.9 | 60.1 | 106.0 |
| | | % within Department | 40.6% | 59.4% | 100.0% |
| | | % within Looking for information | 21.3% | 23.8% | 22.7% |
| | | % of Total | 9.2% | 13.5% | 22.7% |
| | TRP | Count | 45 | 47 | 92 |
| | | Expected Count | 39.8 | 52.2 | 92.0 |
| | | % within Department | 48.9% | 51.1% | 100.0% |
| | | % within Looking for information | 22.3% | 17.7% | 19.7% |
| | | % of Total | 9.6% | 10.1% | 19.7% |

| | | | | |
|---|---|---|---|---|
| Total | Count | 202 | 265 | 467 |
| | Expected Count | 202.0 | 265.0 | 467.0 |
| | % within Department | 43.3% | 56.7% | 100.0% |
| | % within Looking for information | 100.0% | 100.0% | 100.0% |
| | % of Total | 43.3% | 56.7% | 100.0% |

**Table 6.22: Chi-Square Tests**

| | Value | df | Asymp. Sig. (2-sided) |
|---|---|---|---|
| Pearson Chi-Square | 1.596(a) | 2 | .450 |
| Likelihood Ratio | 1.588 | 2 | .452 |
| Linear-by-Linear Association | .791 | 1 | .374 |
| N of Valid Cases | 467 | | |

a 0 cells (.0%) have expected count less than 5. The minimum expected count is 39.79.

- ***Academic Year * QD401 – Chi-square test for independence***

As shown in Table 6.23, Table 6.24 and Table 6.25, there was a significant association between the academic years of students and whether or not the students were likely to look for information towards greater environmental sensitivity, $\chi^2(3) = 14.41$, $p < .01$; and the effect size was small (Cramer's V = .18). Although there was a tendency that students in the higher academic years were more likely to look for information about living in a more sustainable way, students in the second year was an exception.

Further, for the proportion of students who were likely to look for information about living in a more sustainable way, students in MA or at an equal level (68.9%) was larger than students in the 3rd year (60.6%) and students in the 1st year (59.2%); and all of them were larger than students in the 2nd year (44.1%).

**Table 6.23: Academic year * Looking for information about living in a more sustainable way Crosstabulation**

| | | | Looking for information about living in a more sustainable way | | Total |
|---|---|---|---|---|---|
| | | | No | Yes | |
| Academic year | 1st year | Count | 53 | 77 | 130 |
| | | Expected Count | 56.2 | 73.8 | 130.0 |
| | | % within Academic year | 40.8% | 59.2% | 100.0% |
| | | % within Looking for information | 26.2% | 29.1% | 27.8% |
| | | % of Total | 11.3% | 16.5% | 27.8% |

| | | | | |
|---|---|---|---|---|
| 2nd year | Count | 76 | 60 | 136 |
| | Expected Count | 58.8 | 77.2 | 136.0 |
| | % within Academic year | 55.9% | 44.1% | 100.0% |
| | % within Looking for information | 37.6% | 22.6% | 29.1% |
| | % of Total | 16.3% | 12.8% | 29.1% |
| 3rd year | Count | 50 | 77 | 127 |
| | Expected Count | 54.9 | 72.1 | 127.0 |
| | % within Academic year | 39.4% | 60.6% | 100.0% |
| | % within Looking for information | 24.8% | 29.1% | 27.2% |
| | % of Total | 10.7% | 16.5% | 27.2% |
| MA | Count | 23 | 51 | 74 |
| | Expected Count | 32.0 | 42.0 | 74.0 |
| | % within Academic year | 31.1% | 68.9% | 100.0% |
| | % within Looking for information | 11.4% | 19.2% | 15.8% |
| | % of Total | 4.9% | 10.9% | 15.8% |
| Total | Count | 202 | 265 | 467 |
| | Expected Count | 202.0 | 265.0 | 467.0 |
| | % within Academic year | 43.3% | 56.7% | 100.0% |
| | % within Looking for information | 100.0% | 100.0% | 100.0% |
| | % of Total | 43.3% | 56.7% | 100.0% |

**Table 6.24: Chi-Square Tests**

| | Value | df | Asymp. Sig. (2-sided) |
|---|---|---|---|
| Pearson Chi-Square | 14.411(a) | 3 | .002 |
| Likelihood Ratio | 14.465 | 3 | .002 |
| Linear-by-Linear Association | 4.090 | 1 | .043 |
| N of Valid Cases | 467 | | |

a 0 cells (.0%) have expected count less than 5. The minimum expected count is 32.01.

**Table 6.25: Symmetric Measures**

| | | Value | Approx. Sig. |
|---|---|---|---|
| Nominal by Nominal | Phi | .176 | .002 |
| | Cramer's V | .176 | .002 |
| | Contingency Coefficient | .173 | .002 |
| N of Valid Cases | | 467 | |

a Not assuming the null hypothesis.

b Using the asymptotic standard error assuming the null hypothesis.

- ***Cultural Background (Original Residence Places) * QD401 – Chi-square test for independence***

As shown in Table 6.26 and Table 6.27, there was not a significant association between the cultural background (original residence places) of students and whether or not the students were likely to look for information towards greater environmental sensitivity, $\chi^2(2) = 1.08$, $p > .05$. However, the proportions of students in the sub-groups who were likely to look for information about living in a more sustainable way could be described in descending order according to their original residence places as international students (62.0%), students from London (58.1%) and students from other cities in the UK (55.4%).

**Table 6.26: Original residence places * Looking for information about living in a more sustainable way Crosstabulation**

| | | | Looking for information about living in a more sustainable way | | Total |
|---|---|---|---|---|---|
| | | | No | Yes | |
| Original residence places | London | Count | 26 | 36 | 62 |
| | | Expected Count | 26.8 | 35.2 | 62.0 |
| | | % within Original residence places | 41.9% | 58.1% | 100.0% |
| | | % within Looking for information | 12.9% | 13.6% | 13.3% |
| | | % of Total | 5.6% | 7.7% | 13.3% |
| | Other UK cities | Count | 149 | 185 | 334 |
| | | Expected Count | 144.5 | 189.5 | 334.0 |
| | | % within Original residence places | 44.6% | 55.4% | 100.0% |
| | | % within Looking for information | 73.8% | 69.8% | 71.5% |
| | | % of Total | 31.9% | 39.6% | 71.5% |
| | Other countries | Count | 27 | 44 | 71 |
| | | Expected Count | 30.7 | 40.3 | 71.0 |
| | | % within Original residence places | 38.0% | 62.0% | 100.0% |
| | | % within Looking for information | 13.4% | 16.6% | 15.2% |
| | | % of Total | 5.8% | 9.4% | 15.2% |
| Total | | Count | 202 | 265 | 467 |
| | | Expected Count | 202.0 | 265.0 | 467.0 |
| | | % within Original residence places | 43.3% | 56.7% | 100.0% |
| | | % within Looking for information | 100.0% | 100.0% | 100.0% |
| | | % of Total | 43.3% | 56.7% | 100.0% |

**Table 6.27: Chi-Square Tests**

| | Value | df | Asymp. Sig. (2-sided) |
|---|---|---|---|
| Pearson Chi-Square | 1.084(a) | 2 | .581 |
| Likelihood Ratio | 1.093 | 2 | .579 |

| | | | |
|---|---|---|---|
| Linear-by-Linear Association | .256 | 1 | .613 |
| N of Valid Cases | 467 | | |

a 0 cells (.0%) have expected count less than 5. The minimum expected count is 26.82.

In summary, based on the chi-square test for independence in SPSS, students' willingness to change lifestyles towards greater environmental sensitivity was not significantly associated with their gender, major subject (department) or cultural background (original residence place), $p > .05$. Although there was a significant association between students' academic years and their willingness to look for information about living in a more sustainable way ($p < .01$), the relationship was not linear. Specifically, although it was argued earlier (see 2.7.2) that issues related to 'education' and 'social group' should have significant impacts on peoples' willingness to change their lifestyle towards greater environmental sensitivity, findings from the study of a target group of students were very negative. However, it provided an insight into the challenge and opportunities for future social intervention work.

### 6.4.4 WILLINGNESS TO LIFESTYLE CHANGE (QD401) * KNOWLEDGE OF LIFESTYLE ISSUES (QD101-107)

In the previous section (6.4.3), the association between students' willingness to look for information related to sustainable lifestyle and issues related to students' 'education' and 'social group' was explored. Based on this study, another interesting research question was arising that whether students' willingness to look for sustainability-related information would have an impact on their knowledge of the living issues addressed in QD101-107.

- ***Willingness to Lifestyle Change (QD401) * QD101-107 – Mann-Whitney U test***

The Mann-Whitney U test (*2 Independent Samples* underneath *Nonparametric Tests*) was conducted to compare the knowledge differences of some living issues (QD101-107) between students who were looking for information about living in a more sustainable way and those who were not.

As shown in Table 6.28, aggregated results of the consultations showed that there were significant knowledge differences of most of the palette of living issues addressed in QD101-107 between students who were concerned with sustainable lifestyle (those who would look for information about living in a more sustainable way) and those who were not ($p < .01$), except QD104 (awareness of information related to local public transport). Further details can be found in Appendix 1.3.

**Table 6.28: Knowledge difference between students with consciousness of sustainable lifestyle and those without – Mann-Whitney U test [a]**

| | Mann-Whitney U | Wilcoxon W | Z | Asymnp. Sig. (2-tailed) |
|---|---|---|---|---|
| QD101 | 21767.500 | 42270.500 | -3.545 | .000(**) |
| QD102 | 22420.500 | 42923.000 | -3.152 | .002(**) |
| QD103 | 22521.500 | 43024.500 | -3.020 | .003(**) |
| QD104 | 24086.500 | 44589.500 | -1.954 | .051 |
| QD105 | 18459.000 | 38962.000 | -5.931 | .000(**) |
| QD106 | 15895.000 | 36398.000 | -7.715 | .000(**) |
| QD107 | 18347.500 | 38850.500 | -6.054 | .000(**) |

(*) significant difference at level of $p < .05$
(**) significant difference at level of $p < .01$
a. Grouping Variable: Looking for information about living in a more sustainable way

Specifically, students who were concerned about sustainable living (who would look for information about living in a more sustainable way) in their day-to-day lives often had better understanding of some living issues related to energy saving, carbon reductions and waste recycling than those students who were not. This finding validated the earlier argument that students' awareness of and willingness to change lifestyle towards greater environmental sensitivity would play an important role in tackling climate change (see 2.4.2).

## 6.5 A FOLLOW-UP PROCEDURE – COMPARATIVE DESIGN

As argued earlier (see 6.2), student samples in the investigation were drawn from the Faculty of Architecture based on the convenience sampling method. As a non-probability sampling method, aggregated results of the consultation (sustainability-related issues) in the target students group could not be claimed to be representative of the genuine opinions from the university students, but only the feedback from students in the Faculty of Architecture. Further, some students from the Faculty of Architecture even argued that architectural students were not necessarily more aware of these sustainability-related issues or more ready to change their lifestyle towards greater environmental sensitivity (see 6.3.4). To have a deep insight into the given phenomena, a follow-up procedure was carried out to see whether there was any difference between students from the Faculty of Architecture and students from other departments in the university. This follow-up procedure also aimed to accommodate issues referring to generalisation.

### 6.5.1 CONSULTATION RESPONSES

In total 43 students were randomly recruited in the follow-up programme, including students from Department of Law, Department of History, Management School, Medicine School, Department of Probability and Statistics and so on. However, it was important to note that, strictly speaking, the sampling method in this follow-up procedure was still based on a non-probability approach. Further, with limited financial incentive due to the researcher's budget, the response rate of the self-completion questionnaires was much less than expected, nearly 45%; and some respondents felt reluctant to help with this research.

As shown in Figure 6.13, in order to explore the variation of the given phenomena, whether there was any significant difference between students from the Faculty of Architecture and students from other departments in the university, these 43 responses from a variety of departments were taken into account as one group of variables to compare with the 467 responses from the Faulty of Architecture.

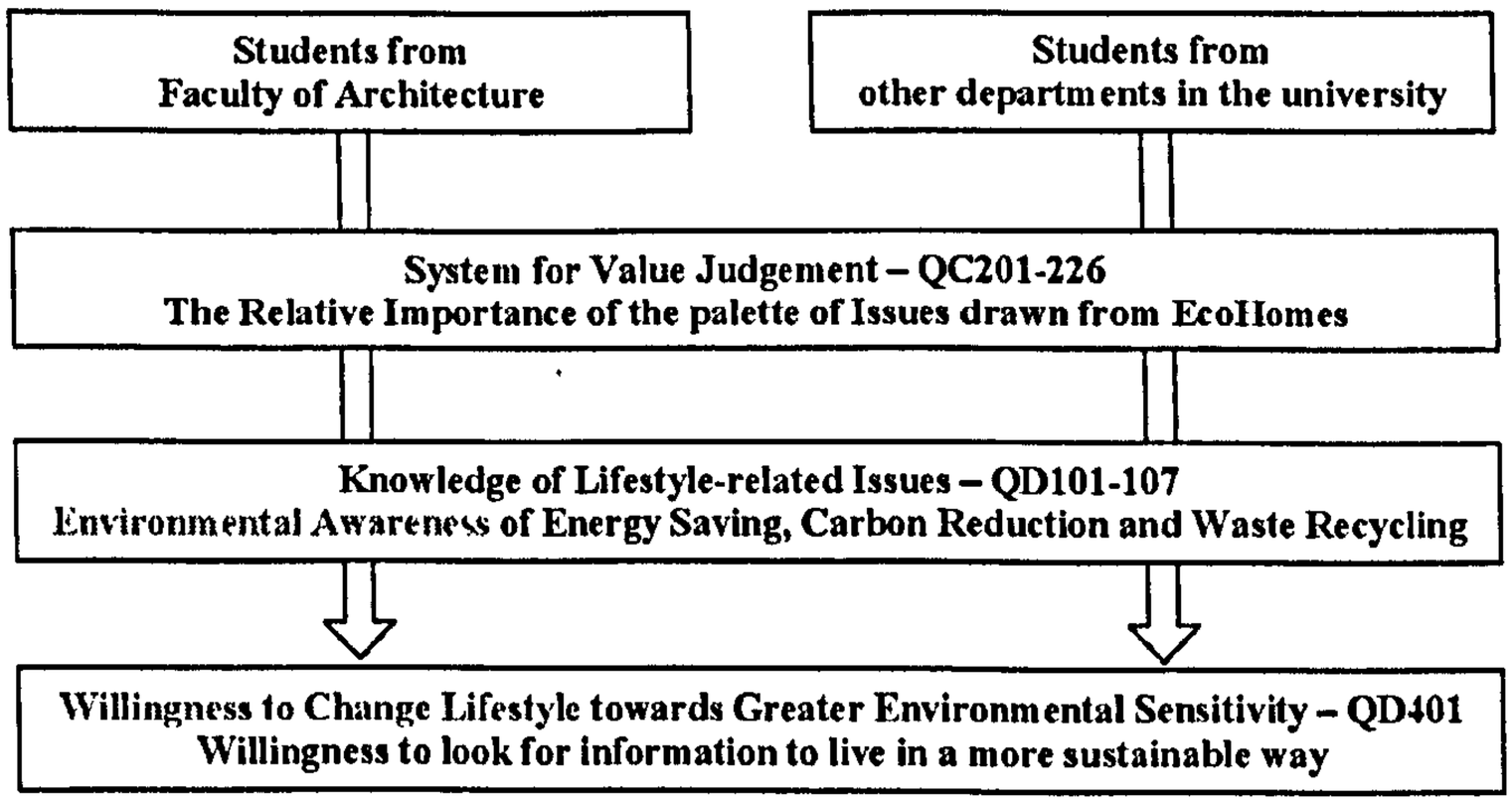


**Figure 6.13: Framework of the comparative design**

- ***Two Student Groups * QC201-226 – Independent T test & Mann-Whitney U test***

The independent t-test (*Independent Samples T test* underneath *Compare Means*) was conducted to compare the means, on the evaluation of the palette of housing environmental issues drawn from EcoHomes (from QC201 to QC226), for students from the Faculty of Architecture and students from other departments in the university.

As shown in Table 6.29 and Table 6.30, aggregated results of the consultations showed that there were significant differences ($p < .05$) between the two groups of variables on the evaluation of the relative importance of four housing environmental issues, which were

QC202, QC203, QC210 and QC225. For the evaluation of the rest of issues, there were no significant differences ($p > .05$) between students from the Faculty of Architecture and students from other university departments. Further details can be found in Appendix 1.4.

**Table 6.29: Group Statistics**

| | Gender | N | Mean | Std. Deviation | Std. Error Mean |
|---|---|---|---|---|---|
| QC201 | Faculty of Architecture | 467 | 4.4304 | .71539 | .03310 |
| | Other Departments | 43 | 4.4884 | .82728 | .12616 |
| QC202 | Faculty of Architecture | 467 | 3.7816 | .84371 | .03904 |
| | Other Departments | 43 | 4.1163 | .82258 | .12544 |
| QC203 | Faculty of Architecture | 467 | 3.5182 | .85492 | .03956 |
| | Other Departments | 43 | 3.7907 | .83261 | .12697 |
| QC204 | Faculty of Architecture | 467 | 4.0878 | .77984 | .03609 |
| | Other Departments | 43 | 4.0465 | .92462 | .14100 |
| QC205 | Faculty of Architecture | 467 | 3.4240 | .87410 | .04045 |
| | Other Departments | 43 | 3.6279 | .95177 | .14514 |
| QC206 | Faculty of Architecture | 467 | 3.5225 | .92244 | .04269 |
| | Other Departments | 43 | 3.7674 | .78185 | .11923 |
| QC207 | Faculty of Architecture | 467 | 3.9315 | .74955 | .03468 |
| | Other Departments | 43 | 3.8372 | .81446 | .12420 |
| QC208 | Faculty of Architecture | 467 | 2.7709 | 1.03427 | .04786 |
| | Other Departments | 43 | 2.5581 | 1.14022 | .17388 |
| QC209 | Faculty of Architecture | 467 | 3.2548 | 1.05501 | .04882 |
| | Other Departments | 43 | 3.2093 | 1.20630 | .18396 |
| QC210 | Faculty of Architecture | 467 | 2.8287 | .96093 | .04447 |
| | Other Departments | 43 | 3.1395 | 1.01375 | .15460 |
| QC211 | Faculty of Architecture | 467 | 4.0578 | .83311 | .03855 |
| | Other Departments | 43 | 3.9302 | .93593 | .14273 |
| QC212 | Faculty of Architecture | 467 | 3.3983 | .87884 | .04067 |
| | Other Departments | 43 | 3.5349 | .90892 | .13861 |
| QC213 | Faculty of Architecture | 467 | 4.3897 | .68564 | .03173 |
| | Other Departments | 43 | 4.3953 | .82056 | .12513 |
| QC214 | Faculty of Architecture | 467 | 3.6959 | .86776 | .04015 |
| | Other Departments | 43 | 3.4651 | 1.00827 | .15376 |
| QC215 | Faculty of Architecture | 467 | 2.9165 | .90034 | .04166 |
| | Other Departments | 43 | 3.1395 | 1.05968 | .16160 |
| QC216 | Faculty of Architecture | 467 | 3.3790 | .97602 | .04516 |
| | Other Departments | 43 | 3.5349 | 1.05444 | .16080 |
| QC217 | Faculty of Architecture | 467 | 3.0000 | 1.01067 | .04677 |
| | Other Departments | 43 | 3.0930 | .97135 | .14813 |
| QC218 | Faculty of Architecture | 467 | 2.3084 | 1.18611 | .05489 |
| | Other Departments | 43 | 2.3488 | 1.21270 | .18494 |
| QC219 | Faculty of Architecture | 467 | 2.1627 | 1.16791 | .05404 |
| | Other Departments | 43 | 2.0465 | 1.13292 | .17277 |
| QC220 | Faculty of Architecture | 467 | 4.0878 | .78533 | .03634 |
| | Other Departments | 43 | 4.0465 | .75446 | .11505 |
| QC221 | Faculty of Architecture | 467 | 2.9058 | .98252 | .04547 |
| | Other Departments | 43 | 2.6977 | 1.14507 | .17462 |
| QC222 | Faculty of Architecture | 467 | 3.7901 | .87089 | .04030 |
| | Other Departments | 43 | 3.8605 | .96563 | .14726 |
| QC223 | Faculty of Architecture | 467 | 3.3983 | .96719 | .04476 |
| | Other Departments | 43 | 3.6279 | 1.15518 | .17616 |
| QC224 | Faculty of Architecture | 467 | 3.5439 | .91230 | .04222 |
| | Other Departments | 43 | 3.8372 | 1.04495 | .15935 |
| QC225 | Faculty of Architecture | 467 | 3.3897 | .94605 | .04378 |
| | Other Departments | 43 | 3.6279 | 1.04707 | .15968 |
| QC226 | Faculty of Architecture | 467 | 2.9251 | 1.04858 | .04852 |
| | Other Departments | 43 | 3.3721 | 1.17561 | .17928 |

**Table 6.30: Independent Samples T Test**

| | | Levene's Test for Equality of Variances | | t-test for Equality of Means | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | 95% Confidence Interval of the Difference | |
| | Equal variances | F | Sig. | t | df | Sig. (2-tailed) | Mean Difference | Lower | Upper |
| QC201 | assumed | .743 | .389 | -.501 | 508 | .616 | -.05797 | -.28505 | .16912 |
| | not assumed | | | -.444 | 47.962 | .659 | -.05797 | -.32022 | .20429 |
| QC202 | assumed | .378 | .539 | -2.494 | 508 | .013(*) | -.33469 | -.59832 | -.07107 |
| | not assumed | | | -2.548 | 50.488 | .014 | -.33469 | -.59851 | -.07088 |
| QC203 | assumed | 1.193 | .275 | -2.004 | 508 | .046(*) | -.27250 | -.53960 | -.00540 |
| | not assumed | | | -2.049 | 50.507 | .046 | -.27250 | -.53955 | -.00544 |
| QC204 | assumed | .973 | .324 | .327 | 508 | .744 | .04128 | -.20694 | .28951 |
| | not assumed | | | .284 | 47.664 | .778 | .04128 | -.25142 | .33398 |
| QC205 | assumed | .490 | .484 | -1.453 | 508 | .147 | -.20392 | -.47969 | .07185 |
| | not assumed | | | -1.353 | 48.750 | .182 | -.20392 | -.50676 | .09891 |
| QC206 | assumed | 4.811 | .029 | -1.686 | 508 | .092 | -.24496 | -.53039 | .04047 |
| | not assumed | | | -1.934 | 53.377 | .058 | -.24496 | -.49893 | .00901 |
| QC207 | assumed | 2.331 | .127 | .783 | 508 | .434 | .09427 | -.14216 | .33069 |
| | not assumed | | | .731 | 48.779 | .468 | .09427 | -.16491 | .35344 |
| QC208 | assumed | 1.975 | .161 | 1.279 | 508 | .201 | .21274 | -.11396 | .53943 |
| | not assumed | | | 1.180 | 48.580 | .244 | .21274 | -.14977 | .57524 |
| QC209 | assumed | 2.565 | .110 | .267 | 508 | .789 | .04552 | -.28897 | .38000 |
| | not assumed | | | .239 | 48.103 | .812 | .04552 | -.33714 | .42817 |
| QC210 | assumed | .019 | .890 | -2.020 | 508 | .044(*) | -.31084 | -.61310 | -.00858 |
| | not assumed | | | -1.932 | 49.207 | .059 | -.31084 | -.63407 | .01239 |
| QC211 | assumed | .142 | .707 | .325 | 105 | .746 | .10317 | -.52687 | .73322 |
| | not assumed | | | .373 | 10.162 | .717 | .10317 | -.51209 | .71844 |
| QC212 | assumed | 1.036 | .309 | .951 | 508 | .342 | .12758 | -.13607 | .39124 |
| | not assumed | | | .863 | 48.329 | .392 | .12758 | -.16962 | .42479 |
| QC213 | assumed | .021 | .885 | -.973 | 508 | .331 | -.13660 | -.41255 | .13935 |
| | not assumed | | | -.946 | 49.509 | .349 | -.13660 | -.42681 | .15361 |
| QC214 | assumed | 2.192 | .139 | -.051 | 508 | .960 | -.00563 | -.22410 | .21285 |
| | not assumed | | | -.044 | 47.556 | .965 | -.00563 | -.26525 | .25399 |
| QC215 | assumed | 1.987 | .159 | 1.646 | 508 | .100 | .23082 | -.04475 | .50638 |
| | not assumed | | | 1.452 | 47.903 | .153 | .23082 | -.08872 | .55035 |
| QC216 | assumed | 2.023 | .156 | -1.530 | 508 | .127 | -.22305 | -.50939 | .06330 |
| | not assumed | | | -1.337 | 47.750 | .188 | -.22305 | -.55863 | .11254 |
| QC217 | assumed | .598 | .440 | -.995 | 508 | .320 | -.15587 | -.46356 | .15182 |
| | not assumed | | | -.933 | 48.861 | .355 | -.15587 | -.49154 | .17980 |
| QC218 | assumed | .032 | .858 | -.579 | 508 | .563 | -.09302 | -.40846 | .22241 |
| | not assumed | | | -.599 | 50.745 | .552 | -.09302 | -.40491 | .21887 |
| QC219 | assumed | .300 | .584 | -.214 | 508 | .831 | -.04049 | -.41255 | .33158 |
| | not assumed | | | -.210 | 49.690 | .835 | -.04049 | -.42801 | .34704 |
| QC220 | assumed | .349 | .555 | .626 | 508 | .532 | .11623 | -.24854 | .48100 |
| | not assumed | | | .642 | 50.578 | .524 | .11623 | -.24726 | .47972 |
| QC221 | assumed | .198 | .656 | .331 | 508 | .741 | .04128 | -.20381 | .28638 |
| | not assumed | | | .342 | 50.753 | .734 | .04128 | -.20098 | .28354 |
| QC222 | assumed | 5.635 | .018 | 1.310 | 508 | .191 | .20811 | -.10404 | .52025 |
| | not assumed | | | 1.153 | 47.868 | .255 | .20811 | -.15472 | .57094 |
| QC223 | assumed | .054 | .817 | -.502 | 508 | .616 | -.07032 | -.34556 | .20493 |
| | not assumed | | | -.461 | 48.502 | .647 | -.07032 | -.37720 | .23657 |
| QC224 | assumed | 2.468 | .117 | -1.464 | 508 | .144 | -.22962 | -.53773 | .07849 |
| | not assumed | | | -1.263 | 47.579 | .213 | -.22962 | -.59516 | .13592 |
| QC225 | assumed | .464 | .496 | -1.992 | 508 | .047(*) | -.29331 | -.58261 | -.00401 |
| | not assumed | | | -1.779 | 48.081 | .082 | -.29331 | -.62475 | .03813 |
| QC226 | assumed | .744 | .389 | -1.565 | 508 | .118 | -.23819 | -.53713 | .06076 |
| | not assumed | | | -1.439 | 48.527 | .157 | -.23819 | -.57099 | .09462 |

(*) significant difference at level of $p < .05$

(**) significant difference at level of $p < .01$

To verify the significant findings from the independent t-test, the Mann-Whitney U test (*2 Independent Samples* (test) underneath *Nonparametric Tests*) was conducted to re-analyse the data and the results were reported in Table 6.31. It was found that students from the Faculty of Architecture and students from other departments in the university had significant differences in their evaluation of QC202, QC203, QC210, QC224 and QC226. Most findings with significant results (QC202, QC203 and QC210) corresponded with those from the independent t-test. However, it is important to note that the significant difference was found on QC225 based on the independent t-test; on the other hand, the significant difference was found on QC224 and QC226 based on the Mann-Whitney U test.

**Table 6.31: Mann-Whitney U test**

| | Mann-Whitney U | Wilcoxon W | Z | Asymnp. Sig. (2-tailed) |
|---|---|---|---|---|
| QC201 | 9168.000 | 118446.000 | -1.063 | .288(**) |
| QC202 | 7810.500 | 117088.500 | -2.596 | .009 |
| QC203 | 8314.000 | 117592.000 | -1.994 | .046(*) |
| QC204 | 9984.000 | 119262.000 | -.066 | .947 |
| QC205 | 8628.000 | 117906.000 | -1.622 | .105 |
| QC206 | 8524.000 | 117802.000 | -1.740 | .082 |
| QC207 | 9326.500 | 10272.500 | -.862 | .389 |
| QC208 | 9137.500 | 10083.500 | -1.016 | .309 |
| QC209 | 9913.500 | 10859.500 | -.143 | .886 |
| QC210 | 8005.000 | 117283.000 | -2.314 | .021(*) |
| QC211 | 9378.000 | 10324.000 | -.769 | .442 |
| QC212 | 9149.000 | 118427.000 | -1.028 | .304 |
| QC213 | 9579.500 | 118857.500 | -.557 | .578 |
| QC214 | 8810.500 | 9756.500 | -1.418 | .156 |
| QC215 | 8535.000 | 117813.000 | -1.720 | .085 |
| QC216 | 9023.000 | 118301.000 | -1.153 | .249 |
| QC217 | 9410.000 | 118688.000 | -.714 | .475 |
| QC218 | 9840.000 | 119118.000 | -.225 | .822 |
| QC219 | 9492.500 | 10438.500 | -.619 | .536 |
| QC220 | 9637.000 | 10583.000 | -.476 | .634 |
| QC221 | 9105.000 | 10051.000 | -1.060 | .289 |
| QC222 | 9309.500 | 118587.500 | -.861 | .389 |
| QC223 | 8528.000 | 117806.000 | -1.717 | .086 |
| QC224 | 8137.500 | 117415.500 | -2.174 | .030(*) |
| QC225 | 8551.500 | 117829.500 | -1.691 | .091 |
| QC226 | 7973.000 | 117251.000 | -2.340 | .019(*) |

(*) significant difference at level of $p < .05$
(**) significant difference at level of $p < .01$

Since non-parametric statistics tended to be less sensitive and powerful than parametric statistics (Field 2005: 533; Pallant 2007: 210), results from the parametric statistics (independent t-test) were taken into account as the main research findings.

However, it is important to note that, for those issues with significant differences, the relative magnitudes of the differences between means were very small and only represented a very small size effect (see Appendix 1.4 for their effect sizes). In some cases, such as QC203, QC210 and QC225, the effect sizes *r* were even smaller than the lowest criterion set by Cohen (1988, 1992; cited in Field 2005: 32), $r < .10$. This meant that less than 1% of variance in the evaluation of the relative importance of the specific environmental issue could be explained by the separation of these two student groups (or by the difference between students from the Faculty of Architecture and students from other departments in the university).

To a great extent, therefore, it was reasonable to believe that there was a close consensus on the relative importance of the palette of housing environmental issues drawn from EcoHomes (QC201-226) between the two groups of students. In other words, although people might have doubts about the generalisation of this study by arguing that it was only a case study focusing on students' opinions from the Faculty of Architecture, it was found that there was a close consensus between students from the Faculty of Architecture and students from other departments in the university. Therefore, some earlier findings, such as the impacts of students' 'education' and 'social group' on their evaluation of the relative importance of the housing environmental issues drawn from EcoHomes (as summarised in Table 6.13), can be considered as the representative of the opinions from all university students (University of Sheffield). In the future, likely validation procedures can be carried out between different universities to see whether these findings can be comparably applied in a broader way.

- ***Two Student Groups * QD101-107 – Mann-Whitney U test***

Besides the difference in the evaluation of the relative importance of the palette of housing environmental issues (QC201-226), it was interesting to see whether there was any difference in the knowledge of living issues (QD101-107) between these two groups of students. The Mann-Whitney U test (*2 Independent Samples* underneath *Nonparametric Tests*) was then conducted to compare the differences between these two groups of students' knowledge of some living issues (QD101-107).

As shown in Table 6.32, aggregated results of the consultations showed that there was only one significant difference ($p < .05$) between the two groups of students, which was students' knowledge of QD103. For the rest of the issues, no significant difference ($p > .05$) was found between these two groups. Further details can be found in Appendix 1.4.

**Table 6.32: Knowledge difference between two groups of students – Mann-Whitney U test**

| | Mann-Whitney U | Wilcoxon W | Z | Asymnp. Sig. (2-tailed) |
|---|---|---|---|---|
| QD101 | 9808.500 | 10754.500 | -.257 | .797 |
| QD102 | 9248.000 | 10194.000 | -.900 | .368 |
| QD103 | 8221.500 | 9167.500 | -2.021 | .043(*) |
| QD104 | 8654.500 | 9600.500 | -1.581 | .114 |
| QD105 | 9587.000 | 10533.000 | -.506 | .613 |
| QD106 | 9684.000 | 118962.000 | -.396 | .692 |
| QD107 | 8489.500 | 9435.500 | -1.745 | .081 |

(*) significant difference at level of $p < .05$

Again, the effect size *r* in this case (see Appendix 1.4 for its effect size) was even smaller than the lowest criterion set by Cohen (1988, 1992; cited in Field 2005: 32), $r < .10$. This meant that less than 1% of variance in the knowledge of the specific issue (QD103) could be explained by the separation of these two student groups (or by the difference between students from the Faculty of Architecture and students from other departments in the university). To a great extent, therefore, it was reasonable to believe that students in these two groups had a similar level of knowledge of these lifestyle-related issues (QD101-107) and the results (Figure 6.5 and 6.6) could be comparably applied to all university students. It is important to note that this finding did not correspond with the earlier expectation that students studying architecture or built environment related disciplines should have been better educated on sustainability issues (such as issues related to energy saving, carbon reductions and waste recycling in the operational phase of house occupation) as the first step to tackling climate change. This must be taken into account in the way to improve current sustainability-related architectural education programmes.

- ***Two Student Groups * QD401 – Chi-square test for independence***

The chi-square test (*Crosstabs* underneath the *Descriptive Statistics*) was conducted to see whether there was any difference for students' willingness to look for information related to sustainable living between these two groups.

As shown in Table 6.33 and Table 6.34, there was not a significant association between the group of students and whether or not the students were likely to look for information towards greater environmental sensitivity, $\chi^2(1) = 1.85$, $p > .05$. However, the proportion of students from other departments (67.4%) who would look for information about living in a more sustainable way was larger than students from the Faculty of Architecture (56.7%). This might be because the investigation in the Faculty of Architecture was conducted with support

from the course tutors, and some students were recruited though they felt reluctant to participate. On the other hand, the investigation in the follow-up procedure was carried out completely based on voluntary principles, and therefore all participants were interested in this research topic, more or less. Nevertheless, to some extent, this result further validated the earlier finding (see 5.4.2) that students studying architecture or built environment related disciplines had *not* been educated to have more willingness to look for information relating to lifestyle change towards greater environmental sensitivity, though this had been argued to be a necessary step to tackling climate change.

**Table 6.33: Two Student Groups * Looking for information about living in a more sustainable way Crosstabulation**

| | | | Looking for information about living in a more sustainable way | | Total |
|---|---|---|---|---|---|
| | | | No | Yes | |
| Group | Students from the Faculty of Architecture | Count | 202 | 265 | 467 |
| | | Expected Count | 197.8 | 269.2 | 467.0 |
| | | % within Group | 43.3% | 56.7% | 100.0% |
| | | % within Looking for information | 93.5% | 90.1% | 91.6% |
| | | % of Total | 39.6% | 52.0% | 91.6% |
| | Students from other departments | Count | 14 | 29 | 43 |
| | | Expected Count | 18.2 | 24.8 | 43.0 |
| | | % within Group | 32.6% | 67.4% | 100.0% |
| | | % within Looking for information | 6.5% | 9.9% | 8.4% |
| | | % of Total | 2.7% | 5.7% | 8.4% |
| Total | | Count | 216 | 294 | 510 |
| | | Expected Count | 216.0 | 294.0 | 510.0 |
| | | % within Group | 42.4% | 57.6% | 100.0% |
| | | % within Looking for information | 100.0% | 100.0% | 100.0% |
| | | % of Total | 42.4% | 57.6% | 100.0% |

**Table 6.34: Chi-Square Tests**

| | Value | df | Asymp. Sig. (2-sided) | Exact Sig. (2-sided) | Exact Sig. (1-sided) |
|---|---|---|---|---|---|
| Pearson Chi-Square | 1.845(b) | 1 | .174 | | |
| Continuity Correction(a) | 1.433 | 1 | .231 | | |
| Likelihood Ratio | 1.893 | 1 | .169 | | |
| Fisher's Exact Test | | | | .199 | .115 |
| Linear-by-Linear Association | 1.842 | 1 | .175 | | |
| N of Valid Cases | 510 | | | | |

a Computed only for a 2x2 table

b 0 cells (.0%) have expected count less than 5. The minimum expected count is 18.21.

### 6.5.2 GENERALISATION OF THE FINDINGS

Compared with students from other departments in the university, students from the Faculty of Architecture do not have significantly more knowledge of the lifestyle-related issues (QD101-107) and are not significantly more willing to look for information about living in a more sustainable way (QD401). Further, between these two groups of students, there is a ***close consensus*** on their evaluation of the relative importance of the palette of housing environmental issues drawn from EcoHomes (QC201-226). In other words, students in these two groups often adopt a similar system for value judgement in their accommodation seeking processes.

These kinds of findings are achieved probably because enough of the population (the sampling fraction is nearly 30% of the total students in the University of Sheffield) has been sampled so that public attitudes are likely to be similar (Weisberg *et al.* 1996). As argued by Bryman (2004: 97), having a larger sample size does not guarantee precision of the results but help to decrease the sampling error. Further, the size or percentage of the sample will heavily depend on the research compromises of time and cost (ibid: 98). In this case, the sample carefully drawn from the Faculty of Architecture can be considered as a sample with reasonable size since feedback from this sample is similar to feedback from students randomly drawn from other university departments.

Further, the sampling method within the Faculty of Architecture also provides an opportunity to collect the data from both voluntary and reluctant participants. Compared with data collected from other university departments based on voluntary principles, consultation responses from the Faculty of Architecture are more likely to be considered as the representative of the genuine opinions of university students. As a result, findings drawn in 6.4 can be generalised beyond the confines of the particular context in which the survey is conducted. The order of relative importance of issues drawn from EcoHomes, as shown in Table 6.2, can be used in Chapter 9 for a further comparative study.

Although some people might argue that the investigation in the Faculty of Architecture should only be taken into account as an exemplifying case study, the generalisation of this study has been further validated in the following-up procedure. Since feedback between students from the Faculty of Architecture and students from other university departments is very similar, findings from the investigation in the Faculty of Architecture are claimed to be representative of the genuine opinions of university students (University of Sheffield).

Nevertheless, it is important to note that this finding does not correspond with the earlier expectation that students studying architecture or built environment related disciplines should have been better educated on sustainability issues as the first step to tackling climate change. On the other hand, this finding further validates a fact known in the pilot investigation that architectural students are more likely to consider housing environmental issues from a designer's perspective (from a solution-focused perspective) and show little interest in the research work related to sustainable living manners (from a problem-focused perspective) (see 5.3.2). This must be taken into account in the process of improving current architectural education.

## 6.6 CHAPTER SUMMARY

In this chapter, survey procedures for the collection and analysis of the data from the Occupant Group (467 student residents) are described. Since this chapter is a major part of this research for the collection and analysis of the quantitative data, statistical methods on the basis of SPSS are introduced from a systematic perspective. It is the first time in an architectural research that parametric and non-parametric statistical techniques are viewed as complementary. Moreover, this study also demonstrates how these two strategies can be applied in parallel to explore the maximum variation led by the multiple-indicator (or multiple-item) measures of concepts (for instance, 5-point Likert-type scales in this study) and validate the significant findings. Some findings from aggregated feedback, with both quantitative and qualitative information, are summarised.

It is found that, as the Occupant Group of this research, architectural students are likely to take into account housing environmental issues in order of relative importance (see Table 6.2 and Figure 6.4). However, this order (or one may say their systems for value judgement in the accommodation seeking processes) does not correspond with criteria in EcoHomes. These kinds of biased awareness from the student occupants will be compared with designers' intention and clients' interests in Chapter 9. Moreover, it is also found that current sustainability-related architectural education does not equip students with sufficient knowledge of some important living issues (above 'neutral'), though these issues are related to energy saving, carbon reductions and waste recycling in the operational phase of house occupation (see Figure 6.5 and Figure 6.6).

Then this research explores the impacts of students' 'education' and 'social group', including factors related to gender, major subject (department), academic year and cultural background (original residence places), on their evaluation of the relative importance of a range of

housing environmental issues drawn from EcoHomes. Findings with significant results (see Table 6.13), can be used to inform related education programmes and design processes of student accommodation. On the other hand, since a close consensus is achieved on students' evaluation of some issues (issues without significant differences), these issues can be evaluated based on samples of relatively smaller sizes in future collaborative design decision-making processes. These issues are 'QC207 close to a supermarket or late shops' (related to Tra3 in EcoHomes), 'QC208 close to gymnasium or sports centre' (Tra3), 'QC213 study and work from home' (Tra4), 'QC222 control system for heating and hot water' (Man1), 'QC223 facilities for house waste recycling' (Mat4) and 'QC225 energy efficient fridge, wash machine' (Ene4). This simplified procedure can also help improve the efficiency of information flow.

This research also explores the impacts of students' 'education' and 'social group' on their knowledge of some important living issues (related to energy saving, carbon reductions and waste recycling in the operational phase of house occupation). It is found that the more independently students live, the better understanding of the relevant living issues they have. Education might have a latent effect on students' understanding of these issues while social group (cultural differences in particular) does not have any significant impact on their understanding of these issues. This finding needs to be further validated in the future by comparing student group with other social groups.

It is also found that, within this target group, 'education' and 'social group' do not have any significant impact on students' willingness to look for information relating to lifestyle change towards greater environmental sensitivity, though this has been argued to be a necessary step to tackling climate change.

To validate the generalisation of this study, a follow-up procedure is conducted. A group of students (a total of 43) are recruited from other university departments to make a comparative study. Feedback between students from the Faculty of Architecture and students from other university departments is very similar. Therefore, it is concluded that findings of this study can be generalised beyond the case. Since this result does not correspond with the earlier expectation (that students studying architecture or built environment related disciplines should have been better educated on sustainability issues as the first step to tackling climate change), this study provides an insight into the challenges and opportunities for future architectural education and social intervention work.

The researcher also attempts to provide causal explanations for some issues. However, it is important to note that this is only done in terms of *interpretive understanding*. Some limitations of this research stage will be discussed in Chapter 11.

# CHAPTER 7

# CONSULTATION RESPONSES FROM THE CLIENT GROUP

## 7.1 CHAPTER OUTLINE

This chapter describes the interviews being conducted in this research. Inspiration drawn from the grounded theory is applied for data collection and analysis, though the techniques and procedures are not followed rigidly. Both qualitative and quantitative information is collected from the Client Group. With the opportunity to communicate with both Designer Group and Occupant Group, it is expected that stakeholders in the Client Group should have a general understanding of the needs of the other two stakeholder groups. This constitutes the main objectives of this survey.

## 7.2 INSPIRATION FROM GROUNDED THEORY

In this research stage, although quantitative and qualitative research strategies were combined again for data collection and analysis, particular attention was paid to the qualitative approach. Much useful qualitative information was collected in the face-to-face interview procedures. To analyse the qualitative data and create a meaningful picture of the investigated scenario, techniques and procedures drawn from the grounded theory were applied. As set by Strauss and Corbin (1998: 12), the term 'grounded theory' meant:

> The theory 'was derived from data, systematically gathered and analysed through the research process. In this method, data collection, analysis, and eventual theory stand in close relationship to one another. ... Theory derived from data is more likely to resemble the "reality" than is theory derived by putting together a series of concepts based on experience or solely through speculation (how one thinks things ought to work).'

To a great extent, in this inductive approach, the theory was developed from the data rather than the other way around, moving from the specific to the more general progressively. As results drawn from data, the application of grounded theories aimed to 'offer insight, enhance understanding, and provide a meaningful guide to action' (ibid: 12).

Data collection in the interview procedure was directed by theoretical sampling[1] which was considered as 'a defining property of grounded theory' by Charmaz (2000: 519). This

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[1] 'Data gathering driven by concepts derived from the evolving theory and based on the concept of "making comparisons", whose purpose is to go to places, people, or events that will maximize opportunities to discover variations among concepts and to density categories in terms of their properties and dimensions' (Strauss and Corbin 1998: 201)

technique is concerned with the refinement of ideas rather than boosting sample size (Charmaz 2000:519, cited in Bryman 2001: 305), and it tends to become more purposeful and focused as the research progresses (Strauss and Corbin 1998: 215). It clearly does not result in a sample that is representative of the population. However, since this technique enables the researcher to 'choose those avenues of sampling that can bring about the greatest theoretical return' (ibid: 202), it is good for exploring new or uncharted areas and outlining key relevant issues which might inform further research. And this was exactly the aim of this research stage.

In this research stage, therefore, the interviewees were recruited cumulatively based on the principles below:

> 'sampling continues until all categories are saturated; that is, no new or significant data emerge, and categories are well developed in terms of properties and dimensions' (Strauss and Corbin 1998: 215).

Adequacy of sample size in qualitative research is often relative. As argued by Sandelowski (1995: 179), it is 'a matter of judging a sample neither small nor large per se, but rather too small or too large for the intended purposes of sampling and for the intended qualitative product'. Many scholars suggest that a sample size between 10 and 30 may lead to adequate (or theoretical saturation) for certain kinds of homogeneous or critical case sampling, and can provide the skeleton of a theoretical structure (following analysis and interpretation) (Strauss and Corbin 1998, cited in Parnell 2003a: 40; Sandelowski 1995: 179).

In this study, although only 6 good interviews had been conducted ultimately, attention was still paid to the consultation responses from the client panel available. Since the procedures of data collection and analysis were consciously combined and conducted in tandem, it was expected that the density and saturation of recurring categories could be increased within the limited interviews available. The well organised interview procedures were also designed to increase insights and generate enough in-depth data to illuminate 'patterns, concepts, categories, properties, and dimensions' of the given phenomena (Strauss and Corbin 1998). However, since the sample size was relatively small (less than 10), issues related to reliability and validity needed to be considered, for instance whether the data was too small to achieve maximum variation of a complex phenomenon or to develop theories. This kind of limitation will be discussed in Chapter 11.

## 7.3 INTERVIEW SCHEDULE

In 2007, semi-structured interviews[li], align with structured interviews[lii], were conducted in the Department of Accommodation and Campus Services (ACS) at the University of Sheffield. PM was appointed by ACS initially to respond to the research enquiries. And thereafter the other four responses were collected based on the snowball voluntary sampling method[liii] (Strauss and Corbin 1998: 280; Bryman 2004: 100), whereby the interviewees either directly recommended further contacts or the data suggested a direction to take. Participants included Energy and Environmental Co-ordinator (EEC); Private Sector Housing Officer (PSHO); General Manager of Residential Services (GMRS); Operations Manager for Student Halls (OMSH); Project Manager (PM).

In the follow-up programme later, University Energy Manager (EM), was recruited deliberately based on independent contacts. Although he is not working in the ACS and his job is mainly focused on non-residential buildings, he provides advices on energy saving and carbon reductions for people working in the ACS and analyses the data of energy consumption (electricity, gas and water) for all university buildings. Therefore, it is believed that opinions from EM should also be taken into account as important in the development of sustainable student accommodation.

It is important to note that all participants' names are abbreviated to their job titles due to ethical consideration.

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[li] '*Semi-structured interview*. This is a term that covers a wide range of instances. It typically refers to a context in which the interviewer has a series of questions that are in the general form of an interview schedule but is able to vary the sequence of questions. The questions are frequently somewhat more general in their frame of reference from that typically found in a structured interview schedule. Also, the interviewer usually has some latitude to ask further questions in response to what are seen as significant replies.' (Bryman 2004: 113 and 321)

[lii] 'A *structured interview*, sometimes called a *standardized interview*, entails the administration of an interview schedule by an interviewer. The aim is for all interviewees to be given exactly the same context of questioning. This means that each respondent receives exactly the same interview stimulus as any other. The goal of this style of interviewing is to ensure that interviewees'' replies can be aggregated and this can be achieved reliably only if those replies are in response to identical cues. ... Questions are usually very specific and very often offer the interviewee a fixed range of answers.' (Bryman 2004: 110) Further, since structured interview is used to standardising the asking and often the recording of answers, this research instrument can keep the interviewer-related error to a minimum, which is particularly helpful when the interviewer is from abroad. This is also why interviews conducted in this study are preferred to be structured or semi-structured rather than unstructured. (see Chapter 3)

[liii] 'With this approach to sampling, the researcher makes initial contact with a small group of people who are relevant to the research topic and then uses these to establish contacts with others' (Bryman 2004: 100). Further, as argued by Bryman (2004: 102), 'there is a much better "fit" between snowball sampling and the theoretical sampling strategy of qualitative research'. To a great extent, the process of selecting participants is also an evolving process based on the evolving patterns, categories and dimensions emerging from the data.

**Table 7.1: Interview Schedule**

| Interview Schedule |
|---|
| • **Energy and Environment Co-ordinator (EEC)**, interviewed from 10:00am-11:00am, on 29 March 2007, at 51 Gell Street |
| The Energy and Environment Co-ordinator's principal job was about looking at the cost and benefits of implementing environmentally positive measures, such as waste recycling, energy efficiency and so on. |
| • **Private Sector Housing Officer (PSHO)**, interviewed from 10:00am-11:00am, 27 April 2007, at Stephenson Hall of Residence, 7 Oakholme Road |
| The Private Sector Housing Officer's major job was to implement the private sector registration scheme, providing approximate 1,100 registered properties (7,500 registered beds) for students. |
| • **General Manager of Residential Services (GMRS)**, Interviewed from 3:00pm-4:00pm, on 21 May 2007, at 8 Oakholme Road |
| The General Manager was in charge of the residential services. He took the overall responsibility for all university residential accommodation and associated services, except catering. |
| • **Operations Manager for Student Halls (OMSH)**, interviewed from 10:00am-11:00am, on 31 May 2007, at Ranmoor House |
| The Operations Manager's major job was to set the day-to-day residence strategies for student accommodation operations, and to implement them. |
| • **Project Manager (PM)**, interviewed from 2:00pm-3:00pm, on 6 June 2007, at Ranmoor House |
| The Project Office was liaison between the University and Bovis Land Lease. He also paid particular attention to issues arising from students and local residents during the construction of the new student village. |
| • **Energy Manager (EM)**, interviewed from 2:00pm-3:00pm, on 05 August 2008, at 45 Victoria Street |
| The Energy Manager was responsible for ensuring the university buildings were energy efficient. He also set the Strategy and Implementation Plan (SIP) for the University of Sheffield Carbon Management Programme (for details, see Riley 2008), as part of the Higher Education Carbon Management Programme conducted by University of Sheffield and the Carbon Trust. |

In summary, the whole interview schedule of this research is summarised in Table 7.1. Since these interviewees' works have covered most of the important duties during the operational phase of student accommodation occupation, it is believed that their understanding of sustainability principles are important to encourage students to save energy and reduce carbon dioxide emissions. Further, they might also be able to provide deep insights into the emerging patterns, categories and dimensions of the given phenomena – sustainability issues for student accommodation (referring to both design and living factors). Their viewpoints, reflecting clients' interests in the design processes for student accommodation, can be compared with designers' intention, occupants' awareness and legislators' constraints based on the palette of environmental issues addressed in EcoHomes or the Government's Code.

## 7.4 CONSULTATION RESPONSES

As argued in Chapter 2 (see 2.5.1), design could be described as a process of knowledge transfer between different stakeholder groups. Among the key stakeholders, clients often play an important role to get the message across between designers and occupants. Hence it was expected that the design brief proposed by the Client Group should meet the requirements of occupants and, at the same time, set a proper scenario within which designers must work. However, since clients also had their own standpoints in the decision-making processes, it was questionable whether they would be able to take this responsibility faithfully and implement it in time. To achieve better results, therefore, it was better for clients or developers to understand other stakeholders' needs. The semi-structured interviews aimed to investigate whether a general consensus on sustainability issues could be reached within the Client Group and likewise, whether there was any cognitive gap between the Client Group and other stakeholder groups.

Issues addressed in the structured interviews mainly come from the questionnaire for future designers and the one for current housing occupants which have been described in Chapter 5 (see Appendix 2.4). The consultation responses are summarised in the following sections.

### 7.4.1 RELATIVE IMPORTANCE OF DESIGN ISSUES FROM A CLIENT'S PERSPECTIVE

The first part of this interview was designed to be structured. It aimed to investigate clients' opinions on sustainable design issues for student accommodation. Interviewees were asked to rate the relative importance of the palette of design issues drawn from EcoHomes, with 1-5 range-of-opinion based on a Likert-type scale, from 'Not at all important' to 'Very important'. Responses from the client panel are summarised in Figure 7.1.

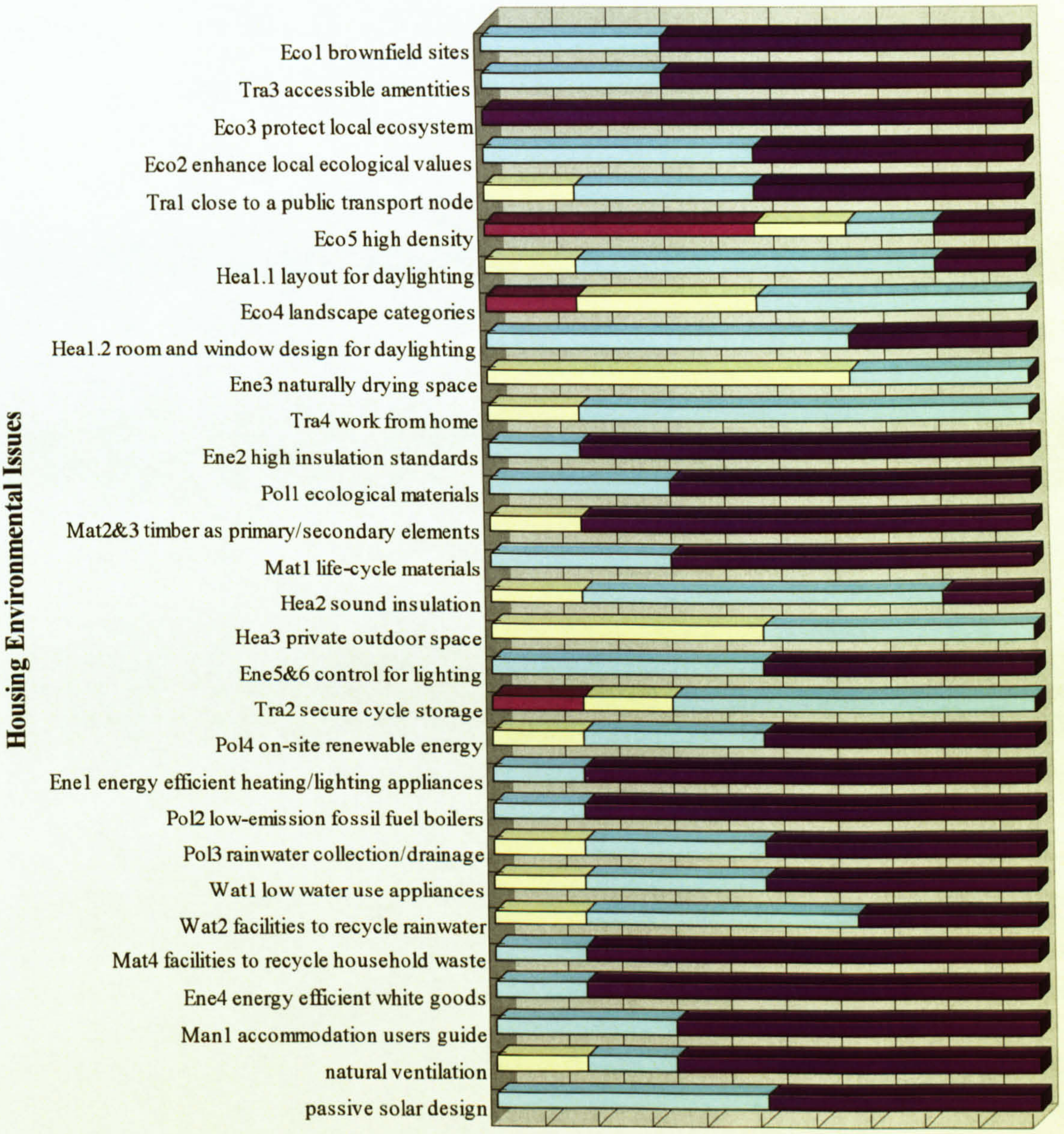


**Figure 7.1: Relative importance of different housing design issues – rated by the client panel based on a Likert-type scale, from 'Not at all important' to 'Very important'**

The aggregated results of the consultation (design issues) in the client panel are shown in this figure. A bar on the graph's Y-axis represents the variety of housing environmental issues arising in the accommodation design processes. The relative importance of different issues are summarised as a percentage of the total response; comparing the length of segments shows the degree of consensus on the relative importance of a particular issue between participants in the client panel.

**Table 7.2: Comparison of different ranks for design issues by the Client Group, EcoHomes 2006 and the Code for Sustainable Homes**

| Comparison of different ranks for design issues by the Client Group, EcoHomes 2006 and the Code for Sustainable Homes | ACS | | EcoHomes 2006 | | | The Code | | |
|---|---|---|---|---|---|---|---|---|
| | Mean | ***Rank*** | Category | Credits | ***Rank*** | Category | Credits | ***Rank*** |
| Protect local ecosystem | 2.00 | 1 | Eco3 | 1.33 | 23 | Eco3 | 1.33 | 19 |
| Energy efficient heating & lighting | 1.83 | 2 | Ene1 | 13.75 | 1 | Ene1 | 18.83 | 1 |
| Low-emission fossil fuel boilers | 1.83 | 3 | Pol2 | 2.73 | 10 | Pol2 | 2.10 | 15 |
| Facilities to recycle household waste | 1.83 | 4 | Mat4 | 2.71 | 12 | Was1 | 3.66 | 7 |
| High insulation standards | 1.83 | 5 | Ene2 | 1.83 | 18 | Ene2 | 2.51 | 13 |
| Energy efficient white goods | 1.83 | 6 | Ene4 | 1.83 | 19 | Ene5 | 2.51 | 14 |
| Life-cycle materials | 1.67 | 7 | Mat1 | 7.23 | 3 | Mat1 | 4.50 | 6 |
| Timber as primary/secondary elements | 1.67 | 8 | Mat2&3 | 4.06 | 6 | Mat2&3 | 2.70 | 9 |
| Accessible amenities | 1.67 | 9 | Tra3 | 3.00 | 8 | | | |
| Accommodation users guide | 1.67 | 10 | Man1 | 3.00 | 9 | Man1 | 3.33 | 8 |
| Brownfield sites | 1.67 | 11 | Eco1 | 1.33 | 24 | Eco1 | 1.33 | 20 |
| Ecological insulating materials | 1.67 | 12 | Pol1 | 0.91 | 28 | Pol1 | 0.70 | 26 |
| Control for lighting | 1.50 | 13 | Ene5&6 | 3.66 | 7 | Ene3&6 | 5.02 | 4 |
| Enhance local ecological values | 1.50 | 14 | Eco2 | 1.33 | 25 | Eco2 | 1.33 | 21 |
| Natural ventilation | 1.50 | 15 | | | | | | |
| Passive solar design | 1.50 | 16 | | | | | | |
| Low water use appliances | 1.33 | 17 | Wat1 | 8.33 | 2 | Wat1 | 7.50 | 2 |
| On-site renewable energy | 1.33 | 18 | Pol4 | 2.73 | 11 | Ene7 | 2.51 | 11 |
| Room&window design for daylighting | 1.33 | 19 | Hea1/2 | 2.63 | 14 | Hea1/2 | 1.75 | 16 |
| Close to a public transport node | 1.33 | 20 | Tra1 | 2.00 | 16 | | | |
| Rainwater collection/drainage | 1.33 | 21 | Pol3 | 1.82 | 20 | Sur1 | 1.10 | 25 |
| Facilities to recycle rainwater | 1.17 | 22 | Wat2 | 1.67 | 22 | Wat2 | 1.50 | 18 |
| Sound insulation | 1.00 | 23 | Hea2 | 7.00 | 4 | Hea2 | 4.67 | 5 |
| Layout for daylighting | 1.00 | 24 | Hea1/2 | 2.62 | 15 | Hea1/2 | 1.75 | 17 |
| Work from home | 0.83 | 25 | Tra4 | 1.00 | 26 | Ene9 | 1.26 | 22 |
| Secure cycle storage | 0.50 | 26 | Tra2 | 2.00 | 17 | Ene8 | 2.51 | 12 |
| Private outdoor space | 0.50 | 27 | Hea3 | 1.75 | 21 | Hea3 | 1.17 | 24 |
| Landscape categories | 0.33 | 28 | Eco4 | 5.33 | 5 | Eco4 | 5.33 | 3 |
| Natural drying space | 0.33 | 29 | Ene3 | 0.92 | 27 | Ene4 | 1.26 | 23 |
| High density | 0.00 | 30 | Eco5 | 2.67 | 13 | Eco5 | 2.67 | 10 |
| | | | | | | | | |
| Some housing environmental issues have been considered to be *more* important by the Client Group | | | | | | | | |
| Other housing environmental issues have been considered to be *less* important by the Client Group | | | | | | | | |

**Table 7.2: Comparison of different ranks for design issues by the Client Group, EcoHomes 2006 and the Code for Sustainable Homes**

| Comparison of different ranks for design issues by the Client Group, EcoHomes 2006 and the Code for Sustainable Homes | ACS | | EcoHomes 2006 | | | The Code | | |
|---|---|---|---|---|---|---|---|---|
| | Mean | ***Rank*** | Category | Credits | ***Rank*** | Category | Credits | ***Rank*** |
| **Protect local ecosystem** | **2.00** | **1** | **Eco3** | **1.33** | **23** | **Eco3** | **1.33** | **19** |
| Energy efficient heating & lighting | 1.83 | 2 | Ene1 | 13.75 | 1 | Ene1 | 18.83 | 1 |
| Low-emission fossil fuel boilers | 1.83 | 3 | Pol2 | 2.73 | 10 | Pol2 | 2.10 | 15 |
| Facilities to recycle household waste | 1.83 | 4 | Mat4 | 2.71 | 12 | Was1 | 3.66 | 7 |
| **High insulation standards** | **1.83** | **5** | **Ene2** | **1.83** | **18** | **Ene2** | **2.51** | **13** |
| **Energy efficient white goods** | **1.83** | **6** | **Ene4** | **1.83** | **19** | **Ene5** | **2.51** | **14** |
| Life-cycle materials | 1.67 | 7 | Mat1 | 7.23 | 3 | Mat1 | 4.50 | 6 |
| Timber as primary/secondary elements | 1.67 | 8 | Mat2&3 | 4.06 | 6 | Mat2&3 | 2.70 | 9 |
| Accessible amenities | 1.67 | 9 | Tra3 | 3.00 | 8 | | | |
| Accommodation users guide | 1.67 | 10 | Man1 | 3.00 | 9 | Man1 | 3.33 | 8 |
| **Brownfield sites** | **1.67** | **11** | **Eco1** | **1.33** | **24** | **Eco1** | **1.33** | **20** |
| **Ecological insulating materials** | **1.67** | **12** | **Pol1** | **0.91** | **28** | **Pol1** | **0.70** | **26** |
| Control for lighting | 1.50 | 13 | Ene5&6 | 3.66 | 7 | Ene3&6 | 5.02 | 4 |
| Enhance local ecological values | 1.50 | 14 | Eco2 | 1.33 | 25 | Eco2 | 1.33 | 21 |
| Natural ventilation | 1.50 | 15 | | | | | | |
| Passive solar design | 1.50 | 16 | | | | | | |
| Low water use appliances | 1.33 | 17 | Wat1 | 8.33 | 2 | Wat1 | 7.50 | 2 |
| On-site renewable energy | 1.33 | 18 | Pol4 | 2.73 | 11 | Ene7 | 2.51 | 11 |
| Room&window design for daylighting | 1.33 | 19 | Hea1/2 | 2.63 | 14 | Hea1/2 | 1.75 | 16 |
| Close to a public transport node | 1.33 | 20 | Tra1 | 2.00 | 16 | | | |
| Rainwater collection/drainage | 1.33 | 21 | Pol3 | 1.82 | 20 | Sur1 | 1.10 | 25 |
| Facilities to recycle rainwater | 1.17 | 22 | Wat2 | 1.67 | 22 | Wat2 | 1.50 | 18 |
| Sound insulation | 1.00 | 23 | Hea2 | 7.00 | 4 | Hea2 | 4.67 | 5 |
| Layout for daylighting | 1.00 | 24 | Hea1/2 | 2.62 | 15 | Hea1/2 | 1.75 | 17 |
| Work from home | 0.83 | 25 | Tra4 | 1.00 | 26 | Ene9 | 1.26 | 22 |
| Secure cycle storage | 0.50 | 26 | Tra2 | 2.00 | 17 | Ene8 | 2.51 | 12 |
| Private outdoor space | 0.50 | 27 | Hea3 | 1.75 | 21 | Hea3 | 1.17 | 24 |
| Landscape categories | 0.33 | 28 | Eco4 | 5.33 | 5 | Eco4 | 5.33 | 3 |
| Natural drying space | 0.33 | 29 | Ene3 | 0.92 | 27 | Ene4 | 1.26 | 23 |
| High density | 0.00 | 30 | Eco5 | 2.67 | 13 | Eco5 | 2.67 | 10 |
| | | | | | | | | |
| **Some housing environmental issues have been considered to be *more* important by the Client Group** | | | | | | | | |
| Other housing environmental issues have been considered to be *less* important by the Client Group | | | | | | | | |

There was a high consensus between the interviewees on the relative importance of most of the design issues, for instance all interviewees had rated the issue 'Eco3 protect local ecosystem during construction processes as 'very important'. However, their opinions on some issues were also widely different, such as 'Eco5 high density', 'Eco4 landscape categories' and 'Tra2 secure cycle storage'. To understand their priorities in the decision-making processes better, the mean value was used to rank these issues, as shown in Table 7.2.

As argued by interviewees, the Accommodation and Campus Services (ACS) would like to provide better sustainable living conditions for students based on the budget available. According to OMSH and PM, for example, many sustainable design measures were planned to be applied on site, such as green roof, natural ventilation and water recycling and so on, together with some issues raised by the local authority.

However, as shown in Table 7.2, when proposing or developing new student accommodation towards sustainability standards, people in the Accommodation and Campus Services (the Client Group) were likely to address the palette of environmental issues in order of relative importance which differs from those used in the prevailing benchmarks. Compared with the system for value judgement in EcoHomes or the Code, some environmental issues were considered to be more important by the client panel, such as 'protect local ecosystem and reduce site impacts during construction process' (related to Eco3 in EcoHomes), 'high insulation standards' (Ene2), 'provide energy efficient white goods (i.e. fridge) and relevant information' (Ene4), 'use brownfield sites in preference to greenfield' (Eco1) and 'use of ecological or environmentally friendly insulating materials' (Pol1) and so on. On the other hand, other environmental issues were considered to be less important, such as 'efficient control for external and internal lighting appliances' (related to Ene5&6 in EcoHomes), 'low water use appliances' (Wat1), 'design and test for sound insulation' (Hea2), 'decide landscape categories according to the typology of surrounding sites' (Eco4) and 'high density (the ratio requirement between Floor Area and Footprint)' (Eco5) and so on.

Certainly it was not expected that the Client Group would adopt a system for value judgement exactly like the one used in EcoHomes or the Code. As argued by OMSH, however, as a 40 year project, the student village in Sheffield was designed with a long-term perspective, which aimed to achieve the objective between 'Good' and 'Excellent' under BREEAM standard. Therefore, it was reasonable to believe that better results would be expected if a close consensus between the Client Group and the Legislator Group (referring to the criteria of EcoHomes or the Government's Code) could be achieved.

Since the student village in Sheffield was a reconstruction project, it was easy to understand why interviewees in the client panel paid more attention to sustainability issues encountered in the construction processes, such as those issues related to 'Eco3 Protection of ecological features' and 'Eco1 Ecological value of site' in EcoHomes. The application of these two measures aimed to 'protect existing ecological features from substantial damage during the clearing of the site and the completion of construction works', and to 'encourage development on land that already has a limited value to wildlife, and discourage the development of ecologically valuable sites' (BRE 2006b). EEC furthered this idea and suggested that 'refurbishments should take priority over demolition or reconstruction'.

In the interview processes, interviewees in the client panel also showed a strong initiative for energy saving and carbon reductions in the operational phase of accommodation occupation by providing student residents with energy efficient white goods, including heating, hot water, lighting, cooking appliances, fridge and wash machine and so on (related to Ene1 and Ene4 in EcoHomes). It is believed that clients' willingness would encourage other stakeholders to take sustainability principles into account effectively if it could be well addressed at the early stage of the collaborative decision-making processes. However, OMSH also argued that proposals of having these appliances on site could lead to some other problems in terms of practice, regarding student residents' knowledge of proper use. Some typical cases were discussed based on the observations from students' current lifestyles in their accommodation:

> The Accommodation and Campus Services would like to encourage students to dry their clothes naturally in their own rooms and therefore did not provide dryers but just washing machines in the onsite laundry. In the operational phase of accommodation occupation, however, students sometimes tended to dry their clothes quickly by leaving them directly on the central heating. This might lead to serious safety problems or cause damage to either clothes or the appliances. On the other hand, the provision of natural drying space will depend on the cost of laundry.

> Low water use appliances, for instance spray system on tap or shower, needs to be cleaned every week. Otherwise the sediments in them might cause Legionnaires' disease. Since few students would like to do so, this spray system was not applied in the student village project. In contrast, the dual flush system, which was also designed for water saving, was provided in each toilet as it was easy to manage by students.

About the energy efficient white goods, double low rated goods will be preferred by the Accommodation and Campus Services. However, some products, such as frost-free fridge, are normally not double-low rated. When a fridge needs to be defrosted regularly, students were not likely to do that. Likewise, although the low-emission fossil fuel boiler is good for environmental improvement, it is difficult to achieve in practice.

A car rent scheme has already been enacted in the new student village, known as car pool. And so has the cycle scheme. However, it is still unsure whether student residents will appreciate these kinds of services.

...

Based on the observations above, it was found that the objective of sustainability could not be achieved by efforts from people in the Client Group alone. More people should get involved in the campaign against climate change, especially university students in this case. Furthermore, as argued by OMSH, a successful sustainable development should provide benefits not only for its users, but also for the local communities. Hence in the student village project, recycling had been particularly addressed in the design processes. This aimed to help local people improve their awareness of such an issue. As part of the paper recycling scheme, toilet paper in the student village would be made by the Sheffield-based companies. This would help reduce the unnecessary transportation and increase local employment. Paper recycling agreements were also good to reduce the footprint of paper product.

### 7.4.2 RELATIVE IMPORTANCE OF HOUSING ENVIRONMENTAL ISSUES FROM A CLIENT'S PERSPECTIVE

The second part of this interview was also designed to be structured and quantitative. It aimed to investigate clients' opinions on housing environmental issues, considering the student residents' requirements in particular. Interviewees were asked to rate the relative importance of the palette of housing environmental issues drawn from EcoHomes and other previous studies to student residents, with 1-5 range-of-opinion based on a Likert-type scale, from 'Not at all important' to 'Very important'. Responses from the client panel are summarised in Figure 7.2.

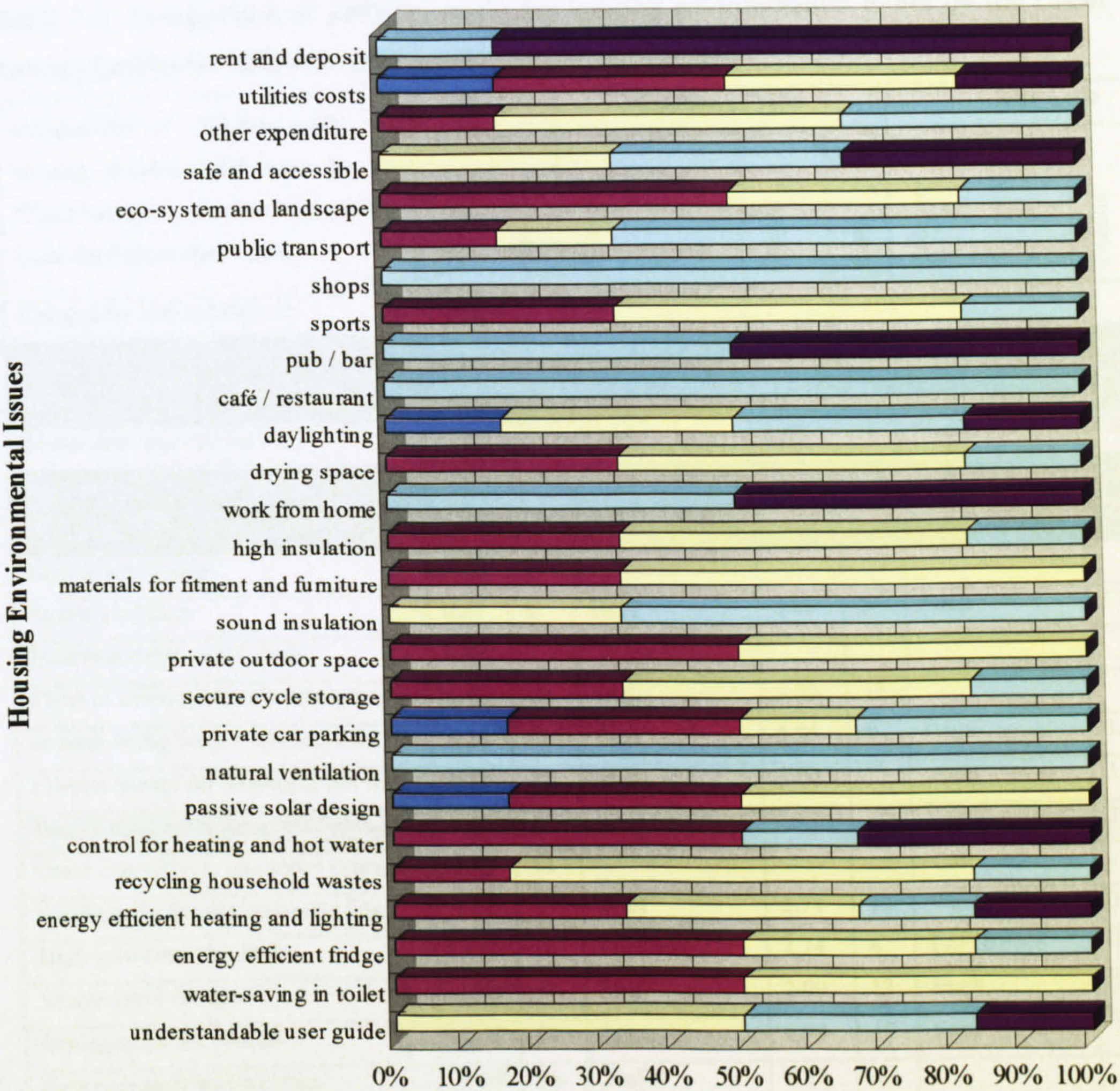


**Figure 7.2: Relative importance of different housing environmental issues – rated by the client panel based on a Likert-type scale, from 'Not at all important' to 'Very important'**

The aggregated results of the consultation (housing environmental issues) in the client panel are shown in this figure. A bar on the graph's Y-axis represents the variety of housing environmental issues encountered in the accommodation seeking processes. The relative importance of different issues are summarised as a percentage of the total response; comparing the length of segments shows the degree of consensus on the relative importance of a particular issue between participants in the client panel.

**Table 7.3: Comparison of different ranks for housing environmental issues by the Client Group, EcoHomes 2006 and the Code for Sustainable Homes**

| Comparison of different ranks for housing environmental issues by the Client Group, EcoHomes 2006 and the Code for Sustainable Homes | ACS | | EcoHomes 2006 | | | The Code | | |
|---|---|---|---|---|---|---|---|---|
| | Mean | *Rank* | Category | Credits | *Rank* | Category | Credits | *Rank* |
| Charges for rent and deposit | 1.83 | 1 | | | | | | |
| Study and work from home | 1.50 | 2 | Tra4 | 1.00 | 16 | Ene9 | 1.26 | 14 |
| Pub or bar | 1.50 | 3 | Tra3/4 | 0.75 | 18 | | | |
| Secure area and safe access | 1.00 | 4 | Man4 | 2.00 | 11 | Man4 | 2.20 | 13 |
| Supermarket or late shops | 1.00 | 5 | Tra3/4 | 0.75 | 19 | | | |
| Café, takeaway or restaurant | 1.00 | 6 | Tra3/4 | 0.75 | 20 | | | |
| Natural ventilation | 1.00 | 7 | | | | | | |
| Sound insulation | 0.67 | 8 | Hea2 | 7.00 | 3 | Hea2 | 4.67 | 4 |
| *Understandable user's guide* | 0.67 | 9 | | | | | | |
| Close to a frequent public transport | 0.50 | 10 | Tra1 | 2.00 | 12 | | | |
| Natural daylighting in the bedroom | 0.33 | 11 | Hea1 | 5.25 | 5 | Hea1 | 3.50 | 6 |
| Control system for heating & hot water | 0.33 | 12 | Man1 | 3.00 | 7 | Man1 | 3.30 | 7 |
| Energy efficient heating and lighting | 0.17 | 13 | Ene1,5,6&Pol2 | 20.14 | 1 | Ene1,3,6&Pol2 | 25.95 | 1 |
| Other expenditure, like travel expense | 0.17 | 14 | | | | | | |
| Facilities for house waste recycling | 0.00 | 15 | Mat4 | 2.71 | 10 | Was1 | 3.66 | 5 |
| High insulation standards | -0.17 | 16 | Ene2&Pol1 | 2.74 | 8 | Ene2&Pol1 | 3.21 | 8 |
| Secure cycle storage | -0.17 | 17 | Tra2 | 2.00 | 13 | Ene8 | 2.51 | 11 |
| Drying space for clothes | -0.17 | 18 | Ene3 | 0.92 | 17 | Ene4 | 1.26 | 15 |
| Gymnasium or sports centre | -0.17 | 19 | Tra3/4 | 0.75 | 21 | | | |
| Good ecological system and landscape | -0.33 | 20 | Eco2&4 | 6.66 | 4 | Eco2&4 | 6.66 | 3 |
| Timber for fitment and furniture | -0.33 | 21 | Mat2&3 | 4.06 | 6 | Mat2&3 | 2.70 | 9 |
| Costs for utilities: electricity/gas/water | -0.33 | 22 | Pol4 | 2.73 | 9 | Ene7 | 2.51 | 10 |
| Energy efficient fridge, wash machine | -0.33 | 23 | Ene4 | 1.83 | 14 | Ene5 | 2.51 | 12 |
| Private car parking | -0.33 | 24 | | | | | | |
| Water-saving toilet | -0.50 | 25 | Wat1 | 8.33 | 2 | Wat1 | 7.50 | 2 |
| Private outdoor space | -0.50 | 26 | Hea3 | 1.75 | 15 | Hea3 | 1.17 | 16 |
| Southern orientation of the bedroom | -0.67 | 27 | | | | | | |
| | | | | | | | | |
| Some housing environmental issues have been considered to be *more* important by the Client Group (ACS) | | | | | | | | |
| Other housing environmental issues have been considered to be *less* important by the Client Group (ACS) | | | | | | | | |

It was found that there was also a general consensus between the interviewees on the relative importance of most of the housing environmental issues, although they were asked to evaluate these issues from a student resident's perspective. To some extent, this implied that interviewees in the client panel were confident about the students' needs. To understand the relevant issues better, the mean value was used to rank these issues.

As shown in Table 7.3, according to the understanding of people in the Accommodation and Campus Services (the Client Group), students might be more concerned about some issues than others in their accommodation seeking processes. However, compared with the order of relative importance in which EcoHomes or the Code addressed the causal issues, the one in which students, from the clients' perspective, often addressed the consequent issues was different. Some issues were considered to be more important by the client panel, such as 'space and service for studying or working from home' (related to Tra4 in EcoHomes), 'close to local accessible amenities (i.e. pub or bar, supermarket or late shops, and café, takeaway or restaurant)' (Tra3) and so on. On the other hand, other issues were considered to be less important, such as 'energy efficient heating and lighting appliances' (related to Ene1&5&6 and Pol2 in EcoHomes), 'friendly surroundings with good ecological system and landscape' (Eco2&4), 'fitment and furniture with timber or environmentally friendly appearance' (Mat2&3) and 'water-saving toilet' (Wat1) and so on.

Since it was about students' lifestyle choices between the alternative options available, some other issues were also addressed by the client panel. EEC argued that it was 'important' to have a 'student bar inside of the accommodation' as this would make students feel more at home. GMRS believed that students would often like to live 'close to their academic departments'. These opinions corresponded with feedback from the target student residents (the Occupant Group) in Chapter 6. To some extent, therefore, this kind of correspondence showed that interviewees in the client panel had a general understanding of the students' needs.

Actually, as argued by PSHO, students were not interested in the building itself or sustainable lifestyle unless some relevant issues affected them directly. For instance, students did not often have awareness of the importance of 'sound insulation' when looking for new accommodation; but when it became a problem in the occupancy processes, they would complain. As a result, this issue was considered to be relatively less important by the client panel, as shown in Table 7.2 and Table 7.3, although OMSH argued that sound insulation should be considered as a 'very important' issue for student accommodation design.

It is interesting to note that this view corresponded with the assumption based on which the researcher designed the *Questionnaires for Current Housing Occupants* (see 5.2.2). Based on this principle, it is easy to understand why the client panel anticipated that student residents were often likely to consider 'space and service for studying or working from home' (related to Tra4 in EcoHomes) to be more important, while consider 'energy efficient heating and lighting appliances' (Ene1&5&6 and Pol2) to be less important. PSHO also indicated that, in a recent consultation, statistical results from the postgraduate students showed that over 70% of students would make 'internet access' (study and work from home, which is related to Tra4 in EcoHomes) their first choice when looking for new accommodation. In contrast, although energy efficient light bulbs (Ene5&6) and facilities for household waste recycling (Mat4) tended to be applied in the student accommodation, it was an open question whether the student residents would be bothered. PM suggested that there was a need to have a welcome booklet in the kitchen for each flat, which could educate student residents to use the facilities properly and let them understand how this would affect their current and future lives. Further, it was believed by the client panel that students would pay more attention to the energy saving issues if they started to pay for the utility bills themselves directly. To encourage students to take more action, therefore, it might be a good idea to change this as currently the university paid for the utility bills.

By comparing the results in Table 7.2 and Table 7.3 from an integrated perspective, it was found that some issues in EcoHomes had been completely ignored by the client panel, such as 'Ene5 External lighting', 'Ene6 Internal lighting', 'Wat1 Internal potable water use' and 'Eco4 Change of ecological value of site' and so on. These issues were not considered to be important by the client panel, both in the accommodation delivering processes and in its later operational phase. Although it was not sure at this research stage whether this finding would correspond with the responses from the Designer Group or Occupant Group, clients' interests in sustainability issues seemed to conflict with legislator's constraints referring to the system for value judgement in EcoHomes or the Code.

### 7.4.3 MOTIVATIONAL FACTORS

To facilitate knowledge transfer in the decision-making processes efficiently, it is important to understand the motivational factors that could engage clients to take sustainability principles into account in the delivering processes of student accommodation. The third part of interview was designed to explore this. Interviewees were asked to mark the top five motivational factors, from both positive and negative perspectives. Aggregated results from the consultation are summarised in the following sections.

***Driving Factors***

As shown in Figure 7.3, important drivers for the Client Group (ACS in this case) to take sustainability principles into account were 'environmental benefits', 'compliance with legislation', 'championing innovation', 'economic benefits', 'enhanced reputation' and 'meeting students' requirement' and so on. As argued by GMRS, reputation was somewhat more important than students' requirements as the students' parents would often pay for the rent. This might also be the reason why 'championing innovation' was considered as one of the most important drivers for the Client Group to deliver more sustainable properties. EM strongly agreed with this viewpoint, though he would prefer to address the marketing issues from a perspective of 'competitive edge'. While on other hand, PSHO argued that, to a great extent, accommodation developers had to comply with compulsory legislations enforced by the local authorities, no matter whether they were motivational drivers or not. In contrast, OMSH would prefer to consider this issue from a positive perspective and argued that the local authority, on the other hand, could be pushed forward by pressure from the local communities.

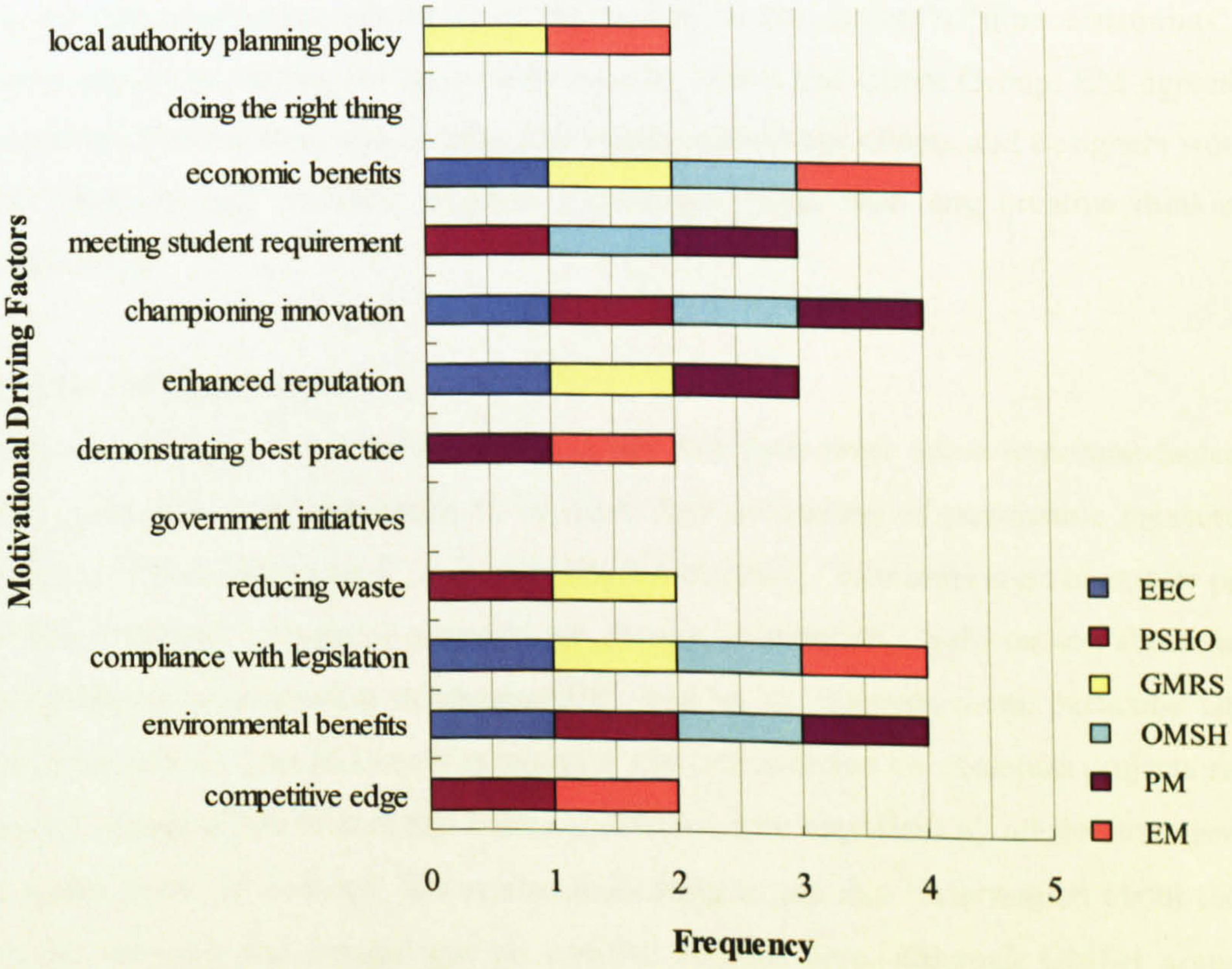


**Figure 7.3: Top 5 drivers to encourage the project team to take sustainability principles into account in the student village project. (QC1)**

### *Hindering Factors*

Likewise, as shown in Figure 7.4, important barriers to prevent the Client Group (ACS in this case) from taking sustainability principles into account were 'affordability or cost', 'lack of understanding or proof of the business case', 'lack of awareness', 'lack of information and relevant training' and 'time constraints' and so on. Other barrier factors were considered as almost equally important to the Client Group. Between the important barrier factors, 'affordability or cost' was considered as the most important one. As argued by GMRS, the price rules for student accommodation design should be envisaged from two perspectives: on one hand, it was important to consider the cost of the properties on the basis of the current market, better with low risk as there would not be high return in a short term (in this case, the student village in Sheffield cost 20 million more than usual – OMSH); on the other hand, following the increase of tuition fees, price competition between different student accommodation was becoming an important issue for decision-making according to students', or their parents', affordability. Actually some design issues in Table 7.2 might be addressed from this economic perspective, for instance student village development with 'high density' (related to Eco5 in EcoHomes) might make more profit. For 'lack of awareness', PM argued that opinions from different stakeholders could vary significantly due to the lack of full-range knowledge. OMSH furthered this idea and argued that lack of time for communication, which might be related to the project's 'time constraints', was another important barrier for knowledge transfer within the Client Group. EM agreed with this and pointed out that, due to time constraints, sometimes clients and designers would be more likely to rely on their previous experience rather than any creative thinking for sustainability.

### *Potential Driving Factors*

As shown in Figure 7.5, interviewees believed that there were some important factors that could encourage their colleagues to increase their awareness of sustainable measures and strategies. These factors were 'cost and benefits analysis', 'information on exemplar projects and best practice', 'forums or networks for sharing information', 'information about funding' and 'publicity or promotion of sustainability' and so on. Between them, particular attention should be paid to 'cost and benefits analysis' and 'information on exemplar projects and best practice' as these two factors had been considered to be important by all the interviewees in the client panel. In contrast, it was also interesting to see that 'information about the latest suitable research and design' got no positive support here, although OMSH argued that benchmark and shared information would be helpful to increase other stakeholder's awareness of sustainable strategies.

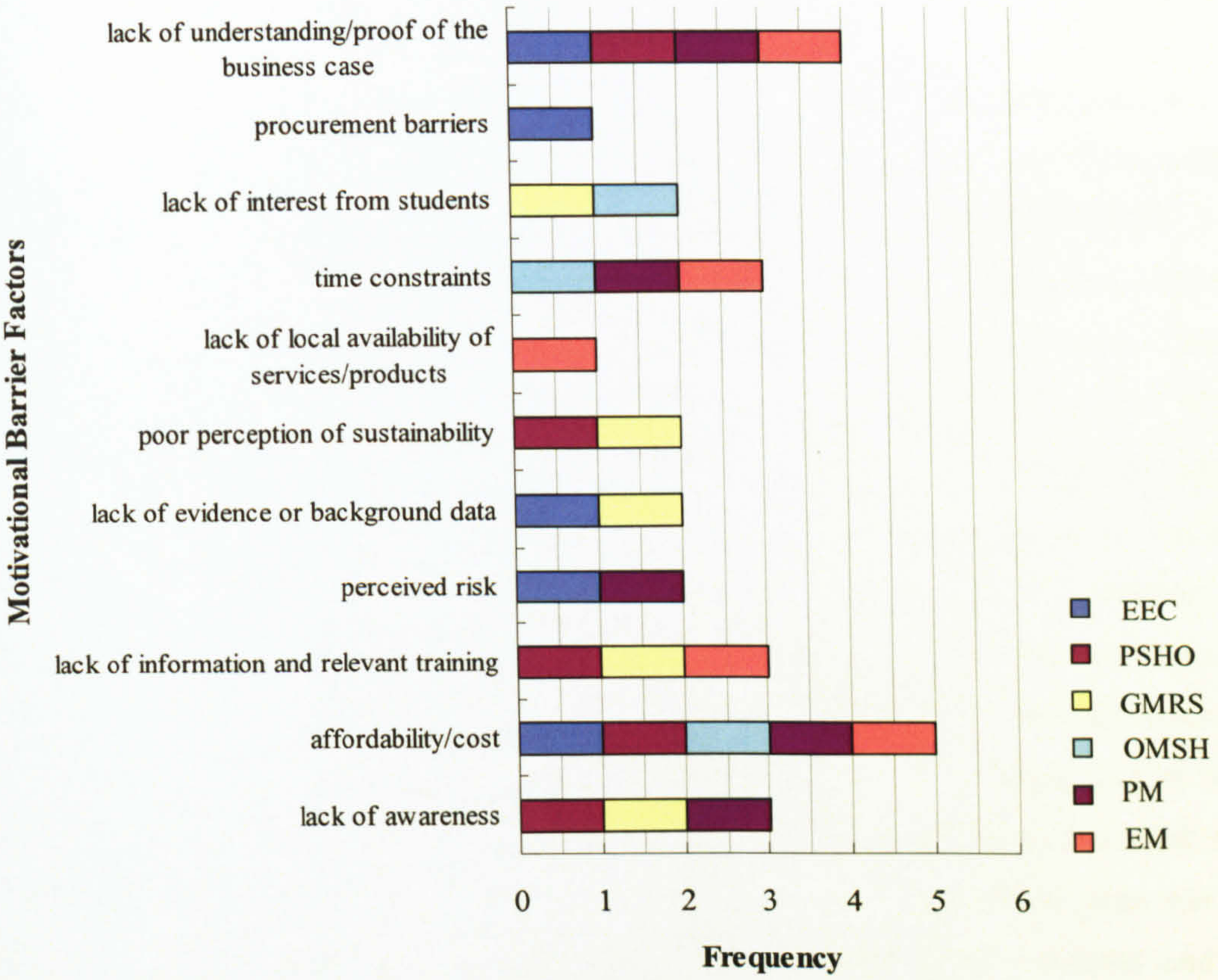


**Figure 7.4: Top 5 barriers to prevent the project team from taking sustainability principles into account in the student village project. (QC2)**

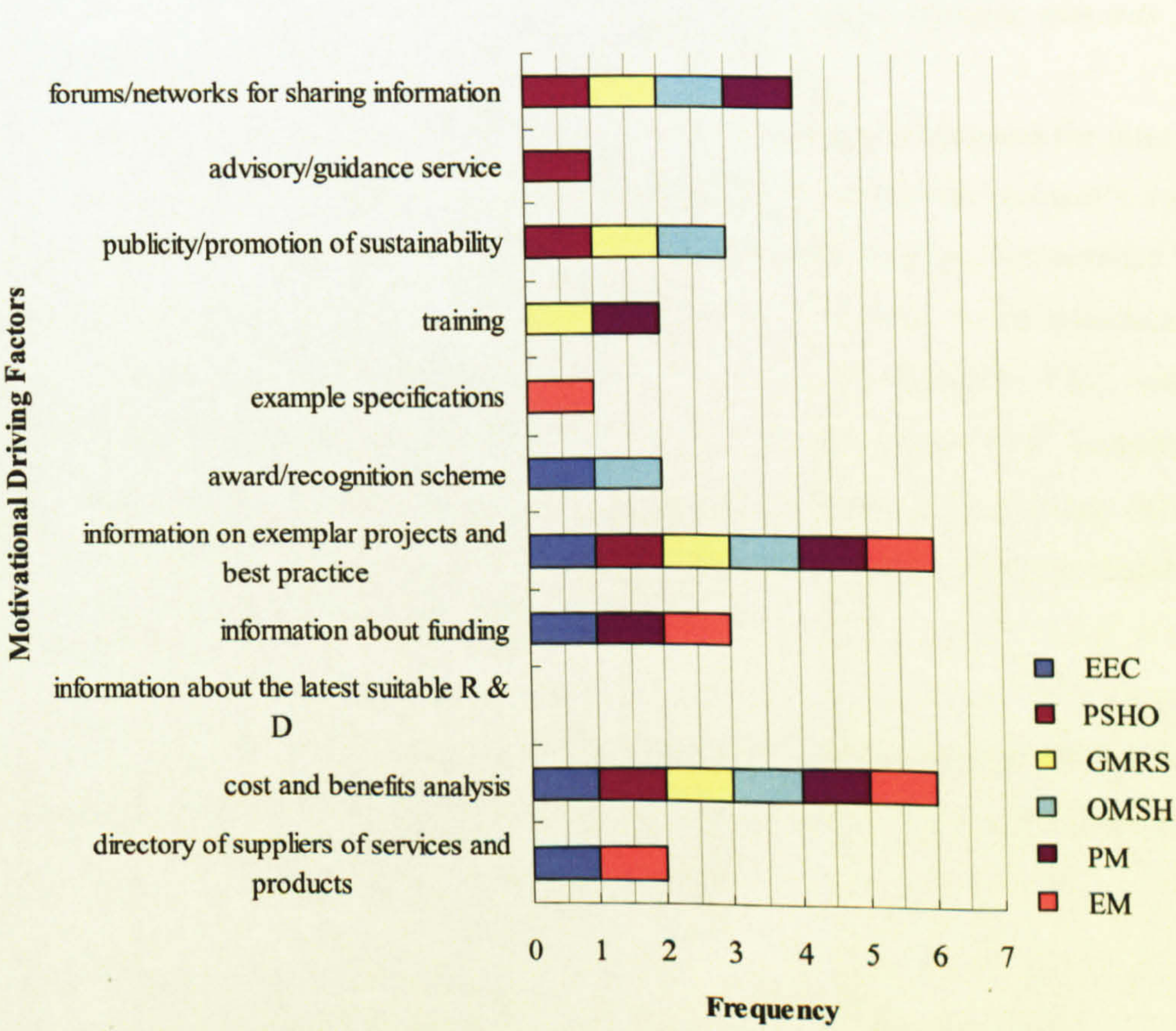


**Figure 7.5: Top 5 factors that would help people in the Client Group to increase their awareness or interests on sustainable measures and strategies. (QC3)**

### 7.4.4 OPEN DISCUSSION

The final part of this interview was designed to be semi-structured and qualitative. In this stage, an interview guide was prepared, where research questions were open-ended and general, and the emergent theory, that engaging students to change their lifestyle towards greater environmental sensitivity is important in tackling climate change, accounted for a phenomenon that was relevant to participants. Based on the techniques drawn from the grounded theory, qualitative data from the semi-structured interview was analysed. However, the coding[liv] procedure was not followed rigidly. Firstly, the interview transcripts were read and re-read by the researcher and the key words and phrases were highlighted and labelled accordingly (open coding). In this way the researcher interpreted the content of the interviewees' words, identified concepts and the relationships between concepts, which evolved into categories. Then the connections were built up between categories according to their properties or characteristics (axial coding). Finally a core category was selected (selective coding) which was systematically related to all other categories and often acted as the central issue around which all other categories could be integrated (Strauss and Corbin 1998; Bryman 2004). In this qualitative approach, data collection, analysis and theory formulation were undeniably connected in a reciprocal sense.

***Concept: it is important to encourage students to change lifestyle towards greater environmental sensitivity***

The aggregated responses showed a surprising degree of consensus between the interviewees in the client panel about the overall significance of improving student resident's awareness and understanding of sustainable living issues. The relevant principles, for instance lifestyle change towards greater environmental sensitivity, were considered to be introduced as an important part of the ongoing Student Residences Strategy. As argued by EEC, individuals could still have a cognitive impact on the environment no matter how appropriate the building was. PSHO furthered this view and suggested that, to encourage students to participate, it was important to make information available related to environmental impacts and what students could do to make things different.

However, a variety of robust ideas were developing when the interviewees were asked about the effective methods to encourage students to take action. Some core inspirations are categorised and summarised in the following sections.

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[liv] Coding: 'the analytic processes through which data are fractured, conceptualised, and integrated to form theory' (Strauss and Corbin 1998: 3). For more details about 'open coding, axial coding and selective coding', please refer to Strauss and Corbin 1998.

- ***Financial Incentive***

Financial incentive was considered by all interviewees as the most effective method to encourage student residents to change their existing lifestyles towards greater environmental sensitivity though different interviewees would like to address it in different formats, such as 'Buy In strategy' suggested by PSHO, 'money refund' suggested by GMRS, and 'rewarding good practices' suggested by EM and so on.

- ***Campaign and Competition***

Campaign and competition were considered as another important method to get the message across to students. As argued by EEC, PSHO, PM and EM, the campaign should start at the beginning of every academic year and continue during the academic terms, including talks at welcome meetings, poster competitions, verbal campaigns, stalls on activity days, and emails and newsletters and so on. Further, they also considered that it was important to remind students about the purpose of energy saving and carbon reductions on a regular basis. In terms of practice, this method was often applied jointly together with financial incentives.

- ***Student to Student***

As argued by GMRS, student-to-student communication was still the best way to encourage students to make a step change. As suggested by him, Green Ambassadors should be nominated onsite who took the responsibility to improve student residents' awareness of relevant living issues on the basis of peer pressure, for instance talking with them about how to make differences in similar accommodation units through the study of consequences and benefits in an exemplar. OMSH furthered the idea of person-to-person contact and suggested that all staff, including cleaners, porters and residence tutors, should be involved though with different responsibilities and in different phases.

- ***Online Forums***

Online forums were considered by the interviewees as another important communication platform to share the sustainability-related information. Actually, there were forums already available for university staff, such as EAUC (the Environmental Association of Universities and Colleges[lv]) mentioned by PM and EM, to get the message across. However, it was important to encourage university students to participate in the processes of knowledge transfer.

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[lv] Available online at < URL: http://www.eauc.org.uk/home >

- ***User's Guide***

Likewise, an understandable user's guide with relevant information was also addressed by the client panel as an important communication method to pass the sustainability-related information to student residents (see Table 7.2 and Table 7.3). However, it was an open question whether the paper work was an effective method, and whether the students would also appreciate it. Actually, a general consensus on this method was not achieved between the interviewees, for instance EM argued that a user's guide was important to get the message across; while on the other hand, GMRS and OMSH doubted this strategy and said that 'probably no one would read it'.

To summarise, many good ideas arose from interviewees in the client panel to engage students to change their current lifestyles towards greater environmental sensitivity in the operational phase of accommodation occupation. Further, there was a tendency that information about sustainable living could be shared in a variety of formats. Until now, however, these opinions varied significantly and it was unsure which one was the most effective method to encourage students to participate in the campaign or deliver the relevant information and knowledge. This should be further explored in future work.

Certainly some other issues were also arising in the follow-up open discussion section. EEC argued that the new student village should be designed as a small-scale community rather than traditional dormitories, which aimed to make students feel more at home. GMRS furthered this idea and argued that, besides environmental benefits, the implementation of some design strategies, for instance 'Eco2 Ecological enhancement' and 'Eco4 Change in ecological value of site', should also be addressed to give students more of a feeling of community.

As staff in the Department of Accommodation and Campus Services, interviewees in the client panel also showed a strong interest in sustainable living issues encountered in their own lives. Compared with their friends, they were more likely to use energy efficient light bulbs at home, buy food from sustainably sourced shops, rely on public transport or shared cars, dispose separately and recycle household waste, and increase the insulation standards during refurbishments and so on. PSHO and OMSH even started to consider applying renewable energy to their own homes. As argued by PSHO, she would like to eventually consider fitting solar panels (PV) in her house. For OMSH, more attention was paid to the application of wind turbulence though he also implied the need for better education and widely shared awareness of this issue. Since they were more aware of the sustainability-related issues than others, they gave advice to their friends regarding sustainable living

issues. For instance, GMRS often told his friends that, besides environmental benefits, sustainable lifestyle could also be cost effective if it could be considered from a longer-term perspective.

To a great extent, feedback from the consultation showed a very good start for the vast campaigns of education, debate, and public participation from a client's perspective, though these clients probably need to be further advised to embrace intrinsic sustainability principles rather than visible symbols (such as photovoltaics and micro-turbines). People in the Client Group also seemed to have confidence on issues about what the student residents need. However, whether there was a general consensus on sustainable living issues between the Client Group and the Occupant Group was still to be further tested. For instance, OMSH argued that 'younger students are more aware of environmental issues than older students' and 'students' awareness of sustainable living issues sometimes depends on where they are coming from, especially when there is no incentive in the campaign'. Although this argument seemed to be in the nature of things, it did not correspond with findings from the previous quantitative analysis within the Occupant Group (see 6.4.2). Further issues relating to the consensus between different stakeholder groups will be discussed in Chapter 9.

## 7.5 CHAPTER SUMMARY

In this chapter, the interview procedures for the collection and analysis of the data from the Client Group (six successful interviews) are described. Although this is a small sample size, the researcher believes that the quality of the interviews and the level of authority of each individual result in information that illustrates the conflicting objectives and similarities of stakeholders at all levels in the Client Group (also see a comparable study, Nelms *et al.* 2007: 241). Since this chapter is a major stage of this research for the collection and analysis of the qualitative data, inspiration drawn from the grounded theory is introduced to facilitate the study. Some findings from aggregated feedback, with both quantitative and qualitative information, are summarised.

Compared with criteria in EcoHomes, it is found that some sustainability issues are considered to be more important while others less important by the Client Group (see Figure 7.1 and Table 7.2; and Figure 7.2 and Table 7.3, considering the student residents' requirements). These kinds of biased interests from the Client Group will be compared with designers' intention and occupants' awareness in Chapter 9.

A general consensus is achieved within the Client Group on the relative importance of a range of housing environmental issues (either from a client's perspective or an occupant's perspective), though this needs to be further validated in the future based on samples of relatively larger sizes. It is also found that some issues in EcoHomes are not considered to be important by the Client Group, both in the accommodation delivering processes and in its later operational phase. These issues, including 'Ene5 External lighting', 'Ene6 Internal lighting', 'Wat1 Internal potable water use' and 'Eco4 Change of ecological value of site' and so on, should be addressed in future collaborative design decision-making processes by getting the related message to the Client Group in particular.

To encourage participants in the Client Group to take sustainability principles into account in the delivering processes of student accommodation, some important motivational factors are specified. Important drivers include 'environmental benefits', 'compliance with legislation', 'championing innovation', 'economic benefits', 'enhanced reputation' and 'meeting students' requirement' and so on. In contrast, important barriers include 'affordability or cost', 'lack of understanding or proof of the business case', 'lack of awareness', 'lack of information and relevant training' and 'time constraints' and so on. There are also some important measures that might encourage participants in the Client Group to increase their awareness of sustainable strategies, such as 'cost and benefits analysis', 'information on exemplar projects and best practice', 'forums or networks for sharing information', 'information about funding' and 'publicity or promotion of sustainability' and so on.

It is also acknowledged by the interviewees that the objective of sustainability cannot be achieved by efforts from members in the Client Group alone. More specifically, energy saving and carbon reductions require a close collaboration between the Client Group and the Occupant Group in the operational phase of accommodation occupation. Some methods that can encourage student residents to participate in the campaign or deliver the relevant information are identified, which are 'financial incentive', 'campaign and competition', 'student to student', 'online forums' and 'user's guide'. Their effectiveness is expected to be further explored in the future.

The researcher attempts to provide causal explanations for some issues. However, it is important to note that this is only done in terms of *interpretive understanding*. To a great extent, findings from this research stage offer insight into the collaborative learning, enhance understanding of the nature of the Client Group and provide a meaningful guide to future action.

# CHAPTER 8

# CONSULTATION RESPONSES FROM THE DESIGNER GROUP

## 8.1 CHAPTER OUTLINE

This chapter describes data collection and analysis from the Designer Group. Postal self-completion questionnaires are used to collect both quantitative and qualitative information. Data analysis in this research stage is mainly based on descriptive statistics. It is important to note that, compared with the procedures of data collection from the Occupant Group (student residents) and the Client Group (ACS), the collection of data from the Designer Group is no longer under the researcher's supervision. Detailed consultation procedures are described in the following sections.

## 8.2 AIMS AND METHODS IN THIS RESEARCH STAGE

From the pilot investigation (see Chapter 5), it was found that postgraduate architectural students' knowledge of sustainable housing design issues drawn from EcoHomes was much less than expected. Furthermore, the distribution of their awareness of these issues also did not correspond with the order of relative importance addressed by EcoHomes. Therefore, it became very questionable, based on their existing knowledge background, whether these future designers would be able to help other stakeholders make informed decisions, or even provide acceptable building products.

However, as argued by Lawson (1997: 43), the more experience the designers have, the more consistently they prefer a strategy of analysis through synthesis. Compared with architectural students, therefore, experienced architects often adopt a different system for value judgement in the design processes. Furthermore, Lawson (1997: 99) also points out that housing design is a typical example for this judgement, where 'the experienced architect will use a process quite unlike that employed by the novice student'. More specifically, the experienced architects are likely to consider different constraints in order referring to their early similar experience. As argued by Herman Hertzberger (1991, cited in Lawson 1997: 113),

> 'Everything that is absorbed and registered in your mind adds to the collection of ideas stored in the memory: a sort of library that you can consult whenever a problem arises. So, essentially the more you have seen, experienced and absorbed, the more points of reference you will have to help you decide which direction to take: your frame of reference expands.'

To understand the order of relative importance in which the Designer Group often addresses the palette of design issues drawn from EcoHomes, relevant information should be collected

from experienced architects rather than student trainees. In this research stage, a postal self-completion questionnaire, *Questionnaire for Future Designers* (see Appendix 2.5), was used to collect data from the Designer Group (experienced architects). Detailed consultation procedures are described in the following sections and relevant limitations of this research stage will be discussed in Chapter 11.

## 8.3 CONSULTATION PROCEDURE & RESPONSES – DESCRIPTIVE STATISTICS

Compared with the collection of the data from the Occupant Group and Client Group, the procedure of data collection from the Designer Group, including the processes of how the postal self-completed questionnaires were issued, completed and collected, was no longer under the researcher's supervision. Based on a non-probability sampling method, data was collected from some architectural practices, such as Building Design Partnership (BDP) in Sheffield, Bond Bryan Architects in Sheffield, Home Housing Association (HHA) in Yorkshire and so on. Since the consultation was carried out strictly on a voluntary basis, some architects refused to participate as they admitted freely that they were not particularly interested in the design of student accommodation and, compared with housing design, they had not done a lot of this. As a result, the response rate was much lower than expected, around 30%, and only 26 usable responses were collected ultimately from the target Designer Group (see Appendix 2.6 for a sample). The analyses of consultation responses are described in the following sections, mainly based on descriptive statistics.

### 8.3.1 SAMPLES DESCRIPTION (QA1-3)

There were 26 formal responses from the Designer Group. Of these, 20 respondents were male (77%) and the other 6 respondents were female (23%). As shown in Figure 8.1, the group of designers were made up of architect directors (15%), architects (23%), architectural assistants (35%) and architectural technologists (27%). Furthermore, most of the respondents could be counted as experienced architects according to their considerable working experience, as shown in Figure 8.2. Therefore, it was believed that this sample provided a good opportunity to study designers' opinions in the decision-making processes. However, it was also important to note that, although all of the respondents were interested in the topic of sustainability or sustainable design, only half of them (46%) had done design related to student accommodation before.

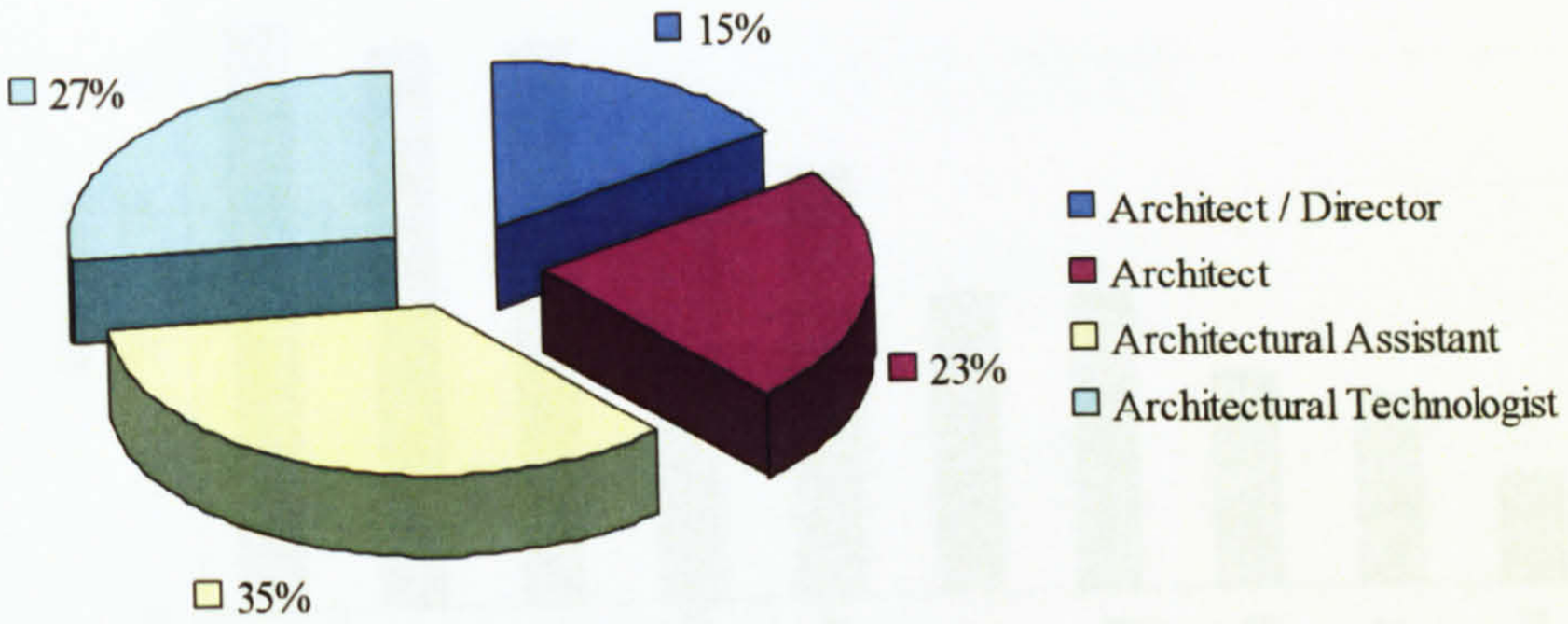


**Figure 8.1: Respondents' job description**

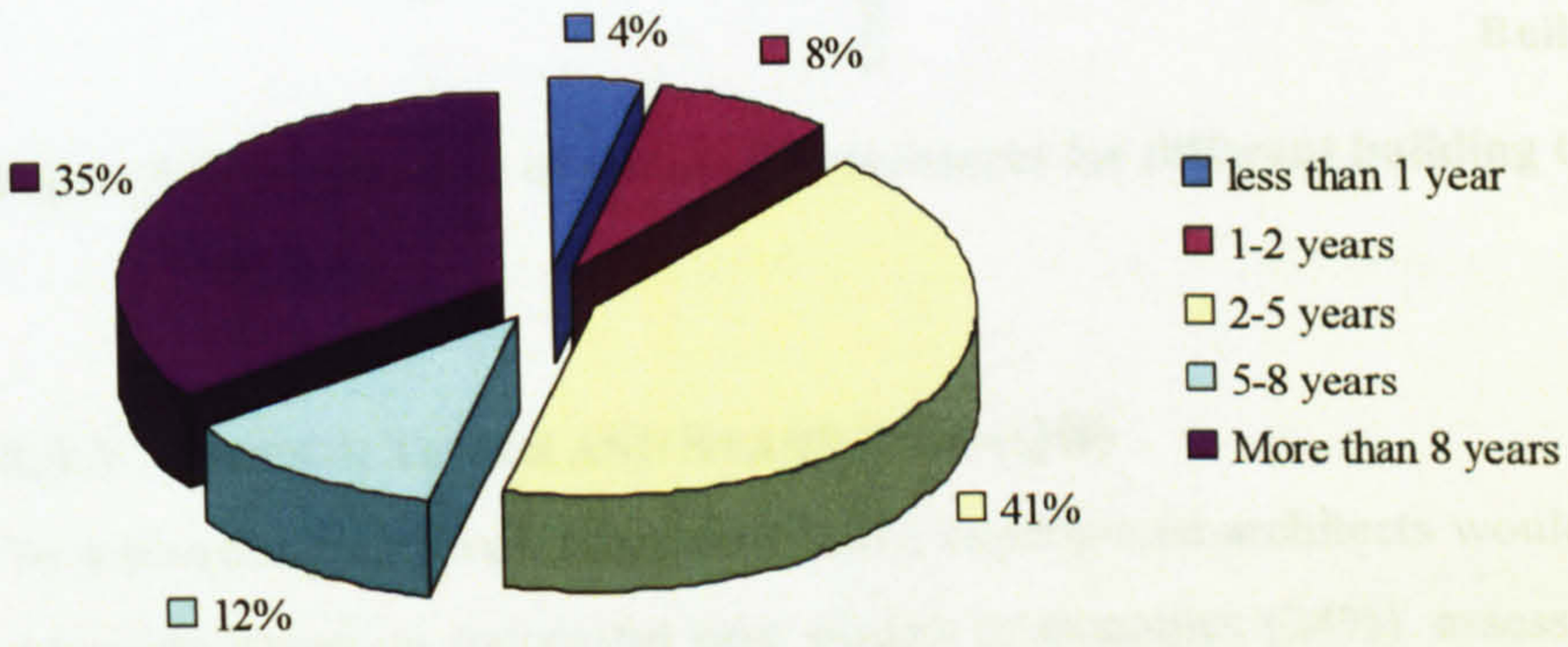


**Figure 8.2: Respondents' working experience**

### 8.3.2 BUILDING TYPES AND SUSTAINABLE MEASURES (QA4)

As shown in Figure 8.3, although most architects argued that sustainability principles and relevant design measures were important for all building types, there was a general consensus on the priorities of addressing them. In descending order, experienced designers believed that sustainable measures were more important to the following building types: housing projects (including both social (15%) and private housing (14%)), educational buildings (14%), civic buildings (12%) and commercial offices (11%). This finding corresponded with the response from higher-level architectural students (see 5.3.1) and the declaration in Chapter 2 (see 2.2.3). Hence it was concluded that, between the building types, the Designer Group (experienced architects) were more likely to take sustainable measures into account in the design processes of housing projects, especially in the approach to social housing design.

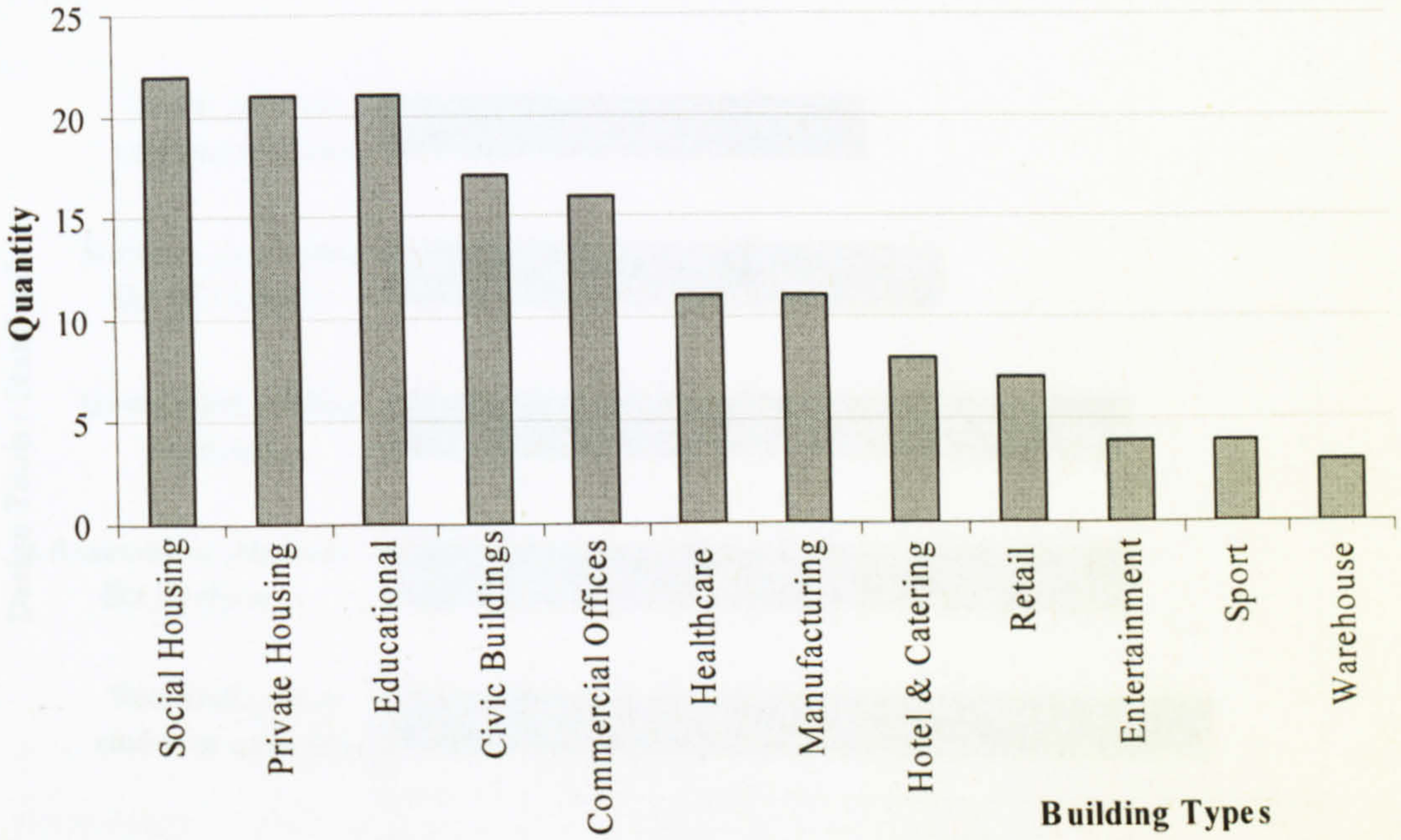


**Figure 8.3: Importance of sustainable measures for different building types**

### 8.3.3 DESIGN TOOLS AND STANDARDS (QB)

To achieve higher levels of sustainability, experienced architects would often prefer to make decisions based on successful case studies or examples (24%), assessment standards (22%) and government building regulations (22%), as shown in Figure 8.4. It was interesting to see that 'similar experience before' had been rated as the last thing based on which the architects would make decisions. This result did not correspond with the earlier statement that the experienced architects were likely to consider the constraints in order referring to their early similar experience. This was probably because the target architects had only limited previous experience related to sustainable housing (student accommodation) design and could only study the relevant information from others' similar experience ('successful case studies or examples').

Furthermore, as shown in Figure 8.5, between the prevailing tools and standards related to sustainable housing design, experienced architects in the target group had better understanding of some mandatory standards in the housing market, such as Building Regulations Part L, BREEAM EcoHomes and the Green Guide to Specification and so on. As argued earlier (see 4.5.1), BREEAM EcoHomes included the requirements from Standard Assessment Procedure (SAP), Building Regulations Part L and the Green Guide to Specification as part of its content. Therefore, it was important to see whether these experienced architects were likely to address the palette of design issues in order of relative importance which was similar to the one used in EcoHomes.

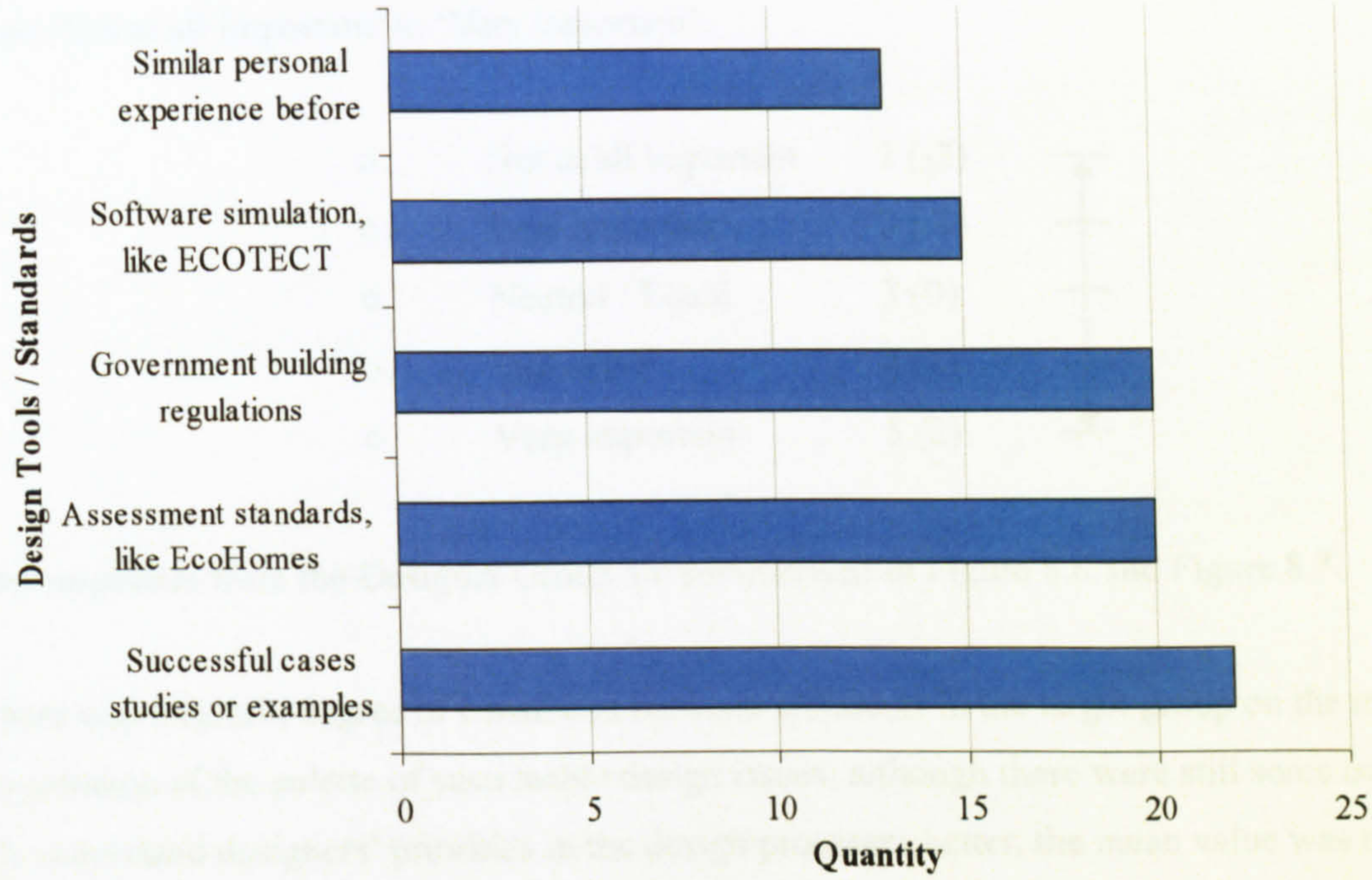


**Figure 8.4: Make sustainable design according to the related tools or standards**

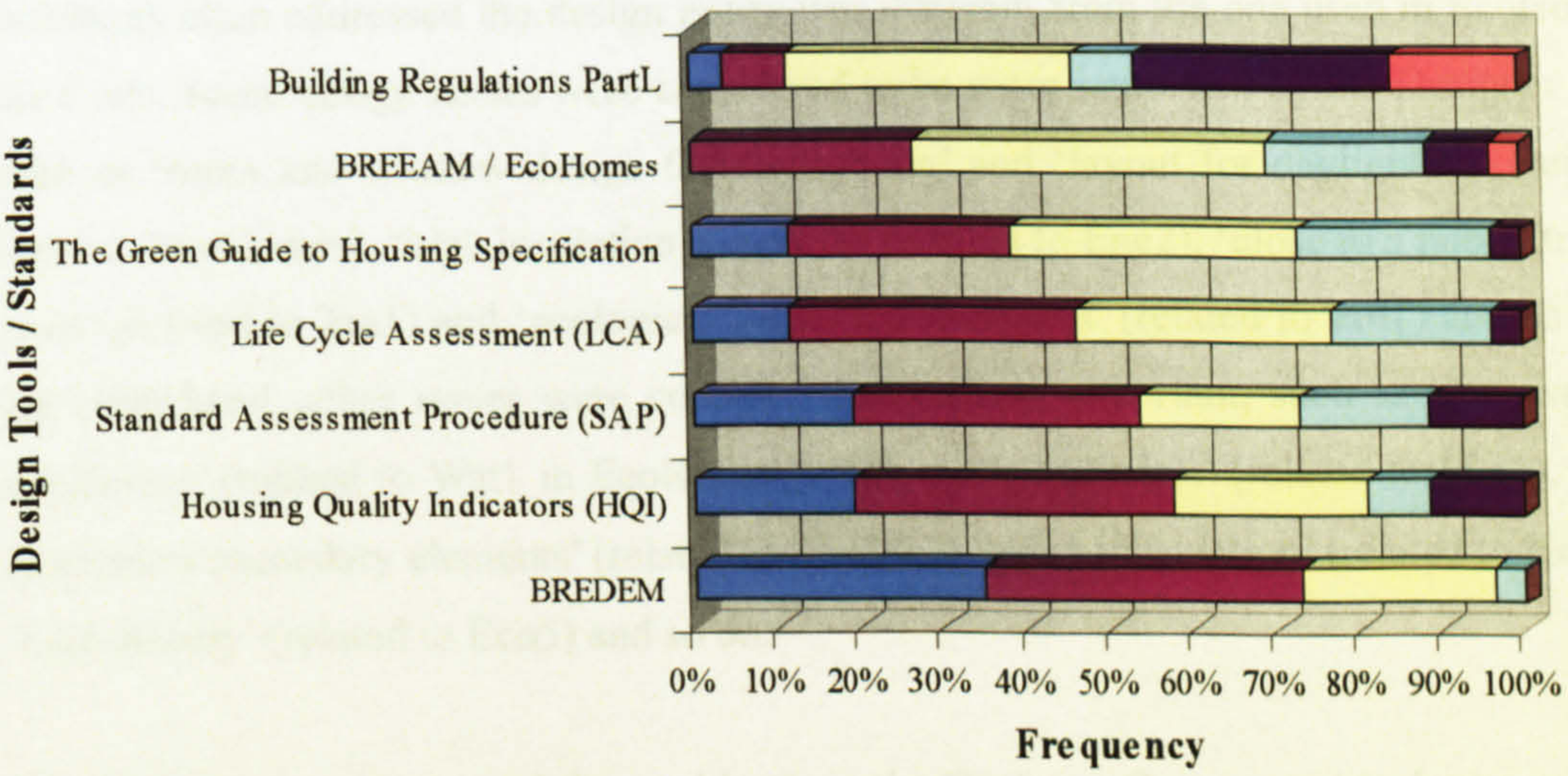


**Figure 8.5: Knowledge and application of the design tools or standards**

### 8.3.4 RELATIVE IMPORTANCE OF DESIGN ISSUES (QC)

To investigate designers' opinions on sustainable design issues for student accommodation, architects in the target group were asked to rate the relative importance of the palette of

design issues drawn from EcoHomes, with 1-5 range-of-opinion based on a Likert-type scale, from 'Not at all important' to 'Very important'.

- Not at all important 1 (-2)
- Less important 2 (-1)
- Neutral / Equal 3 (0)
- Important 4 (1)
- Very important 5 (2)

The responses from the Designer Group are summarised in Figure 8.6 and Figure 8.7.

There was a certain degree of consensus between architects in the target group on the relative importance of the palette of sustainable design issues, although there were still some outliers. To understand designers' priorities in the design processes better, the mean value was used to rank these design issues.

As shown in Table 8.1, it was found that the order of relative importance in which target architects often addressed the design issues was different from the one used in EcoHomes or the Code. Some design issues were considered to be more important by the Designer Group, such as 'room and window design for daylighting' and 'layout for daylighting' (related to Hea1 in EcoHomes), 'high insulation standards' (related to Ene2), 'close to a public transport node' (related to Tra1) and 'ecological insulation materials' (related to Pol1) and so on. On the other hand, other issues were considered to be less important, such as 'low water use appliances' (related to Wat1 in EcoHomes), 'life-cycle materials' (related to Mat1), 'timber as primary/secondary elements' (related to Mat2&3), 'sound insulation' (related to Hea2) and 'high density' (related to Eco5) and so on.

Certainly it was not expected that architects in the Designer Group would adopt a system for value judgement exactly same as the one used in EcoHomes or the Code. However, as argued earlier, better results would be expected if a close consensus between designers and legislators could be achieved.

It is also important to note that the average scores of some design issues were very close to each other due to the 5-point measurement, for instance 'low water use appliances', 'life-cycle materials', 'facilities to recycle household waste' and 'brownfield sites' had all been given an average score of 0.92. To explore the maximum variation of the given phenomena, a larger sample with more detailed measurement is expected in future work.

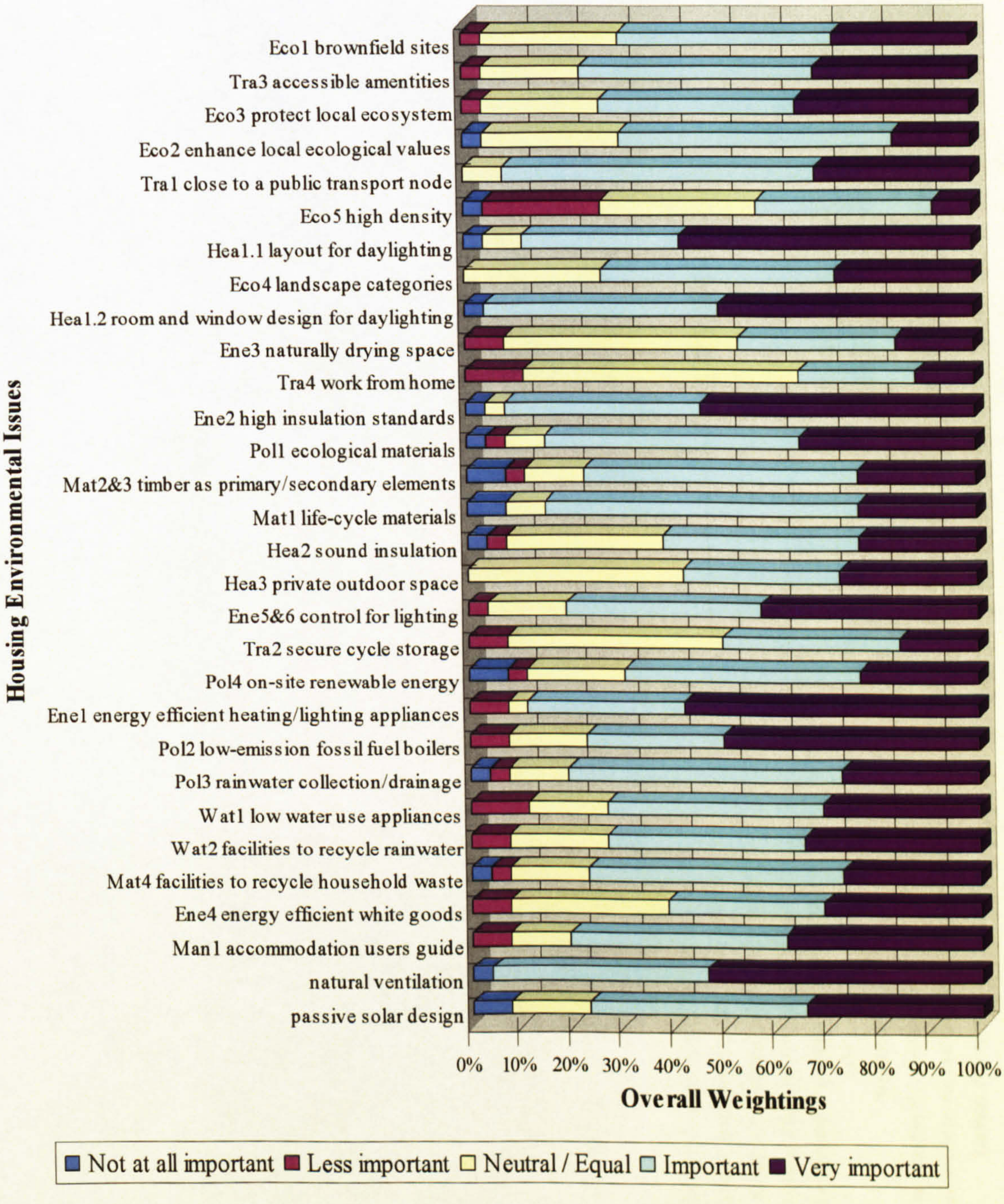


**Figure 8.6: Relative importance of different housing design issues – rated by the target designers based on a Likert-type scale, from 'Not at all important' to 'Very important'**

The aggregated results of the consultation (design issues) in the Designer Group are shown in this figure. A bar on the graph's Y-axis represents the variety of housing environmental issues arising in the accommodation design processes. The relative importance of different issues are summarised as a percentage of the total response; comparing the length of segments shows the degree of consensus on the relative importance of a particular issue between participants in the Designer Group.

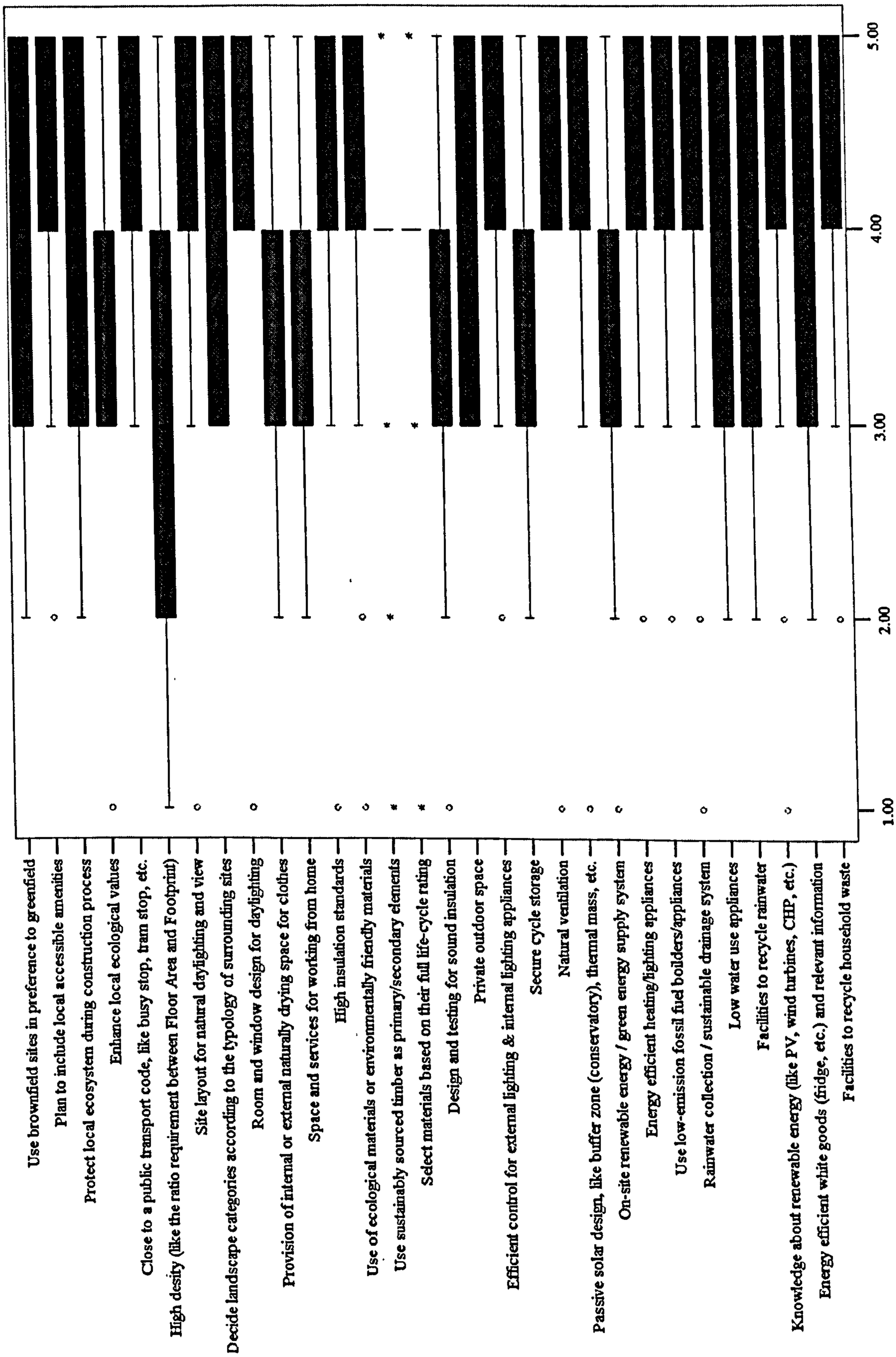


**Figure 8.7: Boxplots of the relative importance of different housing design issues – rated by the target designers based on a 5-point Likert-type scale, from 'Not at all important' (1) to 'Very important' (5)**

**Table 8.1: Comparison of different ranks for design issues by the Designer Group, EcoHomes 2006 and the Code for Sustainable Homes**

| Comparison of different ranks for design issues by the Designer Group, EcoHomes 2006 and the Code for Sustainable Homes | Architects | | EcoHomes 2006 | | | The Code | | |
|---|---|---|---|---|---|---|---|---|
| | Mean | *Rank* | Category | Credits | *Rank* | Category | Credits | *Rank* |
| Natural ventilation | 1.42 | 1 | | | | | | |
| Energy efficient heating & lighting | 1.38 | 2 | Ene1 | 13.75 | 1 | Ene1 | 18.83 | 1 |
| Room&window design for daylighting | 1.38 | 3 | Hea1/2 | 2.63 | 14 | Hea1/2 | 1.75 | 16 |
| Layout for daylighting | 1.38 | 4 | Hea1/2 | 2.62 | 15 | Hea1/2 | 1.75 | 17 |
| High insulation standards | 1.38 | 5 | Ene2 | 1.83 | 18 | Ene2 | 2.51 | 13 |
| Close to a public transport node | 1.23 | 6 | Tra1 | 2.00 | 16 | | | |
| Control for lighting | 1.19 | 7 | Ene5&6 | 3.66 | 7 | Ene3&6 | 5.02 | 4 |
| Low-emission fossil fuel boilers | 1.19 | 8 | Pol2 | 2.73 | 10 | Pol2 | 2.10 | 15 |
| Accommodation users guide | 1.12 | 9 | Man1 | 3.00 | 9 | Man1 | 3.33 | 8 |
| Ecological insulating materials | 1.08 | 10 | Pol1 | 0.91 | 28 | Pol1 | 0.70 | 26 |
| Accessible amenities | 1.04 | 11 | Tra3 | 3.00 | 8 | | | |
| Protect local ecosystem | 1.04 | 12 | Eco3 | 1.33 | 23 | Eco3 | 1.33 | 19 |
| Landscape categories | 1.00 | 13 | Eco4 | 5.33 | 5 | Eco4 | 5.33 | 3 |
| Facilities to recycle rainwater | 1.00 | 14 | Wat2 | 1.67 | 22 | Wat2 | 1.50 | 18 |
| Rainwater collection/drainage | 0.96 | 15 | Pol3 | 1.82 | 20 | Sur1 | 1.10 | 25 |
| Passive solar design | 0.96 | 16 | | | | | | |
| Low water use appliances | 0.92 | 17 | Wat1 | 8.33 | 2 | Wat1 | 7.50 | 2 |
| Life-cycle materials | 0.92 | 18 | Mat1 | 7.23 | 3 | Mat1 | 4.50 | 6 |
| Facilities to recycle household waste | 0.92 | 19 | Mat4 | 2.71 | 12 | Was1 | 3.66 | 7 |
| Brownfield sites | 0.92 | 20 | Eco1 | 1.33 | 24 | Eco1 | 1.33 | 20 |
| Private outdoor space | 0.85 | 21 | Hea3 | 1.75 | 21 | Hea3 | 1.17 | 24 |
| Energy efficient white goods | 0.85 | 22 | Ene4 | 1.83 | 19 | Ene5 | 2.51 | 14 |
| Timber as primary/secondary elements | 0.81 | 23 | Mat2&3 | 4.06 | 6 | Mat2&3 | 2.70 | 9 |
| Sound insulation | 0.73 | 24 | Hea2 | 7.00 | 4 | Hea2 | 4.67 | 5 |
| On-site renewable energy | 0.73 | 25 | Pol4 | 2.73 | 11 | Ene7 | 2.51 | 11 |
| Enhance local ecological values | 0.65 | 26 | Eco2 | 1.33 | 25 | Eco2 | 1.33 | 21 |
| Secure cycle storage | 0.58 | 27 | Tra2 | 2.00 | 17 | Ene8 | 2.51 | 12 |
| Natural drying space | 0.54 | 28 | Ene3 | 0.92 | 27 | Ene4 | 1.26 | 23 |
| Work from home | 0.35 | 29 | Tra4 | 1.00 | 26 | Ene9 | 1.26 | 22 |
| High density | 0.19 | 30 | Eco5 | 2.67 | 13 | Eco5 | 2.67 | 10 |
| | | | | | | | | |
| Some housing environmental issues have been considered to be *more* important by the Designer Group | | | | | | | | |
| Other housing environmental issues have been considered to be *less* important by the Designer Group | | | | | | | | |

As argued by Gething and Bordass (2006: 420), in the self-assessment processes, 'items the architect judged to be much better were usually related to things that had happened during the design and construction process but which were not visible in the completed building and had not been pointed out in the submissions'. As a result, almost all design issues were rated by architects as between 'important' and 'very important' (see Figure 8.7). To figure it out, the researcher tended to take the mean values into account rather than using architects' evaluation of different design issues directly. These kinds of issues should also be addressed in future trans-disciplinary studies, especially those between research and design.

### 8.3.5 MOTIVATIONAL FACTORS (QD AND QE)

As shown in Figure 8.8, experienced architects often looked for information related to sustainable design from 'professional or trade body' (22%), 'professional journal or publication' (22%), 'project team members or colleagues' (20%) and 'government publication' (19%). This provided an insight into the most effective methods to get the sustainability-related message across to the Designer Group.

To facilitate knowledge transfer in the decision-making processes efficiently, it is important to understand the motivational factors that could encourage architects to take sustainability principles into account in the design processes. QD2 and QD3 were designed to explore such kind of issues, from both positive and negative perspectives.

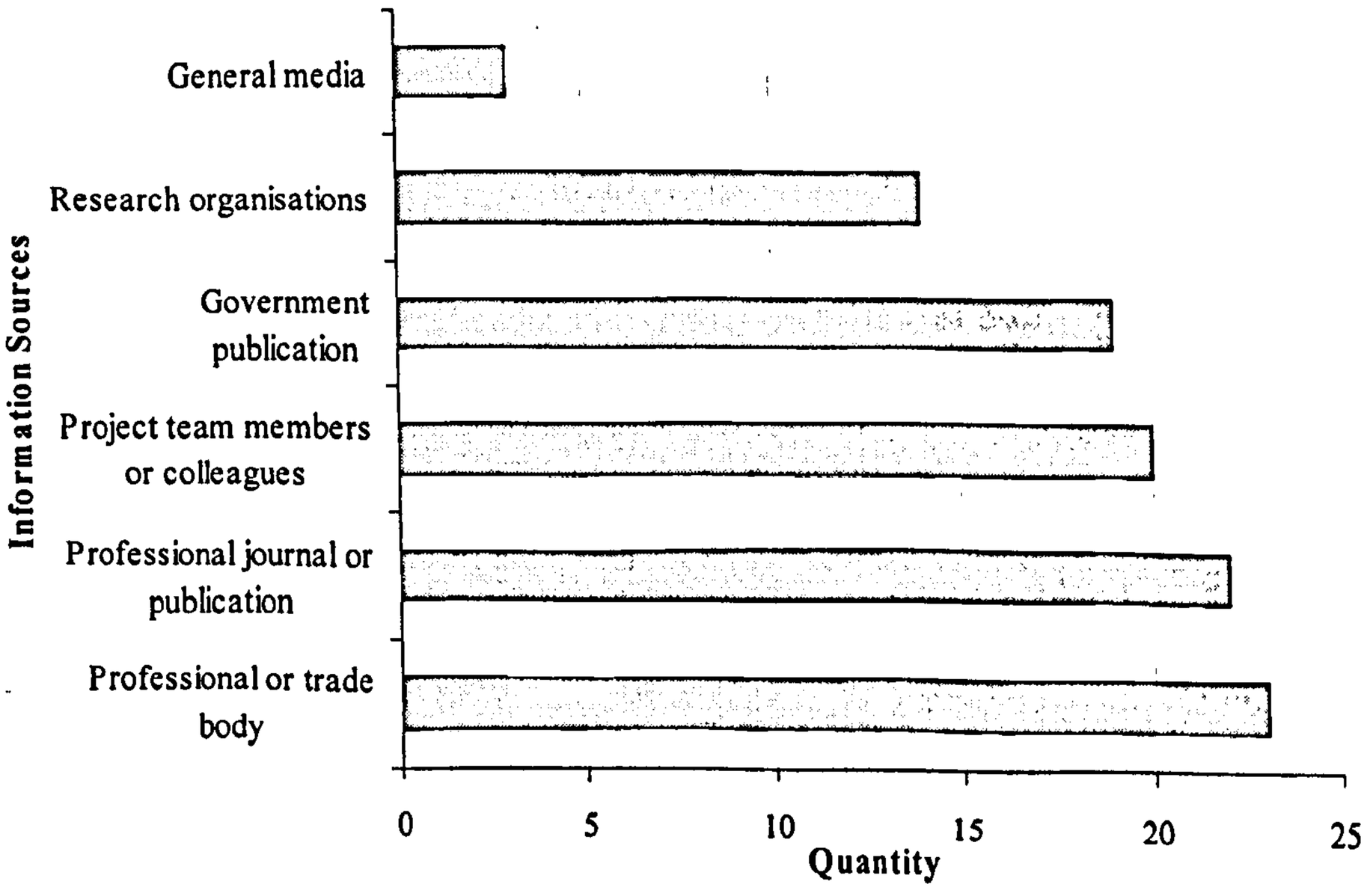


**Figure 8.8: Information sources for sustainable design issues (QD1)**

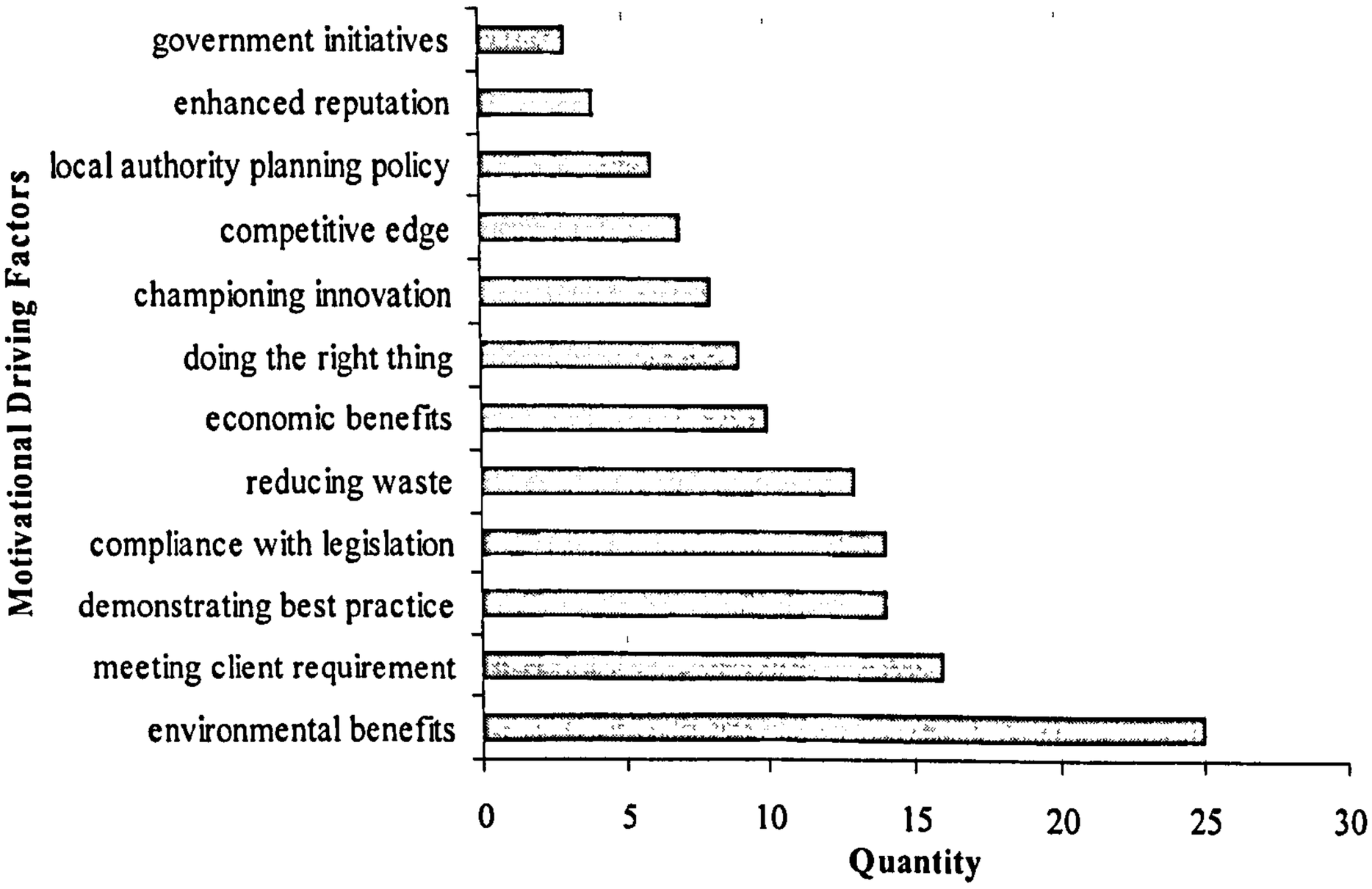


**Figure 8.9: Top 5 drivers to encourage architects to take sustainability measures into account in the design processes. (QD2)**




**Figure 8.10: Top 5 barriers to prevent architects from taking sustainability measures into account in the design processes. (QD3)**

As shown in Figure 8.9, the top five drivers for experienced architects to take sustainable measures into account in the design processes were 'environmental benefits' (19%), 'meeting clients' requirements' (12%), 'demonstrating best practice' (11%), 'compliance with legislation' (11%) and 'reducing waste' (10%). On the other hand, as shown in Figure 8.10, the top five barriers were 'affordability and cost' (18%), 'lack of interest from developers and clients' (15%), 'time constraints' (9%), 'construction industry culture' (9%) and 'lack of awareness' (8%). These findings will be compared with the consultation responses from other stakeholder groups in Chapter 9.

As argued in Chapter 2 (see 2.7.1), it was believed that architects should work closely with other stakeholders in collaborative design processes and take responsibility to offer their specialised decision-making skills rather than being dominant. QE1 and QE2 were designed to see whether experienced architects had been aware of the motivational factors that might encourage other stakeholders, for instance developers or clients and their practices, to take sustainable measures into account in collaborative design processes.

As shown in Figure 8.11, experienced architects in the target group believed that the top five drivers to encourage developers or clients to take sustainable measures into account in collaborative design processes were 'environmental benefits' (13%), 'enhanced reputation' (12%), 'economic benefits' (11%), 'competitive edge' (10%) and 'compliance with legislation' (9%). Compared with the aggregated responses of QD2 (Figure 8.9), it was interesting to see that experienced architects in the target group believed that there were two driving factors that might work on both Designer Group and Client Group – 'environmental benefits' and 'compliance with legislation'. However, other important drivers were different from these two groups.

Likewise, as shown in Figure 8.12, the top five drivers to encourage architectural practices to apply sustainable measures were 'information on exemplar projects and best practice' (15%), 'cost and benefits analysis' (14%), 'example specifications' (11%), 'training' (11%) and 'publicity or promotion of sustainability' (10%).

All these findings (QD1-3 and QE1-2) will be compared with the consultation responses from other stakeholder groups and further discussed in the next chapter.

Most experienced architects (73%) in the target group, but not all of them, also agreed that it was important to encourage housing occupants to change their lifestyles towards greater environmental sensitivity (QE3).

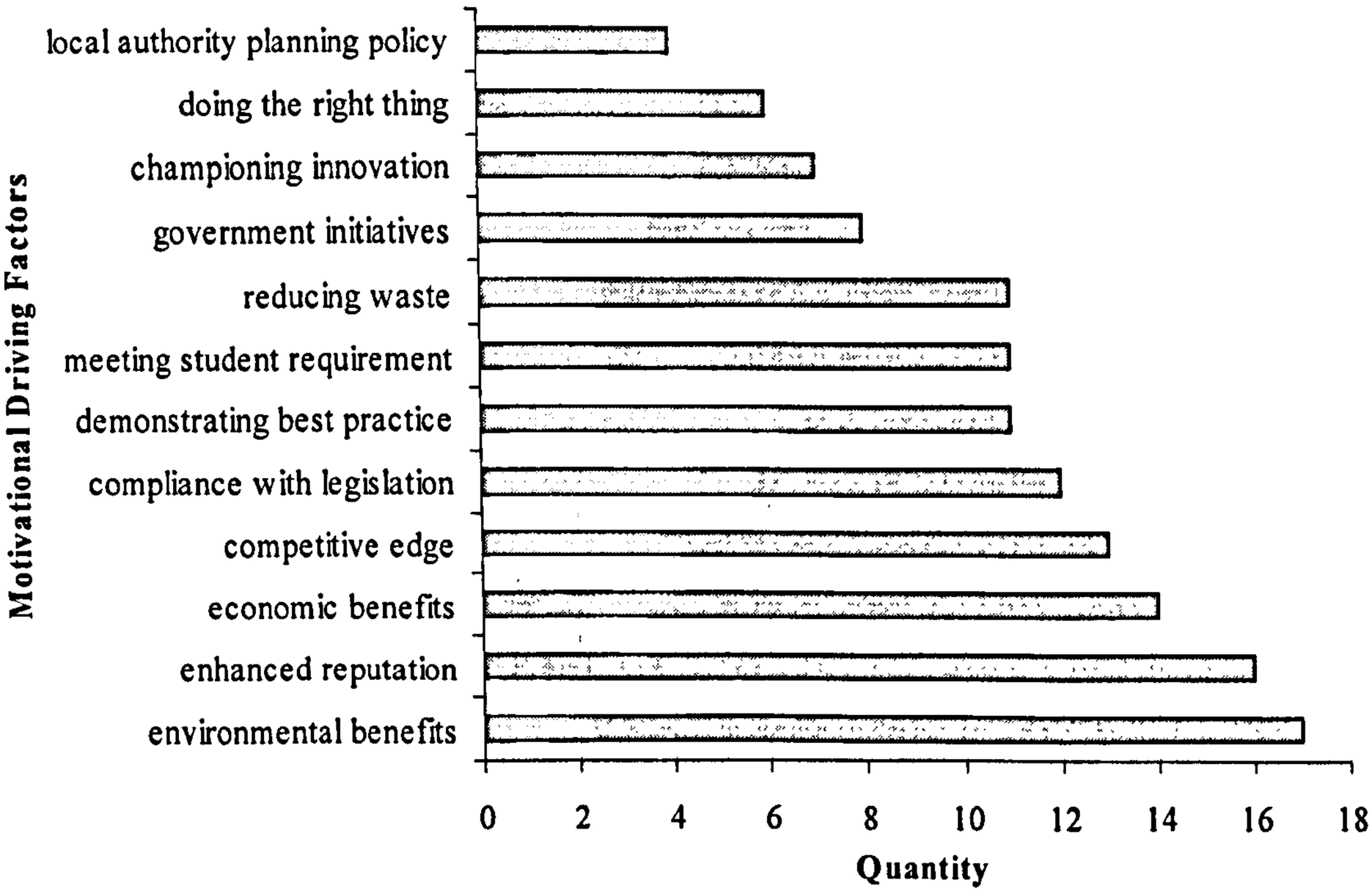


**Figure 8.11: Top 5 drivers for experienced architects to encourage developers/clients to take sustainability measures into account in the design processes. (QE1)**

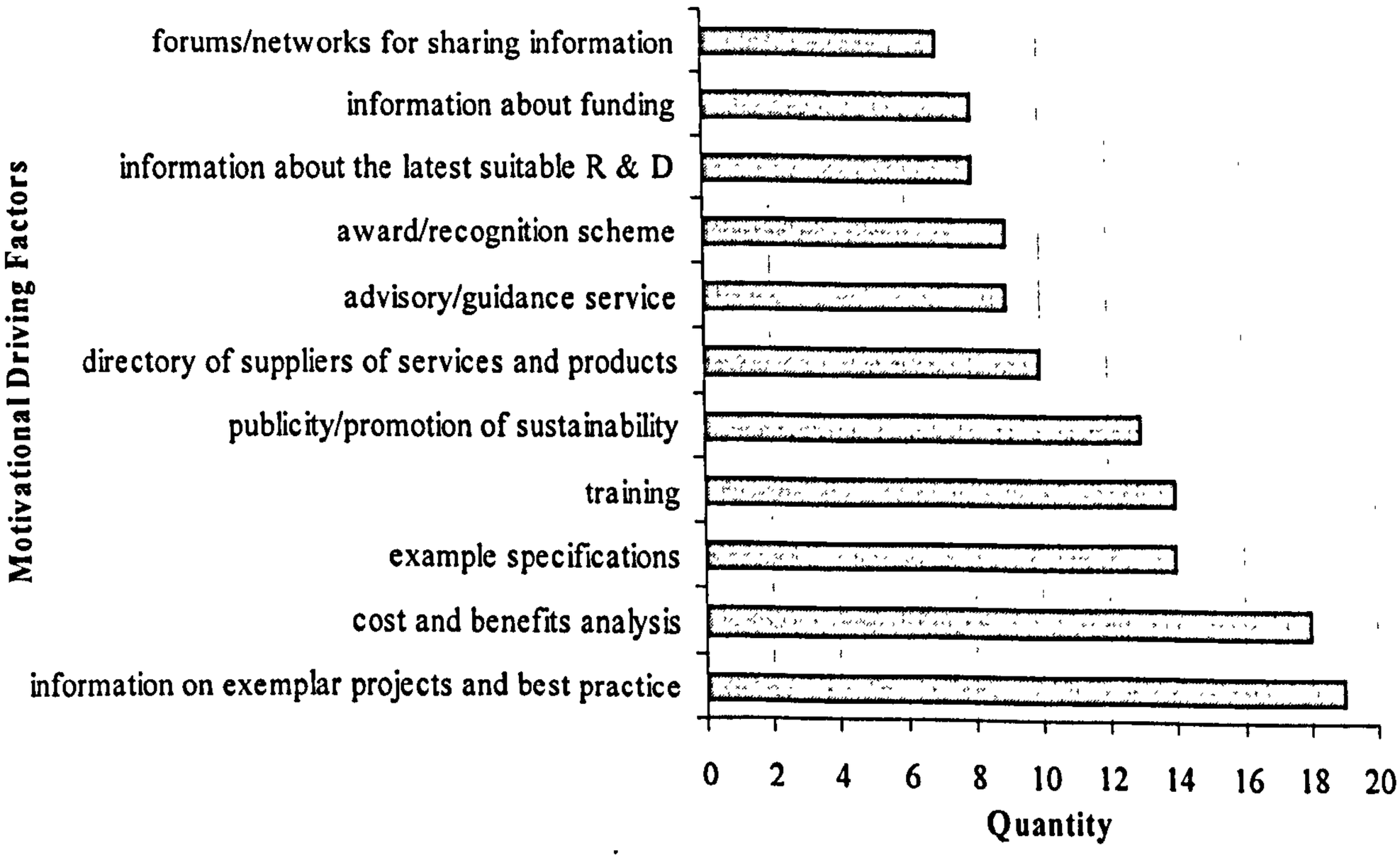


**Figure 8.12: Top 5 drivers for experienced architects to encourage their practices to take sustainability measures into account in the design processes. (QE2)**

## 8.4 COMPARATIVE STUDIES

It is interesting to note that some responses from the experienced architects in this research stage correspond with feedback from the postgraduate architectural students in the pilot investigation (see 5.3, though in this research stage the 5th year architectural students and the one-year taught masters students are considered a group of stakeholders). A close consensus is achieved between these two groups of stakeholders on a variety of issues, such as:

- Priorities of addressing sustainable building design – Between a range of building types, sustainable measures are more important to housing projects (including both social and private housing), educational buildings, commercial offices and civic buildings (see Figure 8.3 and Figure 5.6).

- Priorities of using design tools or standards – In terms of building design, both groups are likely to make decisions based on 'successful case studies or examples' and 'assessment standards' (see Figure 8.4 and Figure 5.7). Nevertheless, experienced architects are more likely to design in compliance with 'government building regulations' in the real world, while architectural students are more likely to use 'software simulation' to obtain better credits (also see Dejesus 2002: 166).

- Important drivers and barriers to take sustainability measures into account – Both groups agree that 'environmental benefits', 'meeting client requirement', 'demonstrating best practice', 'reducing waste' and 'economic benefits' are the most important drivers (see Figure 8.9 and Figure 5.12). Compared with architectural students who are likely to address the importance of 'doing the right thing' from an idealist's perspective, experienced architects in the real world show that they have to comply with compulsory legislations forced by the local authorities ('compliance with legislations'), no matter whether they are motivational drivers or not. On the other hand, both groups agree that 'affordability or cost', 'lack of interest from developers or clients', 'construction industry culture' and 'lack of awareness' are the most important barriers (see Figure 8.10 and Figure 5.13). While architectural students admit freely that there is a 'lack of information and relevant training', experienced architects argue that 'time constraints' is an important barrier to prevent them from taking sustainability measures into account in the design processes (also see the argument by a chief architect cited in Dammann and Elle 2006 in 4.6), though 'relevant training' should be able to educate them to do this efficiently (within time constraints).

- Important drivers to encourage developers or clients to take sustainability measures into account – Both groups agree that 'economic benefits', 'environmental benefits' and

'enhanced reputation' are the most important drivers to encourage developers or clients to participate in sustainable design (see Figure 8.11 and Figure 5.14).

- Important drivers to encourage architectural practices to take sustainability measures into account – Both groups agree that 'information on exemplar projects and best practice', 'cost and benefits analyses and 'training' are useful to encourage their future practices to increase the application of sustainable strategies (see Figure 8.12 and Figure 5.15).

In summary, although experienced architects working in relevant areas and postgraduate architectural students undertaking sustainability-related courses rate the issues above in different orders of importance, there is a *close consensus* between them on the most important ones. This further verifies the assumption in the pilot investigation (see 5.2.3) that, because most postgraduate architectural students have background knowledge and working experience in building-related environmental design, their understanding of some design and motivation issues should be better than junior students and could possibly be close to the knowledge level of experienced architects. However, this kind of consistent cognitive style violates the expectations that one may often have, such as:

- Working experience in the real profession could probably provide designers with more sustainability-related knowledge or different incentives;
- Current education could probably have a latent effect on students' (future architects') knowledge of some important sustainability-related design issues;
- Compulsory legislations could probably increase architects' awareness of some sustainability issues and improve their willingness to apply relevant design strategies, and so on.

In particular, less than half of the target architects have the experience of applying design tools or standards in the design processes, though some of these building standards have already been mandatory in the housing market for many years, such as SAP, Building Regulations Part L and so on (see Figure 8.5). This result corresponds with the finding from the pilot investigation (see Figure 5.8 and Figure 5.9). In other words, just like postgraduate architectural students, experienced architects also see EcoHomes (or other building environmental assessment methods) as a reactive assessment rather than a proactive project appraisal. The strategy of synthesis which these experienced architects often prefer is not related to any of these prevalent assessment methods. Therefore, although the Code for Sustainable Homes (CSH) has replaced EcoHomes and become a mandatory requirement for all new homes since 2008 (DCLG 2008a), it is very doubtful that this shift will make any

difference to the current situation. Since architects' cognitive styles are formulated through their earlier education (see 5.4.1), it is important to modify the current sustainability-related educational programmes by addressing the importance of applying building environmental assessment methods (e.g. EcoHomes) to support the design decision-making processes.

It is important to note that the generalisation of some findings in this comparative study needs to be further validated in the future. Some relevant limitations will be discussed in Chapter 11.

## 8.5 CHAPTER SUMMARY

In this chapter, the collection and analysis of the data from the Designer Group (26 experienced architects) are described. Some findings from aggregated feedback, with both quantitative and qualitative data, are summarised based on descriptive statistics. Compared with criteria in EcoHomes, it is found that some sustainable design issues are considered to be more important while others less important by experienced architects in the target group (see Figure 8.6, Figure 8.7 and Table 8.1). These kinds of biased intentions from the Designer Group will be compared with clients' interests and occupants' awareness in the next chapter.

Some important motivational factors are explored. Specifically, important drivers for these architects to take sustainable measures into account in the design decision-making processes are 'environmental benefits', 'meeting clients' requirements', 'demonstrating best practice', 'compliance with legislation' and 'reducing waste' and the barriers are 'affordability and cost', 'lack of interest from developers and clients', 'time constraints', 'construction industry culture' and 'lack of awareness'. From a designer's perspective, this survey also explores the important drivers that can encourage developers or clients to take sustainable principles into account in collaborative design processes (i.e. 'environmental benefits', 'enhanced reputation', 'economic benefits', 'competitive edge' and 'compliance with legislation') and those measures that can encourage architectural practices to participate in the campaign against climate change (i.e. 'information on exemplar projects and best practice', 'cost and benefits analysis', 'example specifications', 'training' and 'publicity or promotion of sustainability').

By comparing the findings to the results from the pilot investigation, it is found that there is a close consensus between experienced architects and postgraduate architectural students on a variety of issues, such as priorities of addressing sustainable building design and using

design tools or standards, motivational factors for them to take sustainability measures into account in the design processes, motivational factors that can encourage their clients or practices to take sustainability measures into account in the decision-making processes, and so on. This further explores a phenomenon that, though experienced architects have a general awareness of sustainable design tools or standards, it has so far made limited impact on their design protocols. Although Lawson (1997: 43) argues that, the more experience the designers have, the more consistently they prefer a strategy of analysis through synthesis; this kind of variance is not associated with the application of any prevalent assessment methods. Just like postgraduate architectural students, experienced architects also see EcoHomes (or other building environmental assessment methods) as a reactive assessment rather than a proactive project appraisal. To achieve the objective of sustainable homes (as stated in DCLG 2008b, also see 2.2.3), relevant architectural education or training programmes must be provided to inform these architects the importance and methods of applying EcoHomes (or other building environmental assessment methods) to support the design decision-making processes (also see Fowles *et al.* 2003).

The generalisation of this study can be further discussed in the future. Some limitations of this research stage will be discussed in Chapter 11.

# CHAPTER 9

# COMPARISON AND DISCUSSION

## 9.1 CHAPTER OUTLINE

Based on data analysis in previous chapters (Chapter 6, Chapter 7 and Chapter 8), this chapter compares consultation responses from different stakeholder groups from a latitudinous perspective and then identifies the differences of knowledge, motives and value systems among them. The researcher attempts to provide causal explanations for some issues. However, it is important to note that this is only done in terms of interpretive understanding.

## 9.2 AIMS AND METHODS IN THIS RESEARCH STAGE

As argued by Lawson (1997, 2004), design can be described as a transfer between areas of knowledge bearing on a particular project, aiming for consensus of problem solving (also see 2.5). In previous chapters (Chapter 6, Chapter 7 and Chapter 8), however, it is found that, in the design decision-making processes, none of the systems for value judgement adopted by ***occupants***, ***clients*** and ***designers*** corresponds with the one used by ***legislators*** or ***experts*** (referring to such system used in EcoHomes).

To have a deeper insight into the given phenomena, this chapter explores the priority variances between the Occupant Group, the Client Group and the Designer Group. Occupants' awareness can be compared with clients' interest directly as they are evaluated based on an identical criterion (see Appendix 2.3 and Appendix 2.4). So is the comparison between designers' intention and clients' interest (see Appendix 2.5 and Appendix 2.4). However, to compare occupants' awareness and designers' intention, the communication platform needs to be applied, as proposed in Chapter 5 (see Figure 5.23), to bridge the knowledge gaps (see Figure 4.11). The comparisons between different stakeholder groups are made mainly from a qualitative perspective, although some possible quantitative analyses are described. Some important discussions in this chapter are also planned to further the model of Bayesian Belief Network (see Figure 2.9) in detail.

## 9.3 COMPARISONS BETWEEN DIFFERENT STAKEHOLDER GROUPS

In the following sections, cross comparisons are made between the Occupant Group, the Client Group and the Designer Group in pairs. It is important to note that stakeholders in different groups often have different systems for value judgement. Therefore, the rating scores are only relative within each group (Leaman and Bordass 2007: 672). For instance, designers, clients and occupants can evaluate an identical issue with the same weighting of relative importance (i.e. Neutral – 3); however, this rating score can be located in the middle

of the whole responses from the Occupant Group while, in the responses from the Designer Group or the Client Group, it can probably become an outlier.

To get a full picture of the given phenomena, therefore, it is important to study the differences within a proper context. In this case, comparisons in the following sections are made mainly based on the ranks of issues between different stakeholder groups. Rank variances are considered significant when the differences are more than 10. This is set based on the general difficulty of getting the message across and reaching a close consensus between different stakeholder groups in knowledge transfer. The criterion, a certain difference in rankings or above, has also been applied in earlier comparisons to determine where significant priority variances exist (e.g. Table 6.2, Table 7.2 and Table 8.1)

### 9.3.1 CLIENTS & DESIGNERS

As shown in Table 9.1, there are major differences in ranking the relative importance of some design issues (rank variance > 10) between the Client Group and the Designer Group. Based on study of these highlighted issues, it is found that both clients and designers are likely to be more concerned with issues related to their own duties. For instance, clients tend to pay more attention to issues confronted in the construction processes and the operational phase of house occupation, such as 'protect local ecosystem' (related to Eco3 in EcoHomes), 'facilities to recycle household waste' (Mat4), 'energy efficient white goods' (Ene4), 'timber as primary/secondary elements' (Mat2&3) and 'enhance local ecological values' (Eco2) and so on. On the other hand, architects pay more attention to issues arising in the design processes, such as 'natural ventilation', 'room and window design for daylighting' and 'layout for daylighting' (Hea1), 'close to a public transport node' (Tra1) and 'landscape categories' (Eco4) and so on. It is proposed that these kinds of priority variances can be solved in the decision-making processes through effective communication.

As shown in Table 9.2 and Figure 9.1, designers and clients agree on some important drivers that can encourage them to take sustainability principles into account in the decision-making processes. These drivers include 'environmental benefits', 'meet clients'/occupants' requirements' and 'compliance with legislation'. In terms of knowledge transfer, however, it is also found that there are some knowledge gaps on other driving factors. For instance, designers believe that 'enhanced reputation' and 'competitive edge' are important drivers to encourage clients to take sustainability measures into account. In fact, however, clients think 'championing innovation' and 'meet occupants' requirements' are more important for them. This kind of misunderstanding should be well addressed in architectural educational

programmes as it might cause communication to be ineffective in the collaborative design decision-making processes.

**Table 9.1: Difference of the ranks of design issues between the Client Group and the Designer Group**

| Comparison of consultation responses from the Client Group and Designer Group | Clients – ACS | | Designers | | *Rank Variance* | EcoHomes 2006 | | |
|---|---|---|---|---|---|---|---|---|
| | Mean | *Rank* | Mean | *Rank* | | Category | Credits | *Rank* |
| Protect local ecosystem | 2.00 | 1 | 1.04 | 12 | 11 | Eco3 | 1.33 | 23 |
| Energy efficient heating & lighting | 1.83 | 2 | 1.38 | 2 | 0 | Ene1 | 13.75 | 1 |
| High insulation standards | 1.83 | 3 | 1.38 | 5 | 2 | Ene2 | 1.83 | 18 |
| Low-emission fossil fuel boilers | 1.83 | 4 | 1.19 | 8 | 4 | Pol2 | 2.73 | 10 |
| Facilities to recycle household waste | 1.83 | 5 | 0.92 | 19 | 14 | Mat4 | 2.71 | 12 |
| Energy efficient white goods | 1.83 | 6 | 0.85 | 22 | 16 | Ene4 | 1.83 | 19 |
| Accommodation users guide | 1.67 | 7 | 1.12 | 9 | 2 | Man1 | 3.00 | 9 |
| Ecological insulating materials | 1.67 | 8 | 1.08 | 10 | 2 | Pol1 | 0.91 | 28 |
| Accessible amenities | 1.67 | 9 | 1.04 | 11 | 2 | Tra3 | 3.00 | 8 |
| Life-cycle materials | 1.67 | 10 | 0.92 | 18 | 8 | Mat1 | 7.23 | 3 |
| Brownfield sites | 1.67 | 11 | 0.92 | 20 | 9 | Eco1 | 1.33 | 24 |
| Timber as primary/secondary elements | 1.67 | 12 | 0.81 | 23 | 11 | Mat2&3 | 4.06 | 6 |
| Natural ventilation | 1.50 | 13 | 1.42 | 1 | 12 | | | |
| Control for lighting | 1.50 | 14 | 1.19 | 7 | 7 | Ene5&6 | 3.66 | 7 |
| Passive solar design | 1.50 | 15 | 0.96 | 16 | 1 | | | |
| Enhance local ecological values | 1.50 | 16 | 0.65 | 26 | 10 | Eco2 | 1.33 | 25 |
| Room&window design for daylighting | 1.33 | 17 | 1.38 | 3 | 14 | Hea1/2 | 2.63 | 14 |
| Close to a public transport node | 1.33 | 18 | 1.23 | 6 | 12 | Tra1 | 2.00 | 16 |
| Rainwater collection/drainage | 1.33 | 19 | 0.96 | 15 | 4 | Pol3 | 1.82 | 20 |
| Low water use appliances | 1.33 | 20 | 0.92 | 17 | 3 | Wat1 | 8.33 | 2 |
| On-site renewable energy | 1.33 | 21 | 0.73 | 25 | 4 | Pol4 | 2.73 | 11 |
| Facilities to recycle rainwater | 1.17 | 22 | 1.00 | 14 | 8 | Wat2 | 1.67 | 22 |
| Layout for daylighting | 1.00 | 23 | 1.38 | 4 | 19 | Hea1/2 | 2.62 | 15 |
| Sound insulation | 1.00 | 24 | 0.73 | 24 | 0 | Hea2 | 7.00 | 4 |
| Work from home | 0.83 | 25 | 0.35 | 29 | 4 | Tra4 | 1.00 | 26 |
| Landscape categories | 0.33 | 26 | 1.00 | 13 | 13 | Eco4 | 5.33 | 5 |
| Private outdoor space | 0.50 | 27 | 0.85 | 21 | 6 | Hea3 | 1.75 | 21 |
| Secure cycle storage | 0.50 | 28 | 0.58 | 27 | 1 | Tra2 | 2.00 | 17 |
| Natural drying space | 0.33 | 29 | 0.54 | 28 | 1 | Ene3 | 0.92 | 27 |
| High density | 0.00 | 30 | 0.19 | 30 | 0 | Eco5 | 2.67 | 13 |
| | | | | | | | | |
| Major differences (> 10) between the Client Group and the Designer Group on the rank of design issues | | | | | | | | |

**Table 9.2: Comparisons of the top 5 drivers to encourage designers and clients to take sustainability principles into account**

| Comparisons of the top 5 drivers to encourage different stakeholder groups to take sustainability principles into account | Designers | | Clients | | Rank Variance \|D–C\| | D for C | | Rank Variance \|DC–C\| |
|---|---|---|---|---|---|---|---|---|
| | Overall Percentage (%) | *Rank (D)* | Overall Percentage (%) | *Rank (C)* | | Overall Percentage (%) | *Rank (DC)* | |
| Environmental benefits | 19% | 1 | 13% | 1 | 0 | 13% | 1 | 0 |
| Meeting clients' / occupants' requirements | 12% | 2 | 10% | 5 | 3 | 8% | 6 | 1 |
| Compliance with legislation | 11% | 3 | 13% | 2 | 1 | 9% | 5 | 3 |
| Demonstrating best practice | 11% | 4 | 7% | 7 | 3 | 8% | 7 | 0 |
| Reducing waste | 10% | 5 | 7% | 8 | 3 | 8% | 8 | 0 |
| Economic benefits | 8% | 6 | 13% | 3 | 3 | 11% | 3 | 0 |
| Doing the right thing | 7% | 7 | 0% | 11 | 4 | 5% | 11 | 0 |
| Championing innovation | 6% | 8 | 13% | 4 | 4 | 5% | 10 | 3 |
| Competitive edge | 5% | 9 | 7% | 9 | 0 | 10% | 4 | 5 |
| Local authority planning policy | 5% | 10 | 7% | 10 | 0 | 3% | 12 | 2 |
| Enhanced reputation | 3% | 11 | 10% | 6 | 5 | 12% | 2 | 4 |
| Government initiatives | 2% | 12 | 0% | 12 | 0 | 6% | 9 | 3 |
| | | | | | | | | |
| Highlighted as the top 5 drivers to encourage stakeholders to take sustainability principles into account | | | | | | | | |

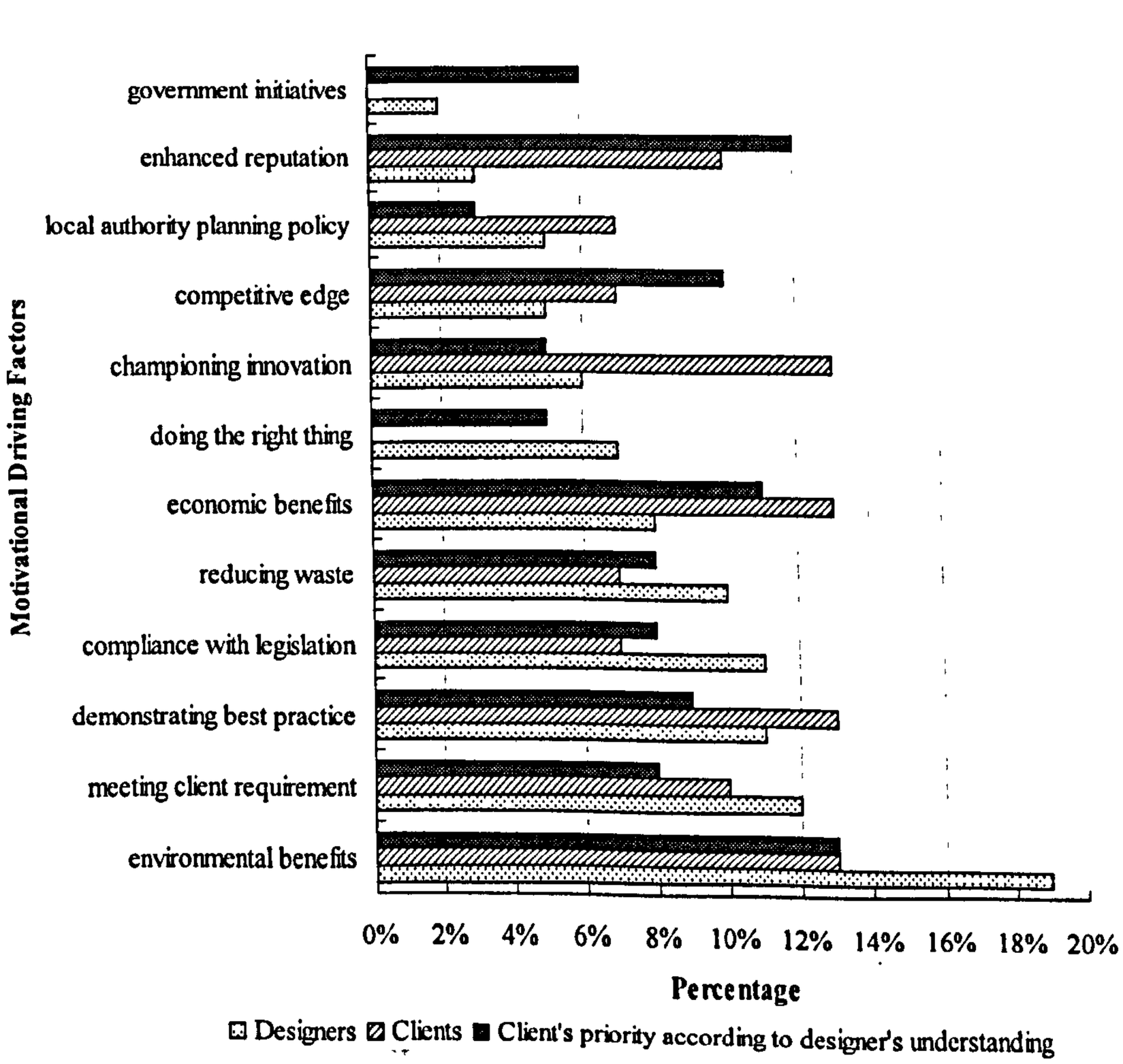


**Figure 9.1: Comparisons of the important drivers to encourage designers and clients to take sustainability principles into account**

Likewise, important barriers for the Designer Group and the Client Group to take sustainability principles into account are also compared. As shown in Table 9.3 and Figure 9.2, designers and clients agree on important barriers that often prevent them from taking sustainability principles into account in the decision-making processes, such as 'affordability or cost', 'time constraints' and 'lack of awareness'. However, differences are also found between these two groups. For designers, it seems that 'lack of interest from clients' and 'construction industry culture' are also important barriers. On the other hand, clients need 'understanding or proof of the business case' and 'information and relevant training'.

Supporting measures that can encourage different stakeholder groups to take sustainability principles into account are also compared. As shown in Table 9.4 and Figure 9.3, both the Designer Group and the Client Group believe that there are three supporting methods that can get the message across effectively in the decision-making processes. They are 'information on exemplar projects and best practice', 'cost and benefits analysis' and 'publicity and promotion of sustainability'. These three issues should be well addressed in future campaigns of education, debate and public participation. On the other hand, it is also important to note the difference between these two groups. For designers, they consider 'training' and 'example specifications' important supporting methods. For clients, 'forums or networks for sharing information' and 'information about funding' seem to be more helpful.

To summarise, it is interesting to note that both clients and designers are more concerned with issues related to their own duties or under their control. The priority differences between the Designer Group and the Client Group show that there is an inherent tension between these two stakeholder groups. Both of them are dependent of each other while, in their own ways, both are also anxious of the other exerting too much control. This corresponds with some early arguments (see Lawson 1997: 88), and it is therefore proposed that these opinion variances can often be solved creatively through an ideal interaction (see 2.5.2).

In the future, variances in different stakeholders' motivational factors, from both positive and negative perspectives, should be further analysed with more data collected from each sub-group. Some findings can be fed back into the decision-making processes and lead to better communication and interaction between different stakeholder groups. Furthermore, discussions related to these variances can also be helpful to incentivise future investment in energy efficiency and low-carbon technologies and to change behaviour, such as regulations, emissions trading and taxation that have been studied in Chapter 2 (see 2.2.2).

**Table 9.3: Comparisons of the top 5 barriers to prevent designers and clients from taking sustainability principles into account**

| Comparisons of the top 5 barriers to prevent different stakeholder groups taking sustainability principles into account | Designers | | Clients | | Rank Variance \|D–C\| |
|---|---|---|---|---|---|
| | Overall Percentage (%) | *Rank* | Overall Percentage (%) | *Rank* | |
| Affordability / cost | 18% | 1 | 18% | 1 | 0 |
| Lack of interest from clients or students | 15% | 2 | 7% | 6 | 4 |
| Time constraints | 9% | 3 | 11% | 3 | 0 |
| Construction industry culture, e.g. inertia, fear of change | 9% | 4 | 0% | 12 | 8 |
| Lack of awareness | 8% | 5 | 11% | 4 | 1 |
| Procurement barriers | 7% | 6 | 4% | 10 | 4 |
| Lack of information and relevant training | 7% | 7 | 11% | 5 | 2 |
| Perceived risk | 6% | 8 | 7% | 7 | 1 |
| Lack of evidence or background information | 6% | 9 | 7% | 8 | 1 |
| Lack of understanding or proof of the business case | 6% | 10 | 14% | 2 | 8 |
| Poor perception of sustainability | 5% | 11 | 7% | 9 | 2 |
| Lack of local availability of services and products | 2% | 12 | 4% | 11 | 1 |
| Lack of requirements from purchasers | 2% | 13 | 0% | 13 | 0 |
| | | | | | |
| Highlighted as the top 5 barriers to take sustainability principles into account | | | | | |

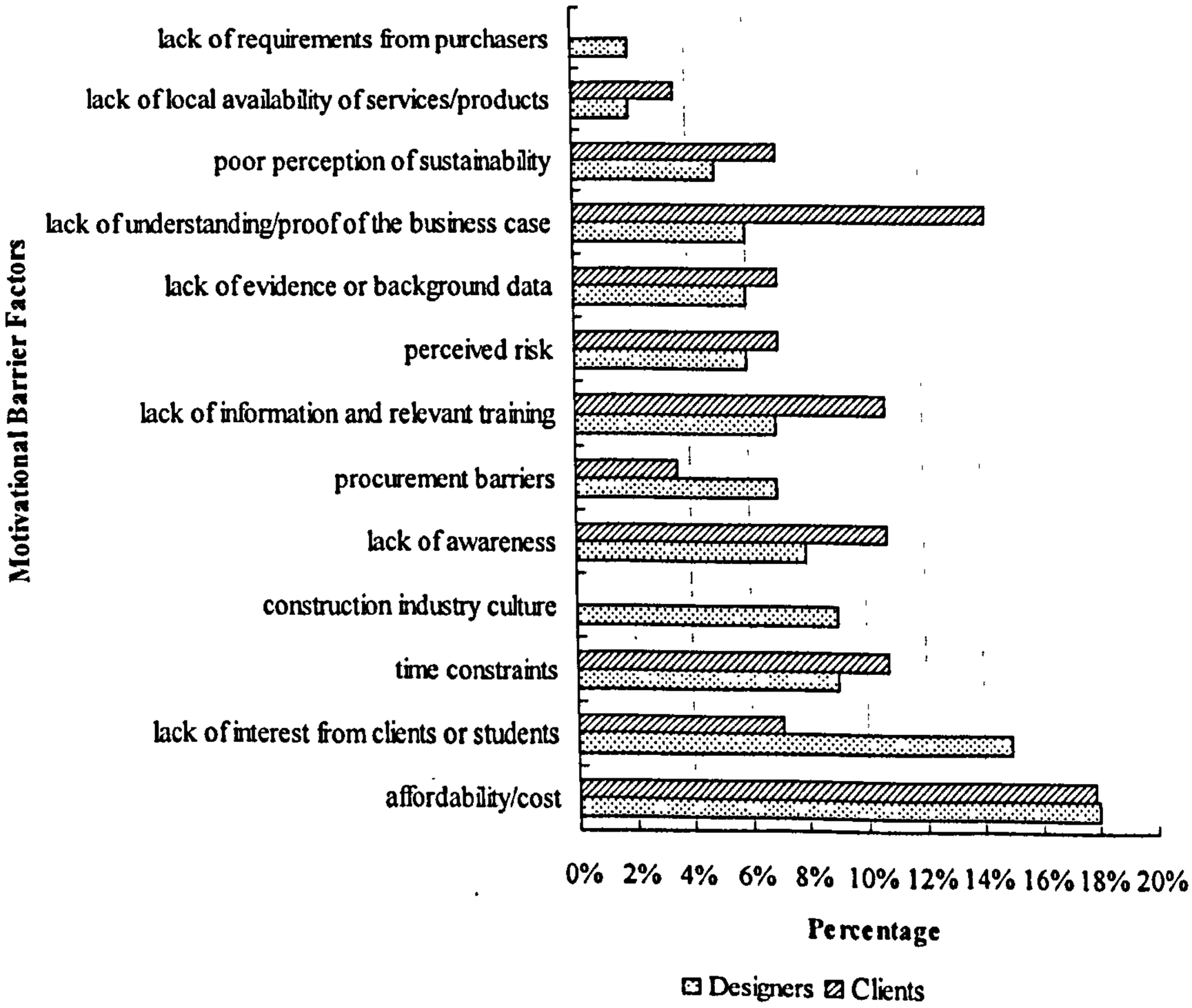


**Figure 9.2: Comparisons of the important barriers to prevent designers and clients from taking sustainability principles into account**

## Table 9.4: Comparisons of the important supporting methods to get the message across

| Comparisons of the top 5 supporting methods to get the message across | Designers | | Clients | | Rank Variance \|D–C\| |
|---|---|---|---|---|---|
| | Overall Percentage (%) | *Rank* | Overall Percentage (%) | *Rank* | |
| Information on exemplar projects and best practice | 15% | 1 | 20% | 1 | 0 |
| Cost and benefits analysis | 14% | 2 | 20% | 2 | 0 |
| Training | 11% | 3 | 7% | 6 | 3 |
| Example specifications | 11% | 4 | 3% | 9 | 5 |
| Publicity/promotion of sustainability | 10% | 5 | 10% | 4 | 1 |
| Directory of suppliers of services and products | 8% | 6 | 7% | 7 | 1 |
| Award/recognition scheme | 7% | 7 | 7% | 8 | 1 |
| Advisory/guidance service | 7% | 8 | 3% | 10 | 2 |
| Information about funding | 6% | 9 | 10% | 5 | 4 |
| Information about the latest suitable R & D | 6% | 10 | 0% | 11 | 1 |
| Forums/networks for sharing information | 5% | 11 | 13% | 3 | 8 |
| | | | | | |
| Highlighted as the top 5 drivers to take sustainability principles into account | | | | | |

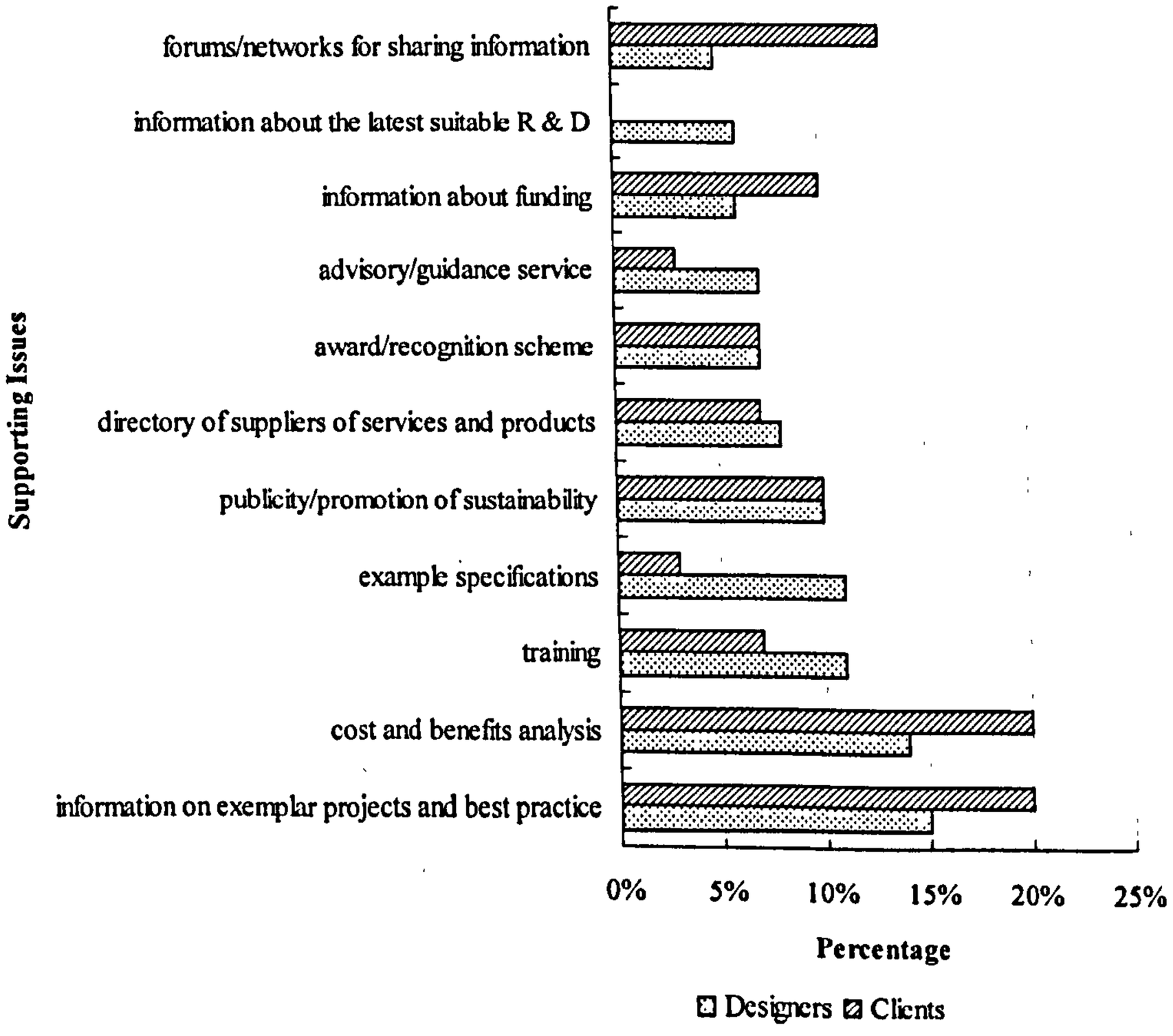


**Figure 9.3: Comparisons of the supporting methods to get the message across**

### 9.3.2 CLIENTS & OCCUPANTS

As shown in Table 9.5, there are also major differences in ranking the relative importance of some housing environmental issues (rank variance > 10) between the Client Group and the Occupant Group. Compared with the priority differences between the Client Group and the Designer Group (see Table 9.1), however, there is a larger degree of consensus and only three major differences are found.

**Table 9.5: Difference of the ranks of living issues between the Client Group and the Occupant Group**

| Comparison of consultation responses from the Client Group and the Occupant Group | Clients – ACS | | Occupants | | Rank Variance | EcoHomes 2006 | | |
|---|---|---|---|---|---|---|---|---|
| | Mean | *Rank* | Mean | *Rank* | | Category | Credits | *Rank* |
| Charges for rent and deposit | 1.83 | 1 | 1.43 | 1 | 0 | | | |
| Study and work from home | 1.50 | 2 | 1.39 | 2 | 0 | Tra4 | 1.00 | 16 |
| Pub or bar | 1.50 | 3 | 0.25 | 18 | 15 | Tra3/4 | 0.75 | 18 |
| Secure area and safe access | 1.00 | 4 | 1.09 | 3 | 1 | Man4 | 2.00 | 11 |
| Natural ventilation | 1.00 | 5 | 1.09 | 4 | 1 | | | |
| Supermarket or late shops | 1.00 | 6 | 0.93 | 6 | 0 | Tra3/4 | 0.75 | 19 |
| Café, takeaway or restaurant | 1.00 | 7 | -0.17 | 23 | 16 | Tra3/4 | 0.75 | 20 |
| User's guide for control systems | 0.67 | 8 | 0.79 | 7 | 1 | Man1 | 3.00 | 7 |
| Sound insulation | 0.67 | 9 | 0.38 | 17 | 8 | Hea2 | 7.00 | 3 |
| Close to a frequent public transport | 0.50 | 10 | 0.52 | 11 | 1 | Tra1 | 2.00 | 12 |
| Natural daylighting in the bedroom | 0.33 | 11 | 1.06 | 5 | 6 | Hea1 | 5.25 | 5 |
| Energy efficient heating and lighting | 0.17 | 12 | 0.54 | 10 | 2 | Ene1,5,6&Pol2 | 20.14 | 1 |
| Other expenditure, like travel expense | 0.17 | 13 | 0.52 | 12 | 1 | | | |
| Facilities for house waste recycling | 0.00 | 14 | 0.40 | 15 | 1 | Mat4 | 2.71 | 10 |
| High insulation standards | -0.17 | 15 | 0.70 | 9 | 6 | Ene2&Pol1 | 2.74 | 8 |
| Drying space for clothes | -0.17 | 16 | 0.40 | 14 | 2 | Ene3 | 0.92 | 17 |
| Gymnasium or sports centre | -0.17 | 17 | -0.23 | 24 | 7 | Tra3/4 | 0.75 | 21 |
| Secure cycle storage | -0.17 | 18 | -0.69 | 25 | 7 | Tra2 | 2.00 | 13 |
| Costs for utilities: electricity/gas/water | -0.33 | 19 | 0.78 | 8 | 11 | Pol4 | 2.73 | 9 |
| Good ecological system and landscape | -0.33 | 20 | 0.42 | 13 | 7 | Eco2&4 | 6.66 | 4 |
| Energy efficient fridge, wash machine | -0.33 | 21 | 0.39 | 16 | 5 | Ene4 | 1.83 | 14 |
| Timber for fitment and furniture | -0.33 | 22 | -0.08 | 21 | 1 | Mat2&3 | 4.06 | 6 |
| Private car parking | -0.33 | 23 | -0.84 | 26 | 3 | | | |
| Private outdoor space | -0.50 | 24 | 0.00 | 19 | 5 | Hea3 | 1.75 | 15 |
| Water-saving toilet | -0.50 | 25 | -0.07 | 20 | 5 | Wat1 | 8.33 | 2 |
| Southern orientation of the bedroom | -0.67 | 26 | -0.09 | 22 | 4 | | | |
| | | | | | | | | |
| Major differences (> 10) between the Client Group and the Occupant Group on the rank of the living issues | | | | | | | | |

It seems that the Client Group (Accommodation and Campus Services) has a good understanding of what student residents need. However, there are some major variances that need to be taken into account in terms of knowledge transfer. More specifically, some local amenities, such as 'pub or bar' and 'café, takeaway or restaurant' (related to Tra3 in EcoHomes), are not considered by student residents as important as they are by clients. On the other hand, students in the target group are more concerned with 'costs for utilities: electricity/gas/water' (Pol4) than clients are.

### 9.3.3 DESIGNERS & OCCUPANTS

To explore the priority variance between the Designer Group and the Occupant Group, it is necessary to use the communication platform, as proposed in Chapter 5 (see Figure 5.23), to link designers' intention and occupants' awareness.

As shown in Table 9.6, it is interesting to see that, although there is often a communication gap between the Designer Group and the Occupant Group in the design processes (see 2.5.2), a certain degree of consensus on the relative importance of housing environmental issues is achieved between these two stakeholder groups. In other words, experienced designers often have a good understanding of what student residents need. Some major differences are found but most of them can be easily interpreted. For instance, difference in the evaluation of 'local amenities' (related to Tra3 in EcoHomes) is led by a fact that different amenities should be addressed in order of relative importance rather than equally. Difference in the evaluation of 'work from home' (Tra4) might be because architects believe that this kind of issues can be solved by student residents (the Occupant Group) or the Accommodation and Campus Services (the Client Group) in the operational phase of accommodation occupation. Difference in the evaluation of 'on-site renewable energy', in contrast, implies an agreement between these two stakeholder groups on practical considerations (capital investigation of on-site renewable energy is often more than normal). However, it is also important to note that experienced architects from the Designer Group regard some issues to be less important, such as provision of 'natural drying space' (Ene3) and improvement of 'local ecological value' (Eco2). This should be taken into account in future knowledge transfer processes.

In previous building designs, many experienced architects have probably already realised the information mismatch between the Designer Group and the Occupant Group. However, they often try to solve this problem by proposing solid solutions based on their own knowledge. The application of the communication platform provides an effective method to get the message across and can therefore help architects better understand what building users need.

**Table 9.6: Difference of the ranks of housing environmental issues between the Designer Group and the Occupant Group**

| Comparison of consultation responses from the Designer Group and Occupant Group | Designers | | | Occupants | | |
|---|---|---|---|---|---|---|
| | Mean | *Rank* | | *Rank* | Mean | |
| Natural ventilation | 1.42 | 1 | | 1 | 1.43 | Charges for rent and deposit |
| Energy efficient heating & lighting | 1.38 | 2 | | 2 | 1.39 | Study and work from home |
| Room&window design for daylighting | 1.38 | 3 | | 3 | 1.09 | Secure area and safe access |
| Layout for daylighting | 1.38 | 4 | | 4 | 1.09 | Natural ventilation |
| High insulation standards | 1.38 | 5 | | 5 | 1.06 | Natural daylighting in the bedroom |
| Close to a public transport node | 1.23 | 6 | | 6 | 0.93 | Supermarket or late shops |
| Control for lighting | 1.19 | 7 | | 7 | 0.79 | User's guide for control systems |
| Low-emission fossil fuel boilers | 1.19 | 8 | | 8 | 0.78 | Costs for utilities: electricity/gas/water |
| Accommodation users guide | 1.12 | 9 | | 9 | 0.70 | High insulation standards |
| Ecological insulating materials | 1.08 | 10 | | 10 | 0.54 | Energy efficient heating and lighting |
| Accessible amenities | 1.04 | 11 | | 11 | 0.52 | Close to a frequent public transport |
| Protect local ecosystem | 1.04 | 12 | | 12 | 0.52 | Other expenditure, like travel expense |
| Landscape categories | 1.00 | 13 | | 13 | 0.42 | Good ecological system and landscape |
| Facilities to recycle rainwater | 1.00 | 14 | | 14 | 0.40 | Drying space for clothes |
| Rainwater collection/drainage | 0.96 | 15 | | 15 | 0.40 | Facilities for house waste recycling |
| Passive solar design | 0.96 | 16 | | 16 | 0.39 | Energy efficient fridge, wash machine |
| Low water use appliances | 0.92 | 17 | | 17 | 0.38 | Sound insulation |
| Life-cycle materials | 0.92 | 18 | | 18 | 0.25 | Pub or bar |
| Facilities to recycle household waste | 0.92 | 19 | | 19 | 0.00 | Private outdoor space |
| Brownfield sites | 0.92 | 20 | | 20 | -0.07 | Water-saving toilet |
| Private outdoor space | 0.85 | 21 | | 21 | -0.08 | Timber for fitment and furniture |
| Energy efficient white goods | 0.85 | 22 | | 22 | -0.09 | Southern orientation of the bedroom |
| Timber as primary/secondary elements | 0.81 | 23 | | 23 | -0.17 | Café, takeaway or restaurant |
| Sound insulation | 0.73 | 24 | | 24 | -0.23 | Gymnasium or sports centre |
| On-site renewable energy | 0.73 | 25 | | 25 | -0.69 | Secure cycle storage |
| Enhance local ecological values | 0.65 | 26 | | 26 | -0.84 | Private car parking |
| Secure cycle storage | 0.58 | 27 | | | | |
| Natural drying space | 0.54 | 28 | | | | |
| Work from home | 0.35 | 29 | | | | |
| High density | 0.19 | 30 | | | | |
| | | | | | | |
| Major differences (> 10) between the Client Group and the Designer Group on the rank of the design issues | | | | | | |

As a follow-up procedure, the *2 Independent Samples* (test) underneath *Nonparametric Tests* is conducted to explore the maximum variance between the Designer Group and the Occupant Group by looking at those issues (design issues and housing environmental issues) corresponding with each other in the two questionnaires. As shown in Table 9.7, it is interesting to see that significant differences ($p < .05$) are found between the Designer Group and the Occupant Group on almost every issue. However, the results do not correspond with the findings in Table 9.6. For instance, based on SPSS output, no significant difference is found on issue related to provision of 'naturally drying space' between these two groups, although the ranks of this issue by these two groups are obviously different (> 10). To a great extent, this further validates the early hypothesis that the rating scores are only relative within each group. Therefore, it is important to study the differences within a proper context. In other words, it is better to make cross comparisons between different stakeholder groups based on the ranks of issues within their own context.

**Table 9.7: Mann-Whitney U test**

| | Mann-Whitney U | Wilcoxon W | Z | Asymnp. Sig. (2-tailed) |
|---|---|---|---|---|
| Public transport | 3403.000 | 112681.000 | -3.999 | .000(**) |
| Drying space | 5739.000 | 115017.000 | -.501 | .617 |
| Work from home | 2204.500 | 2555.500 | -6.041 | .000(**) |
| Sound insulation | 4831.000 | 114109.000 | -1.839 | .066 |
| Private outdoor space | 3391.500 | 112669.500 | -3.966 | .000(**) |
| Secure cycle storage | 2495.000 | 111773.000 | -5.226 | .000(**) |
| Natural ventilation | 4381.000 | 113659.000 | -2.608 | .009(**) |
| Passive solar design | 2675.000 | 111953.000 | -5.026 | .000(**) |
| Waste recycling | 3564.500 | 112842.500 | -3.721 | .000(**) |
| White goods | 4555.000 | 113833.000 | -2.253 | .024(*) |
| Water saving | 3008.500 | 112286.500 | -4.536 | .000(**) |

(*) significant difference at level of $p < .05$
(**) significant difference at level of $p < .01$

The major sources where experienced architects search for information related to sustainable design and student residents search for information related to sustainable living are different. As shown in Table 9.8 and Figure 9.4, designers often search from 'professional or trade body' (23%), while occupants often search from 'general media' (33%). To get the message across effectively, it is important to explore the overlapping information sources between these two stakeholder groups, such as 'professional journal and publication' and 'colleagues, friends and project team members' in terms of information flow. In such way, issues related

to sustainable design and sustainable living can be addressed at the same time. The wide array of information sources should also be acknowledged when developing a new assessment method as they allow the results within different communication formats and in different levels of aggregation to facilitate the information exchange between different stakeholders.

**Table 9.8: Comparison of different information sources**

| Comparisons of different information sources | Designers | | Clients | | Rank Variance \|D–C\| |
|---|---|---|---|---|---|
| | Overall Percentage (%) | *Rank* | Overall Percentage (%) | *Rank* | |
| Professional or trade body | 23% | 1 | 6% | 6 | 5 |
| Professional journal or publication | 22% | 2 | 12% | 3 | 1 |
| Colleagues, friends, project team members | 20% | 3 | 27% | 2 | 1 |
| Government publication | 19% | 4 | 8% | 4 | 0 |
| Research organisations | 14% | 5 | 8% | 5 | 0 |
| General media | 3% | 6 | 33% | 1 | 5 |
| Information booklet from ACS | 0% | 7 | 6% | 7 | 0 |

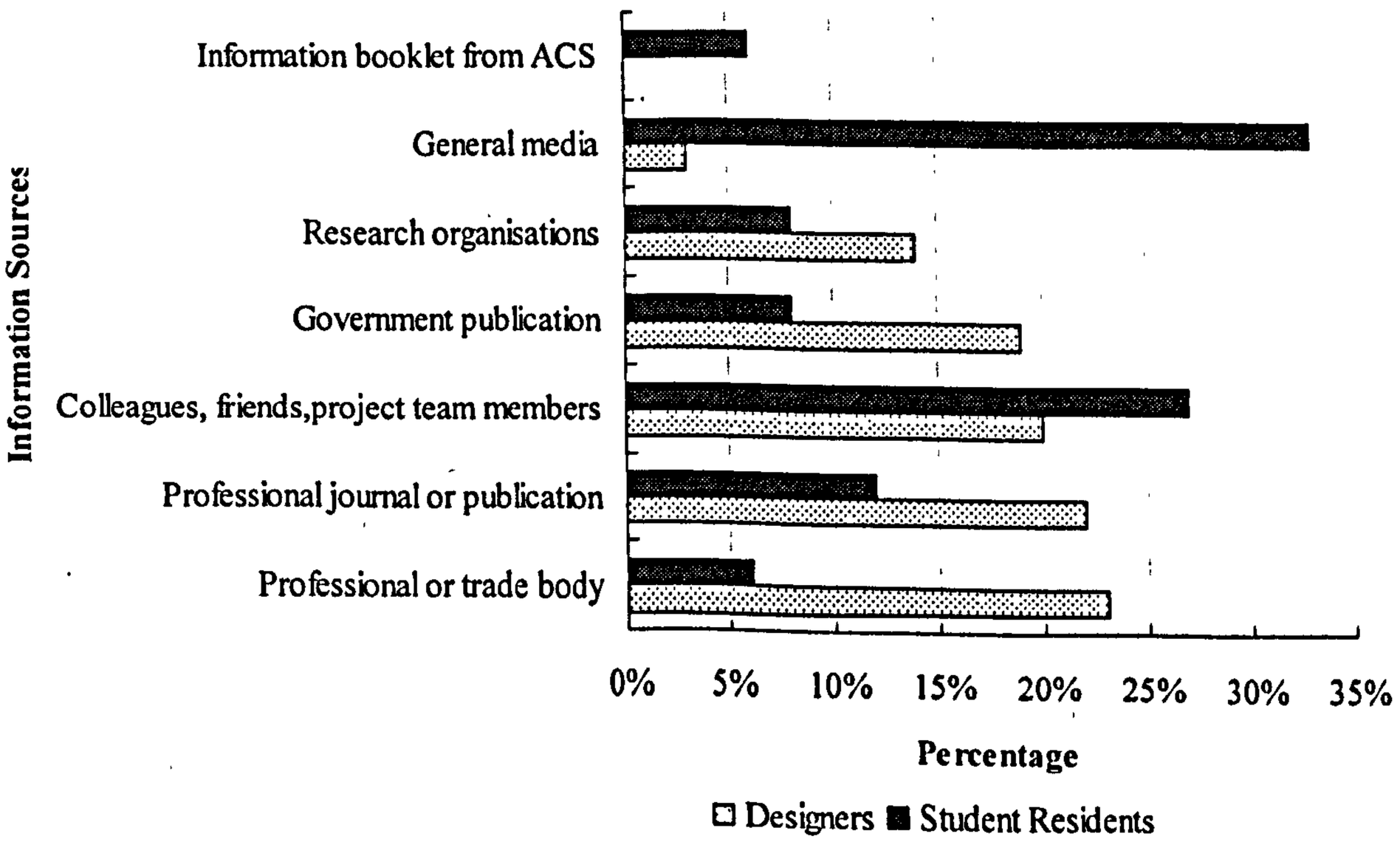


**Figure 9.4: Comparison of different information sources**

### 9.3.4 CROSS COMPARISON: CLIENTS, DESIGNERS, OCCUPANTS & LEGISLATORS

As shown in Figure 9.5, it is found that a complete consensus on the relative importance of the housing environmental issues cannot be achieved between different stakeholder groups, and the degree of variance varies from issue to issue. Further, there is no clear tendency or interrelationship between these variances. This finding corresponds with the earlier argument (Dammann and Elle 2006; cited in 4.7) that **a *complete* consensus across all stakeholders is unlikely to be reached in the near future.**

It is important to note that some housing environmental issues considered important by all focus stakeholder groups (the Occupant Group, the Client Group and the Designer Group), such as 'natural ventilation' and 'passive solar design', are not included in EcoHomes or the Code for Sustainable Homes (the Legislator Group) by now. Based on empirical studies, some probable reasons are provided (also see 4.5.2):

- Natural ventilation is not taken into account by the Legislator Group probably because all housing properties in the UK are mainly designed for winter climate. To reduce energy consumption in cold weather, most houses are designed to be airtight to reduce heat loss.

- Passive solar design is not taken into account probably because solar gain in the operational phase of house occupation is difficult to assess at the design stage and cannot be compared directly.

In the future, it is expected that further work will be carried out in these areas to modify and improve existing housing environmental assessment methods.

Other issues, such as accessibility (e.g. barrier-free access) and building-related illness and so on, are not taken into account in this research as they are either less environment-related or can easily lead to another discussion focused on living standards.

All relevant issues must be well communicated in the procedure of using EcoHomes as a communication platform to support the collaborative design decision-making processes. Further, as argued by Meacham *et al.* (2005: 95), 'much more research and development is needed to understand and characterise better the linkages and how important they are to the overall performance regulatory system (not all linkages are equally important – a sensitivity analysis of the system would help identify where more efforts are needed)'. This will be further explored in Chapter 10 in terms of weighting exercise.

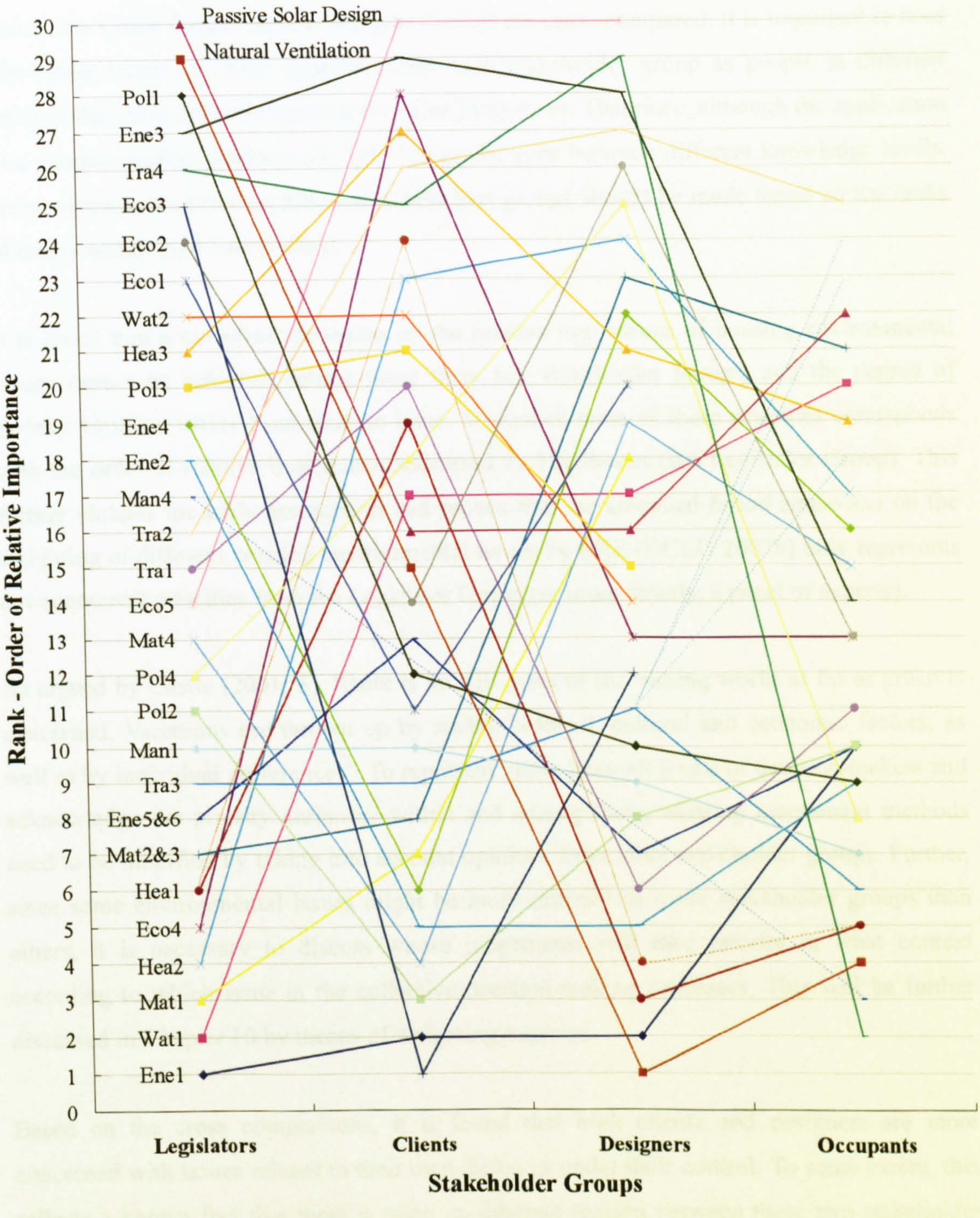


**Figure 9.5: Cross-comparison of the ranks from different stakeholder groups** [lvi]

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[lvi] Clients' opinions on design issues (referring to Table 7.2) are taken into account in this comparison. Since their opinions on housing environmental issues (referring to Table 7.3) were evaluated from a student resident's perspective, the responses were only used to compare with feedback from the Occupant Group (see Table 9.5) and to see whether clients had an understanding of what the student residents needed.

## 9.4 DISCUSSION

In this chapter, consultation responses from different stakeholder groups (the Occupant Group, the Client Group and the Designer Group) are cross-compared. It is important to note that rating scores are only relative within each stakeholder group as people in different groups often have different systems for value judgement. Therefore, although the application of a communication platform can help bridge the gaps between different knowledge levels, cross comparisons between different stakeholder groups should be made based on the ranks of issues within their own context.

It is found that a complete consensus on the relative importance of housing environmental issues cannot be achieved among these three key stakeholder groups, and the degree of priority variance varies from issue to issue. Moreover, none of these priorities corresponds with the order of relative importance addressed by EcoHomes (the Legislator Group). This further violates the early assumption and proves that the so-called *broad consensus* on the weighting of different housing environmental issues by BRE (DCLG 2007b) only represents environmental priorities from the Legislator Group (or more strictly, a panel of experts).

As argued by Castle (2001: 5), 'there is no still point of the turning world as far as green is concerned. Variations are thrown up by social, political, cultural and economic factors, as well as by individual preferences'. To represent views from all levels of decision-makers and acknowledge the priority variances within and among them, existing assessment methods need to be modified by taking into account opinions from other stakeholder groups. Further, since some environmental issues might be more relevant to some stakeholder groups than others, it is necessary to discuss whose judgements will take priority in what context according to which issue in the collective decision-making processes. This will be further discussed in Chapter 10 by means of weighting exercise.

Based on the cross comparisons, it is found that both clients and designers are more concerned with issues related to their own duties or under their control. To some extent, this reflects a known fact that there is often an inherent tension between these two stakeholder groups – both of them are dependent of each other while, in their own ways, both are also anxious of the other exerting too much control (Lawson 1997: 88). As a result, there is a tendency that both clients and designers are longing for being the representative of occupants in the design processes. Actually, it seems that both of them have a general understanding of what occupants need (see Table 9.5 and Table 9.6). However, since both clients and designers have their own standpoints in the decision-making processes, it is very questionable whether they can actually work on behalf of occupants and whether the

knowledge transferred by them would be accurate and in time (also see 2.5.2). In fact, as argued by Kaatz *et al.* (2005: 445), 'typically, these professionals pursue their own agenda during the building process at the expense of other stakeholders'. Therefore, the stakeholder-oriented collaborative approach needs to be addressed cautiously by means of weighting methods, which is steadily becoming a mainstream concern.

Motivational factors, from both positive and negative perspectives, are also explored. It is found that 'environmental benefits', 'meet clients'/occupants' requirements' and 'compliance with legislation' are important drivers that can encourage both clients and designers to take sustainability principles into account in the design processes, while 'affordability or cost', 'time constraints' and 'lack of awareness' are important barriers that often prevent them from doing so. These issues should be further validated in future collaborative studies by means of 'information on exemplar projects and best practice', 'cost and benefits analysis' and 'publicity and promotion of sustainability'. Moreover, in future campaigns of education, debate and public participation, relevant discussions can be helpful to incentivise investment in energy efficiency and low-carbon technologies and to change behaviour, such as regulations, emissions trading and taxation and so on.

It is interesting to note that 'compliance with legislation' is considered an important driver by both the Client Group and the Designer Group. Actually, it is acknowledged that developers (clients) and designers have to comply with compulsory legislations enforced by the local authorities, regardless whether 'compliance with legislation' is a motivational driver or not. However, it is also found that neither of their value systems (the order of relative importance of different housing environmental issues) corresponds with the one used by EcoHomes (the Legislator Group). Moreover, neither the Designer Group nor the Occupant Group searches for relevant information from 'government publication' (which may include EcoHomes, the Code for Sustainable Homes, and the Homes Information Pack and so on).

Obviously, relevant training programmes are necessary to help these key stakeholders increase their familiarity with the systematic consideration of environmental aspects by means of regulations. Nevertheless, it is interesting to note that, although the Client Group admits freely that 'lack of information and relevant training' is an important barrier to prevent them from taking sustainability measures into account, experienced architects in the Designer Group do not agree with this, while they consider 'training' to be an important measure to encourage their practices to take sustainability principles into account. To some extent, therefore, it can be concluded that these experienced architects feel reluctant to accept the fact that they need further training to become *qualified* sustainable housing designers.

This finding corresponds with arguments arising in recent empirical studies (see 2.6.2). Therefore, relevant education and training programmes must be carried out in order to equip architects (and architectural students) with not only sufficient knowledge of sustainability strategies but also intrinsic consciousness of collaborative learning.

## 9.5 CHAPTER SUMMARY

In summary, this chapter illustrates the varied viewpoints, motivations, and conflicting objectives of four key stakeholder groups involved in the sustainable student accommodation design processes. The early assumption, the so-called 'broad consensus on the weighting of different environment impact categories' among all levels of decision-makers by BRE (Howard 1998, cited in Lowe 2006: 406; DCLG 2007b: 13-14), is violated. In order to reflect the variances, a new communication platform is designed to capture the value systems of various stakeholder groups. This will be described in the next chapter.

# CHAPTER 10

# A CODE FOR SUSTAINABLE STUDENT ACCOMMODATION

10

## 10.1 CHAPTER OUTLINE

Based on the discussion in the last chapter, it is argued that current housing environmental assessment methods, such as EcoHomes and the Code for Sustainable Homes, should be modified to show opinions from all levels of decision-makers and acknowledge priority variances within and among them. To achieve this objective, a Code for Sustainable Student Accommodation (CSSA) is proposed based on the framework of EcoHomes. Consultation responses from different stakeholder groups, including the Occupant Group, the Client Group and the Designer Group, are used to inform the weighting system of CSSA. The final result demonstrates an effective method to determine the priority view within and among groups and can therefore be used as a communication platform to steer the collaborative decision-making processes in sustainable student accommodation designs.

## 10.2 A COLLABORATIVE DECISION-MAKING PROCESS

As argued earlier (see 2.3.1), sustainability is an anthropocentric concept which attempts to engage people to re-evaluate everything they do with a broader public purpose in mind and re-appraise their daily lives in a brand new way. Better building performance-in-use, relating to energy saving, carbon reductions and waste recycling in the operational phase of house occupation, can be expected if a close consensus on alternative options is achieved among different stakeholder groups in the design decision-making processes.

In previous chapters (Chapter 6, Chapter 7, Chapter 8 and Chapter 9), consultation responses from different stakeholder groups are collected, analysed and cross-compared. It is important to note that all these studies are based on the criteria of EcoHomes and the potential assumption that the system for value judgement used by EcoHomes can satisfy all levels of decision-makers and therefore be applied to guide other stakeholders to change their attitudes, social values and inspirations towards greater environmental sensitivity.

However, findings from Chapter 9 violate this hypothesis and show that a complete consensus across all stakeholder groups is unlikely to be achieved in the near future. The so-called 'broad consensus on the weighting of different environmental impact categories' among all levels of decision-makers by BRE (Howard 1998, cited in Lowe 2006: 406; DCLG 2007b: 13-14) only represents environmental priorities from the Legislator Group (or more strictly, a panel of experts' subjective weighting decisions[lvii]).

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[lvii] In all, some 60 participants from the expert panels scrutinised the sustainability-related theme (environmental, economic and social), sub-themes and detailed issues establish their meaning. The investigation

| Pie chart key | Organisation Type | Number | % |
|---|---|---|---|
| A | Architects | 10 | 2.3% |
| B | Civil/Structural Engineer | 3 | 0.7% |
| C | Commercial Developers | 2 | 0.5% |
| D | Consultancy | 31 | 7.0% |
| E | House or Property Developer | 9 | 2.0% |
| F | Housing Association (Registered Social Landlords) | 18 | 4.1% |
| G | Other non-governmental organisation | 42 | 9.5% |
| H | Builder/other contractor | 2 | 0.5% |
| I | Local Authority – Building Control | 12 | 2.7% |
| J | Local Authority – Environmental Health | 5 | 1.1% |
| K | Local Authority – Other | 95 | 21.4% |
| L | Manufacturer | 9 | 2.0% |
| M | Trade body or association | 29 | 6.5% |
| N | Private individual (unaffiliated) | 11 | 2.5% |
| O | Professional body or institution | 15 | 3.4% |
| P | Property funder | 1 | 0.2% |
| Q | Research/academic organisation | 7 | 1.6% |
| R | Specific interest or lobby group | 10 | 2.3% |
| S | Individual in practice, trade or profession | 6 | 1.4% |
| T | Insurer | 2 | 0.5% |
| U | Other | 125 | 28.2% |
| | **Total** | **444** | **100.0%** |

**Figure 10.1: Responses by organisation type – with number of respondents from each organisation type** (in the *Summary of Responses to the consultation for the Code for Sustainable Homes*). (DCLG 2006d: 7)

As a result, some key stakeholders, such as housing developers, designers and builders, show little interest to the release of the Code for Sustainable Homes, though they should play a major part in delivering the sustainability objectives of the Code. In *Summary of Responses to the consultation for The Code for Sustainable Homes* (DCLG 2006d), opinions from 'architects', 'commercial developers', 'house or property developers' and 'builders or other

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procedure can be described as *two phases*. 'Firstly, the issues were assessed theme by theme. The participants were asked to "spend" 20 points between all the issues within each theme, giving more points to issues that they considered more important to sustainability. There were more issues than points to force some prioritisation, but the groups were given independence to determine how they should judge their priorities. In a second exercise, participants were asked to score the relative importance of the themes and sub-themes, thus ensuring a test of consistency and enabling evaluation of the overall importance of the themes relative to each other. A high degree of consistency between responses was apparent when comparing the summary results with the detailed results. Overall an objective method was used to collate the expert panels' subjective weighting decisions.' (Dickie and Howard 2000; for further details, please see Dickie and Howard 2000)

contractors', in total, account for only less than 6% of overall responses, as shown in Figure 10.1 (also see Figure 5.1).

Actually, it is interesting to note that, in the consultation described above (see DCLG 2006d), the principal researchers summarise responses from different stakeholder groups as a whole without distinguishing participants according to their knowledge levels and environmental priorities. As argued earlier (see 4.3.5), however, when evaluating building sustainability issues, different stakeholders[lviii] often prefer to address the underlying problems from different dimensions, by different procedures, through different formats and to different extents, taking into account their intrinsically varying incentives. This can lead to a generalisation problem if each participant's view is given an identical weighting factor. More specifically, unless each sub-group (categorised according to stakeholder's knowledge levels and environmental priorities) has the same number of participants, aggregated results from the consultation mainly represent opinions from the stakeholder group with the most participants. In this case, for example, findings from the consultation mainly represent views from the Legislator Group as 'local authorities' and other sub-groups at an equal knowledge level account for more than 25.2% of overall responses.

Although the application of focus groups method can help explore opinion variances among different stakeholder groups and then establish a close consensus across them, misunderstanding or misuse of this research method does not allow findings to be generalised beyond the case. Since this investigation is conducted by the Department for Communities and Local Government (DCLG) based on BRE's earlier work[lvii], it is believed that a similar situation might also apply to the development of the system for value judgement that underpins EcoHomes and the Code for Sustainable Homes comparably (see 4.5.1). More specifically, weightings of different housing environmental issues in EcoHomes or the Code for Sustainable Homes are mainly based on opinions from the Legislator Group and their generalisations are still arguable.

Because some key stakeholders are either not included in the decision-making processes of the Code's weighting system (the Occupant Group) or their opinions are considered less

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[lviii] According to their knowledge levels and environmental priorities, Dammann and Elle (2006: 393) classify legislators, researchers, consultants and assessors as the 'scientific frame', professional clients, administrators and local authorities as the 'public-relations frame', architects and planners as the 'aesthetic-holistic frame', and occupants, residents or non-professional clients who have less detailed knowledge as the 'layperson-sensualist frame'. Likewise, in this research, different stakeholders are classified as the Legislator Group (Chapter 4), the Occupant Group (Chapter 6), the Client Group (Chapter 7) and the Designer Group (Chapter 8).

important (the Client Group and the Designer Group), these stakeholders often feel reluctant to participate in this kind of consultation and show little interest to the release of the new Code (see Table 10.1). Also because of this, designers are likely to see EcoHomes (or other building environmental assessment methods) as a reactive assessment rather than a proactive project appraisal that can support decision-making (see 8.4). Likewise, occupants see it as an incomprehensible expert tool and an untrustworthy challenge (see 4.7).

As argued by Robinson (2004, cited in Kaatz *et al.* 2005: 450),

> 'Arguably, the sustainability of construction initiatives (building projects) can be only achieved through social processes during which expert judgement can be merged with the values, preferences, and beliefs of interested and affected parties.'

Therefore, existing housing environmental assessment methods, such as EcoHomes and the Code for Sustainable Homes, need to be modified by taking into account opinions from other stakeholder groups from a systematic perspective.

At a more practical level, many attempts have been made recently to establish a broad consensus on the weighting of different environmental issues in all levels of decision-makers (Howard 1998, cited in Lowe 2006: 406) and reconcile different expectations of the assessment method among a variety of different cultural viewpoints (Cole and Larsson 2002, cited in Dammann and Elle 2006: 388). However, as found in Chapter 9, a complete consensus across all stakeholder groups is unlikely to be achieved in the near future. Therefore, this research tends to represent opinions from all levels of decision-makers and explore the priority variances within and between them, which have not been fully explored in previous studies. As argued by Guy (2005: 471), 'this emphasis on the participation of stakeholders in the re-balancing of priorities points the way towards an alternative concept of sustainable design'. Furthermore, it is argued that recognition and highlighting of the variations in priorities is actually of more value in the educational function and the achievement of better designs.

The aggregation of different levels of knowledge needs to be carried out in two phases: first, exploring priority variances within each stakeholder group and reaching a close consensus at every knowledge level; second, integrating views from different stakeholder groups into a communication platform by acknowledging priority variances across a variety of different

knowledge levels. The first phase is completed in previous chapters (Chapter 6, Chapter 7 and Chapter 8). This chapter concentrates on the second phase.

## 10.3 FRAMEWORK OF THE COMMUNICATION PLATFORM

As argued in 4.7, EcoHomes has the potential to function as a communication platform in the housing market. This is not only because it comprises all different levels of knowledge aggregation but also because it is formalized based on a common language (see Figure 4.11). This research then designs a communication platform based on the EcoHomes scheme (see Figure 5.23) and tests its effectiveness of getting the message across to different stakeholder groups. Results from previous chapters show that the framework of this communication platform is capable of accommodating the principle of dialogue as a common, consistent and integral part of the decision-making processes. Therefore, it is suggested by the researcher that this framework be comparably used in sustainable student accommodation designs to facilitate knowledge transfer. In terms of collective decision-making, this tool is expected to be used at 'the initial stages of problem definition and analysis, and including the setting of objectives and the consideration of alternative strategies' (Sidaway 2005: 121), such as 'briefing' (including 'inception' and 'feasibility') in RIBA's plan of work[lix] (RIBA *ed.* 1999) or 'initiation' in the evaluative framework of decision-making[lx] (Sidaway 2005: 69-70)

The application of the EcoHomes scheme as the original assessment framework for student accommodation environmental designs is also based on the following considerations:

- First, compared with the BREEAM Multi-Residential, developed by BRE to assess multi-residential homes (including student halls of residence), EcoHomes is more transparent and accessible (see 4.4.1). Furthermore, although BREEAM Multi-Residential tends to cover issues that are important for multi-residential designs, such as 'communal services and the management of communal areas within the building such as catering facilities, lounges, dining rooms, health and leisure areas, offices, meeting rooms and other support areas (e.g. laundries)' (BREEAM 2005), its assessment procedures can vary from case to case because of such integration. As a result, many new student accommodations are likely to be designed

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[lix] RIBA's Plan of Work includes twelve stages: inception, feasibility, outline proposals, scheme design, detail design, production information, bills of quantities, tender action, project planning, operations on site, completion and feedback. (RIBA *ed.* 1999. also see Figure 4.5)

[lx] There are four stages in the evaluative framework of decision-making: initiation, inclusiveness, information and influence (Sidaway 2005: 69-70). Principles of participation can also be collated and summarised under these headings (see ibid: 143)

and assessed under the standard EcoHomes scheme to allow for competitive comparisons and maximum market benefits (examples given by UPP 2008).

- Second, compared with the Code for Sustainable Homes (see Figure 4.2), EcoHomes is more flexible and its framework leaves more room for creative innovation to architects or other decision makers. More specifically, since all issues in EcoHomes are optional, different design strategies can be competitively compared to each other against their related credits, which enables decision-makers to address the most appropriate and beneficial issues for each particular development. By comparing the varying issues separately addressed in these two assessment tools, it is also found that issues addressed in EcoHomes, such as 'public transport' and 'local amenities', are closely related to student residents' everyday lives, while issues addressed in the Code, such as 'lifetime homes' and 'inclusion of composting facilities', are less important to student residents' lifestyles. (also see 4.5.4)

- Third, based on consultation responses from the Occupant Group (see Chapter 6), it is found that university students (out of 467 responses) prefer living in 'private rented properties' (63%) and 'personally or family owned properties' (6%) to 'University or University Partnership properties' (31%). Therefore, it is argued that there is a potential trend that houses, and their environmental assessment methods, should be designed to be more adaptable to allow them to be used for student accommodation if necessary. To a great extent, development of a student accommodation environmental assessment method based on the framework of EcoHomes can be considered a procedure of collaborative learning, where the existing weighting system of EcoHomes is refined by taking into account opinions from other stakeholder groups.

To summarise, the framework of EcoHomes 2006 and its weighing system are considered to be representative of the genuine opinions of the Legislator Group in this research. It can be used to guide student accommodation environmental designs, considering its desirable outcomes, such as integration, transparency and accessibility, and collaborative learning and so on (see Chapter 4 for further details).

## 10.4 THE CODE FOR SUSTAINABLE STUDENT ACCOMMODATION (CSSA)

Although there are some examples given by the University Partnership Programme (2008) in which EcoHomes and the Code for Sustainable Homes are applied to assess the environmental performance of student accommodation, criteria of EcoHomes, or of the Code for Sustainable Homes, are originally designed to assess housing projects. In the construction

sector, there is no criterion that is particularly tailored for sustainable student accommodation designs.

As issues such as energy saving, carbon reductions and waste recycling in the aspect of student accommodation become an important topic (see UPP 2008, Ward *et al.* 2008), there is a need to develop a Code for Sustainable Student Accommodation (CSSA). Rather than attempting to achieve a broad consensus, this new code tends to represent opinions from all levels of decision-makers and explore the priority variances between them. Although opinions from the Legislator Group are important, they should not be taken into account as the *only* ones in the decision-making processes for sustainable student accommodation designs (Robinson 2004: 382). In contrast, in addition to opinions from the Legislator Group, this research takes into account opinions from other important stakeholder groups, such as the Occupant Group, the Client Group and the Designer Group, which have been missed or considered to be less important in previous studies.

Based on the framework of EcoHomes, a code for sustainable student accommodation (CSSA) is proposed. Consultation responses from target stakeholder groups (occupants, clients and designers) are used to inform the existing environmental weightings used in EcoHomes. The hierarchical procedure of CSSA rating calculation is shown in Figure 10.2.

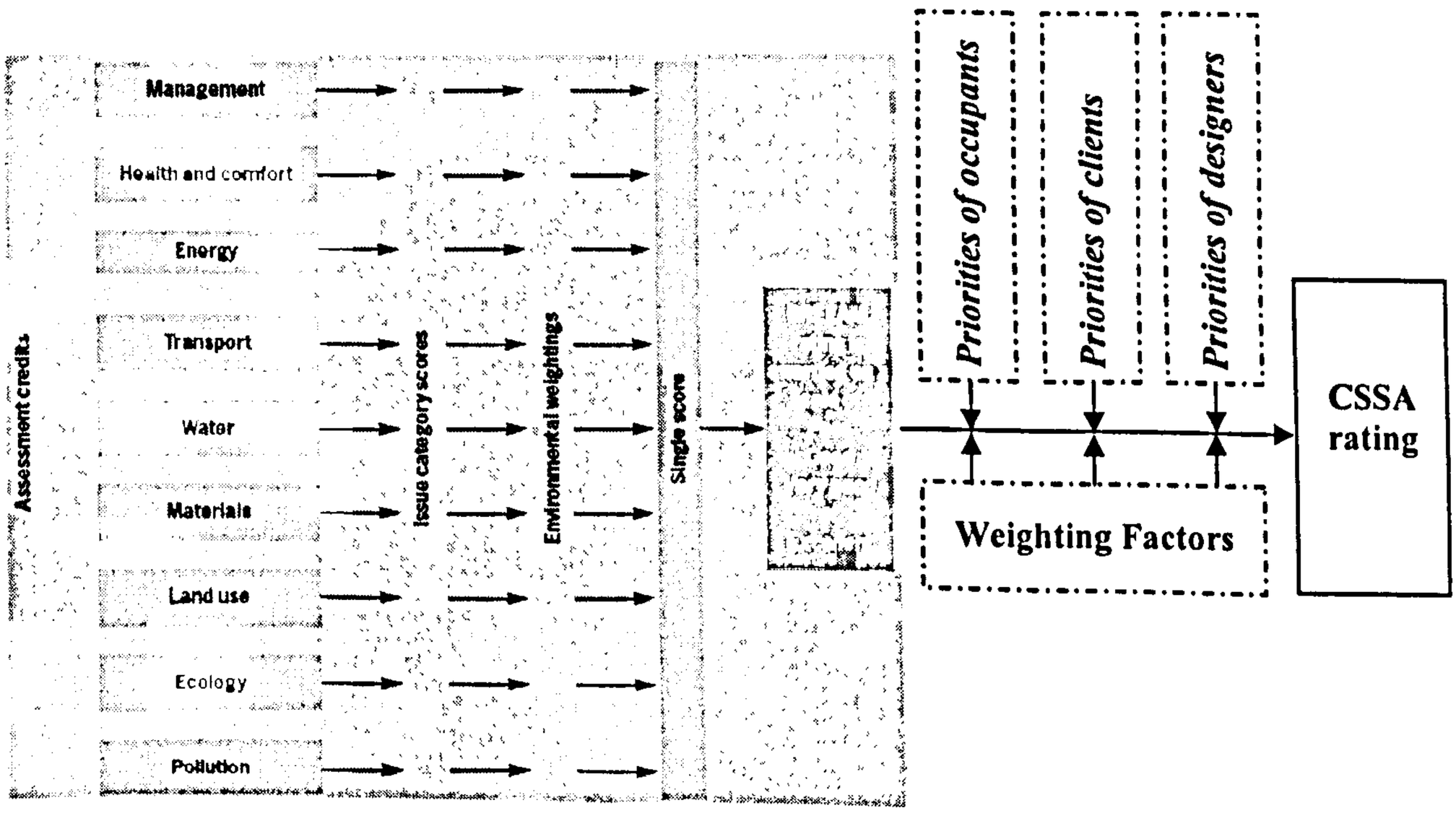


**Figure 10.2: Processes of CSSA weighting exercise** (Picture source: Dickie and Howard 2000: 7)

More specifically, the whole refined procedure of CSSA can be divided into two phases:

- First, consultation responses from the Designer Group (see Table 8.1), the Client Group (see Table 7.2) and the Occupant Group (Table 6.2) are used to modify the existing weighting system of EcoHomes separately, as shown in Table 10.1, Table 10.2 and Table 10.3. The results reflect different stakeholders' viewpoints and value systems by taking into account subjective qualities inherent in sustainable accommodation issues (also see Nelms *et al.* 2007: 239). As argued by Ding (2005: 9), the rationale is that 'from a decision theory point of view, criterion weights must reflect the trade-offs among marginal shifts in the criterion scores'. Therefore, such a process provides people from different stakeholder groups an opportunity to participate in decisions that affect them.

- Second, adjusted credits scores from these three stakeholder groups are fed back into the framework of the Code for Sustainable Student Accommodation (CSSA). As argued in Chapter 9, people from different stakeholder groups often have differing degree of interest or concern in an issue. In terms of collaborative decision-making, a variety of ladders of participation are proposed to position stakeholders to specific design stages at which they might want to contribute to a greater degree than at others (e.g. Arnstein 1969, Wilcox 1994, IAP2 2003; cited in Sidaway 2005: 136). As argued by Sidaway (2005: 136), 'the crucial decisions concern who decides which stakeholders are to be included, at what level of involvement and the techniques that will be used to engage them'. However, in this research, it is argued that, for legitimate purpose, stakeholders from the Designer Group, the Client Group and the Occupant Group should all be included at the initial stages to define and analyse problems, set objectives and consider alternative strategies. The rationale is that

> 'In effect, the decision-making procedure ... makes the outcome legitimate even if someone didn't like the outcome. One of the major functions of public involvement is to create sufficient visibility to the decision-making process so that decisions which result from it are perceived as fair and legitimate. While some of the people most directly impacted by a decision may not be impressed by the equity of the decision, their ability to undermine the credibility of the decision rests on their ability to convince the larger public that the decision was unfairly made.' (Creighton 1978, quoted in Delli Priscoli 1980: 9; cited in Sidaway 2005: 118)

**Table 10.1: Using consultation responses from the Designer Group to modify the existing weighting system**

| Using the consultation responses from the Designer Group to modify the existing weighting system | EcoHomes 2006 | | Designers | | Rating calculation | | |
|---|---|---|---|---|---|---|---|
| | Category | Credits available | Mean values | Credits * Mean | *New Score (NS)* | NS * 91.17 / 364.7578 | *Adjusted credits score* |
| ➢ ***Project Scheme and Management*** | | | | | | | |
| Site choice: prefer to use brownfield sites | Eco1 | 1.33 | 3.92 | → | 5.216 | → | 1.30 |
| Plan to include local amenities | Tra3 | 3.00 | 4.04 | → | 12.12 | → | 3.03 |
| • Supermarket or late shops | | | | | | | |
| • Gymnasium or sports centre | | | | | | | |
| • Pub or bar | | | | | | | |
| • Café, takeaway or restaurant | | | | | | | |
| Protect local ecosystem in construction processes | Eco3 | 1.33 | 4.04 | → | 5.3732 | → | 1.34 |
| ➢ ***Master Plan*** | | | | | | | |
| Enhance local ecological values | Eco2 | 1.33 | 3.65 | → | 4.8545 | → | 1.21 |
| Close to a public transport node | Tra1 | 2.00 | 4.23 | → | 8.46 | → | 2.11 |
| High density | Eco5 | 2.67 | 3.19 | → | 8.5173 | → | 2.13 |
| Site layout for daylighting and view | Hea1/2 | 2.62 | 4.38 | → | 11.4756 | → | 2.87 |
| Decide landscape categories based on typology | Eco4 | 5.33 | 4.00 | → | 21.32 | → | 5.33 |
| ➢ ***Plan / Elevation / Section / Interior Design*** | | | | | | | |
| Room and window design for daylighting | Hea1/2 | 2.63 | 4.38 | → | 11.5194 | → | 2.88 |
| Provision of natural drying space for clothes | Ene3 | 0.92 | 3.54 | → | 3.2568 | → | 0.81 |
| Spaces and services for working from home | Tra4 | 1.00 | 3.35 | → | 3.35 | → | 0.84 |
| High insulation standards | Ene2 | 1.83 | 4.38 | → | 8.0154 | → | 2.00 |
| Ecological insulating materials with low GWP | Pol1 | 0.91 | 4.08 | → | 3.7128 | → | 0.93 |
| Use sustainably sourced timber as main elements | Mat2&3 | 4.06 | 3.81 | → | 15.4686 | → | 3.87 |
| Select materials based on life-cycle rating (LCA) | Mat1 | 7.23 | 3.92 | → | 28.3416 | → | 7.08 |
| Design and testing for sound insulation | Hea2 | 7.00 | 3.73 | → | 26.11 | → | 6.53 |
| Private outdoor space | Hea3 | 1.75 | 3.85 | → | 6.7375 | → | 1.68 |
| Energy efficient external & internal lighting | Ene5&6 | 3.66 | 4.19 | → | 15.3354 | → | 3.83 |
| Secure cycle storage | Tra2 | 2.00 | 3.58 | → | 7.16 | → | 1.79 |
| Natural ventilation | | | 4.42 | | | | |
| Passive solar design | | | 3.96 | | | | |
| ➢ ***Supply and Reuse for Energy and Water*** | | | | | | | |
| On-site renewable energy / green energy supply | Pol4 | 2.73 | 3.73 | → | 10.1829 | → | 2.55 |
| Energy efficient heating & lighting (low DER) | Ene1 | 13.75 | 4.38 | → | 60.225 | → | 15.05 |
| Use low-emission fossil fuel boilers/appliances | Pol2 | 2.73 | 4.19 | → | 11.4387 | → | 2.86 |
| Rainwater collection/sustainable drainage system | Pol3 | 1.82 | 3.96 | → | 7.2072 | → | 1.80 |
| Low water use appliances | Wat1 | 8.33 | 3.92 | → | 32.6536 | → | 8.16 |
| Facilities to recycle rainwater | Wat2 | 1.67 | 4.00 | → | 6.68 | → | 1.67 |
| ➢ ***Other Details in the Operational Phase of Student Accommodation Operation*** | | | | | | | |
| Provision of energy efficient white goods | Ene4 | 1.83 | 3.85 | → | 7.0455 | → | 1.76 |
| Facilities to recycle household waste | Mat4 | 2.71 | 3.92 | → | 10.6232 | → | 2.66 |
| Accommodation users guide | Man1 | 3.00 | 4.12 | → | 12.36 | → | 3.09 |
| | | | | | | | |
| **Overall score in the questionnaires** | | **91.17** | | | **364.7578** | | **91.17** |
| | | | | | | | |
| ➢ ***Issues addressed in EcoHomes 2006 but not included in the questionnaire to the Designer Group*** | | | | | | | |
| Security and safe access | Man4 | 2.00 | | | | | 2.00 |
| Flood risk mitigation | Pol5 | 1.82 | | | | | 1.82 |
| Considerate constructors | Man2 | 2.00 | | | | | 2.00 |
| Construction site impacts | Man3 | 3.00 | | | | | 3.00 |
| | | | | | | | |
| **Overall score in total** | | **100** | | | | | **100** |

**Table 10.2: Using consultation responses from the Client Group to modify the existing weighting system**

| Using the consultation responses from the Client Group to modify the existing weighting system | EcoHomes 2006 | | Clients | | Rating calculation | | |
|---|---|---|---|---|---|---|---|
| | Category | Credits available | Mean values | Credits * Mean | *New Score (NS)* | NS * 91.17 / 397.7153 | *Adjusted credits score* |
| ➢ ***Project Scheme and Management*** | | | | | | | |
| Site choice: prefer to use brownfield sites | Eco1 | 1.33 | 4.67 | → | 6.2111 | → | 1.42 |
| Plan to include local amenities | Tra3 | 3.00 | 4.67 | → | 14.01 | → | 3.21 |
| • Supermarket or late shops | | | | | | | |
| • Gymnasium or sports centre | | | | | | | |
| • Pub or bar | | | | | | | |
| • Café, takeaway or restaurant | | | | | | | |
| Protect local ecosystem in construction processes | Eco3 | 1.33 | 5.00 | → | 6.65 | → | 1.52 |
| ➢ ***Master Plan*** | | | | | | | |
| Enhance local ecological values | Eco2 | 1.33 | 4.50 | → | 5.985 | → | 1.37 |
| Close to a public transport node | Tra1 | 2.00 | 4.33 | → | 8.66 | → | 1.99 |
| High density | Eco5 | 2.67 | 3.00 | → | 8.01 | → | 1.84 |
| Site layout for daylighting and view | Hea1/2 | 2.62 | 4.00 | → | 10.48 | → | 2.40 |
| Decide landscape categories based on typology | Eco4 | 5.33 | 3.33 | → | 17.7489 | → | 4.07 |
| ➢ ***Plan / Elevation / Section / Interior Design*** | | | | | | | |
| Room and window design for daylighting | Hea1/2 | 2.63 | 4.33 | → | 11.3879 | → | 2.61 |
| Provision of natural drying space for clothes | Ene3 | 0.92 | 3.33 | → | 3.0636 | → | 0.70 |
| Spaces and services for working from home | Tra4 | 1.00 | 3.83 | → | 3.83 | → | 0.88 |
| High insulation standards | Ene2 | 1.83 | 4.83 | → | 8.8389 | → | 2.03 |
| Ecological insulating materials with low GWP | Pol1 | 0.91 | 4.67 | → | 4.2497 | → | 0.97 |
| Use sustainably sourced timber as main elements | Mat2&3 | 4.06 | 4.67 | → | 18.9602 | → | 4.35 |
| Select materials based on life-cycle rating (LCA) | Mat1 | 7.23 | 4.67 | → | 33.7641 | → | 7.74 |
| Design and testing for sound insulation | Hea2 | 7.00 | 4.00 | → | 28 | → | 6.42 |
| Private outdoor space | Hea3 | 1.75 | 3.50 | → | 6.125 | → | 1.40 |
| Energy efficient external & internal lighting | Ene5&6 | 3.66 | 4.50 | → | 16.47 | → | 3.78 |
| Secure cycle storage | Tra2 | 2.00 | 3.50 | → | 7 | → | 1.60 |
| Natural ventilation | | | 4.50 | | | | |
| Passive solar design | | | 4.50 | | | | |
| ➢ ***Supply and Reuse for Energy and Water*** | | | | | | | |
| On-site renewable energy / green energy supply | Pol4 | 2.73 | 4.33 | → | 11.8209 | → | 2.71 |
| Energy efficient heating & lighting (low DER) | Ene1 | 13.75 | 4.83 | → | 66.4125 | → | 15.22 |
| Use low-emission fossil fuel boilers/appliances | Pol2 | 2.73 | 4.83 | → | 13.1859 | → | 3.02 |
| Rainwater collection/sustainable drainage system | Pol3 | 1.82 | 4.33 | → | 7.8806 | → | 1.81 |
| Low water use appliances | Wat1 | 8.33 | 4.33 | → | 36.0689 | → | 8.27 |
| Facilities to recycle rainwater | Wat2 | 1.67 | 4.17 | → | 6.9639 | → | 1.60 |
| ➢ ***Other Details in the Operational Phase of Student Accommodation Operation*** | | | | | | | |
| Provision of energy efficient white goods | Ene4 | 1.83 | 4.83 | → | 8.8389 | → | 2.03 |
| Facilities to recycle household waste | Mat4 | 2.71 | 4.83 | → | 13.0893 | → | 3.00 |
| Accommodation users guide | Man1 | 3.00 | 4.67 | → | 14.01 | → | 3.21 |
| | | | | | | | |
| **Overall score in the questionnaires** | | **91.17** | | | **397.7153** | | **91.17** |
| | | | | | | | |
| ➢ ***Issues addressed in EcoHomes 2006 but not included in the questionnaire to the Client Group*** | | | | | | | |
| Security and safe access | Man4 | 2.00 | | | | | 2.00 |
| Flood risk mitigation | Pol5 | 1.82 | | | | | 1.82 |
| Considerate constructors | Man2 | 2.00 | | | | | 2.00 |
| Construction site impacts | Man3 | 3.00 | | | | | 3.00 |
| | | | | | | | |
| **Overall score in total** | | **100** | | | | | **100** |

**Table 10.3: Using consultation responses from the Occupant Group to modify the existing weighting system**

| Using the consultation responses from the Occupant Group to modify the existing weighting system | EcoHomes 2006 | | Occupants | | Rating calculation | | |
|---|---|---|---|---|---|---|---|
| | Category | Credits available | Mean values | Credits * Mean | *New Score (NS)* | NS * 77.12 / 264.748 | *Adjusted credits score* |
| ➢ ***Project Scheme and Management*** | | | | | | | |
| Plan to include local amenities | Tra3 | | | | | | |
| • Supermarket or late shops | | 0.75 | 3.93 | → | 2.9475 | → | 0.86 |
| • Gymnasium or sports centre | | 0.75 | 2.77 | → | 2.0775 | → | 0.61 |
| • Pub or bar | | 0.75 | 3.25 | → | 2.4375 | → | 0.71 |
| • Café, takeaway or restaurant | | 0.75 | 2.83 | → | 2.1225 | → | 0.62 |
| ➢ ***Master Plan*** | | | | | | | |
| Enhance local ecological values | Eco2 | 1.33 | 3.42 | → | 4.5486 | → | 1.32 |
| Close to a public transport node | Tra1 | 2.00 | 3.52 | → | 7.04 | → | 2.05 |
| Site layout for daylighting and view | Hea1/2 | 2.62 | 4.06 | → | 10.6372 | → | 3.10 |
| Decide landscape categories based on typology | Eco4 | 5.33 | 3.42 | → | 18.2286 | → | 5.31 |
| ➢ ***Plan / Elevation / Section / Interior Design*** | | | | | | | |
| Room and window design for daylighting | Hea1/2 | 2.63 | 4.06 | → | 10.6778 | → | 3.11 |
| Provision of natural drying space for clothes | Ene3 | 0.92 | 3.40 | → | 3.128 | → | 0.91 |
| Spaces and services for working from home | Tra4 | 1.00 | 4.39 | → | 4.39 | → | 1.28 |
| High insulation standards | Ene2 | 1.83 | 3.70 | → | 6.771 | → | 1.97 |
| Ecological insulating materials with low GWP | Pol1 | 0.91 | 3.70 | → | 3.367 | → | 0.98 |
| Use sustainably sourced timber as main elements | Mat2&3 | 4.06 | 2.92 | → | 11.8552 | → | 3.45 |
| Design and testing for sound insulation | Hea2 | 7.00 | 3.38 | → | 23.66 | → | 6.89 |
| Private outdoor space | Hea3 | 1.75 | 3.00 | → | 5.25 | → | 1.53 |
| Energy efficient external & internal lighting | Ene5&6 | 3.66 | 3.54 | → | 12.9564 | → | 3.77 |
| Secure cycle storage | Tra2 | 2.00 | 2.31 | → | 4.62 | → | 1.35 |
| Natural ventilation | | | 4.09 | | | | |
| Passive solar design | | | 2.91 | | | | |
| ➢ ***Supply and Reuse for Energy and Water*** | | | | | | | |
| On-site renewable energy / green energy supply | Pol4 | 2.73 | 3.78 | → | 10.3194 | → | 3.01 |
| Energy efficient heating & lighting (low DER) | Ene1 | 13.75 | 3.54 | → | 48.675 | → | 14.18 |
| Use low-emission fossil fuel boilers/appliances | Pol2 | 2.73 | 3.54 | → | 9.6642 | → | 2.82 |
| Low water use appliances | Wat1 | 8.33 | 2.93 | → | 24.4069 | → | 7.11 |
| ➢ ***Other Details in the Operational Phase of Student Accommodation Operation*** | | | | | | | |
| Provision of energy efficient white goods | Ene4 | 1.83 | 3.39 | → | 6.2037 | → | 1.81 |
| Facilities to recycle household waste | Mat4 | 2.71 | 3.40 | → | 9.214 | → | 2.68 |
| Accommodation users guide | Man1 | 3.00 | 3.79 | → | 11.37 | → | 3.31 |
| Security and safe access | Man4 | 2.00 | 4.09 | → | 8.18 | → | 2.38 |
| | | | | | | | |
| **Overall score in the questionnaires** | | **77.12** | | | **264.748** | | **77.12** |
| | | | | | | | |
| ➢ ***Issues addressed in EcoHomes 2006 but not included in the questionnaire to the Occupant Group*** | | | | | | | |
| Site choice: prefer to use brownfield sites | Eco1 | 1.33 | | | | | 1.33 |
| Protect local ecosystem in construction processes | Eco3 | 1.33 | | | | | 1.33 |
| High density | Eco5 | 2.67 | | | | | 2.67 |
| Select materials based on life-cycle rating (LCA) | Mat1 | 7.23 | | | | | 7.23 |
| Rainwater collection/sustainable drainage system | Pol3 | 1.82 | | | | | 1.82 |
| Facilities to recycle rainwater | Wat2 | 1.67 | | | | | 1.67 |
| Flood risk mitigation | Pol5 | 1.82 | | | | | 1.82 |
| Considerate constructors | Man2 | 2.00 | | | | | 2.00 |
| Construction site impacts | Man3 | 3.00 | | | | | 3.00 |
| | | | | | | | |
| **Overall score in total** | | **100** | | | | | **100** |

**Table 10.4: A Communication Platform – the Code for Sustainable Homes**

| Using the consultation responses from the Designer Group (DG), the Client Group (CG) and the Occupant Group (OG) to modify the existing weighting system | EcoHomes 2006 | | Priority Variances | | | | | Creative Design Solutions |
|---|---|---|---|---|---|---|---|---|
| | Category | Default credits available | | Credits score from DG | Credits score from CG | Credits score from OG | | |
| ➢ ***Project Scheme and Management*** | | | | | | | | |
| Site choice: prefer to use brownfield sites | Eco1 | 1.33 | → | 1.30 | 1.42 | | → | |
| Plan to include local amenities | Tra3 | 3.00 | → | 3.03 | 3.21 | | → | |
| • Supermarket or late shops | | | | | | 0.86 | | |
| • Gymnasium or sports centre | | | | | | 0.61 | | ▲ |
| • Pub or bar | | | | | | 0.71 | | ● |
| • Café, takeaway or restaurant | | | | | | 0.62 | | ▲ |
| Protect local ecosystem in construction processes | Eco3 | 1.33 | → | 1.34 | 1.52 | | → | |
| ➢ ***Master Plan*** | | | | | | | | |
| Enhance local ecological values | Eco2 | 1.33 | → | 1.21 | 1.37 | 1.32 | → | ▲ |
| Close to a public transport node | Tra1 | 2.00 | → | 2.11 | 1.99 | 2.05 | → | |
| High density | Eco5 | 2.67 | → | 2.13 | 1.84 | | → | |
| Site layout for daylighting and view | Hea1/2 | 2.62 | → | 2.87 | 2.40 | 3.10 | → | |
| Decide landscape categories based on typology | Eco4 | 5.33 | → | 5.33 | 4.07 | 5.31 | → | |
| ➢ ***Plan / Elevation / Section / Interior Design*** | | | | | | | | |
| Room and window design for daylighting | Hea1/2 | 2.63 | → | 2.88 | 2.61 | 3.11 | → | |
| Provision of natural drying space for clothes | Ene3 | 0.92 | → | 0.81 | 0.70 | 0.91 | → | ▲ |
| Spaces and services for working from home | Tra4 | 1.00 | → | 0.84 | 0.88 | 1.28 | → | ▲ |
| High insulation standards | Ene2 | 1.83 | → | 2.00 | 2.03 | 1.97 | → | |
| Ecological insulating materials with low GWP | Pol1 | 0.91 | → | 0.93 | 0.97 | 0.98 | → | |
| Use sustainably sourced timber as main elements | Mat2&3 | 4.06 | → | 3.87 | 4.35 | 3.45 | → | |
| Select materials based on life-cycle rating (LCA) | Mat1 | 7.23 | → | 7.08 | 7.74 | | → | |
| Design and testing for sound insulation | Hea2 | 7.00 | → | 6.53 | 6.42 | 6.89 | → | |
| Private outdoor space | Hea3 | 1.75 | → | 1.68 | 1.40 | 1.53 | → | |
| Energy efficient external & internal lighting | Ene5&6 | 3.66 | → | 3.83 | 3.78 | 3.77 | → | |
| Secure cycle storage | Tra2 | 2.00 | → | 1.79 | 1.60 | 1.35 | → | |
| Natural ventilation | | | | | | | | |
| Passive solar design | | | | | | | | |
| ➢ ***Supply and Reuse for Energy and Water*** | | | | | | | | |
| On-site renewable energy / green energy supply | Pol4 | 2.73 | → | 2.55 | 2.71 | 3.01 | → | ▲ ● |
| Energy efficient heating & lighting (low DER) | Ene1 | 13.75 | → | 15.05 | 15.22 | 14.18 | → | |
| Use low-emission fossil fuel boilers/appliances | Pol2 | 2.73 | → | 2.86 | 3.02 | 2.82 | → | |
| Rainwater collection/sustainable drainage system | Pol3 | 1.82 | → | 1.80 | 1.81 | | → | |
| Low water use appliances | Wat1 | 8.33 | → | 8.16 | 8.27 | 7.11 | → | |
| Facilities to recycle rainwater | Wat2 | 1.67 | → | 1.67 | 1.60 | | → | |
| ➢ ***Other Details in the Operational Phase of Student Accommodation Operation*** | | | | | | | | |
| Provision of energy efficient white goods | Ene4 | 1.83 | → | 1.76 | 2.03 | 1.81 | → | |
| Facilities to recycle household waste | Mat4 | 2.71 | → | 2.66 | 3.00 | 2.68 | → | |
| Accommodation users guide | Man1 | 3.00 | → | 3.09 | 3.21 | 3.31 | → | |
| Security and safe access | Man4 | 2.00 | → | | | 2.38 | → | |
| | | | | | | | | |
| **Overall score in the questionnaires** | | **93.17** | | | | | | |
| | | | | | | | | |
| ➢ ***Issues addressed in EcoHomes 2006 but not included in the questionnaires*** | | | | | | | | |
| Flood risk mitigation | Pol5 | 1.82 | | | | | | |
| Considerate constructors | Man2 | 2.00 | | | | | | |
| Construction site impacts | Man3 | 3.00 | | | | | | |
| | | | | | | | | |
| **Overall score in total** | | **100** | | | | | | **100** |
| | | | | | | | | |
| Significant priority variances between the Designer Group and the Client Group (ranking difference > 10) | | | | | | | | ■ |
| Significant priority variances between the Designer Group and the Occupant Group (ranking difference > 10) | | | | | | | | ▲ |
| Significant priority variances between the Client Group and the Occupant Group (ranking difference > 10) | | | | | | | | ● |

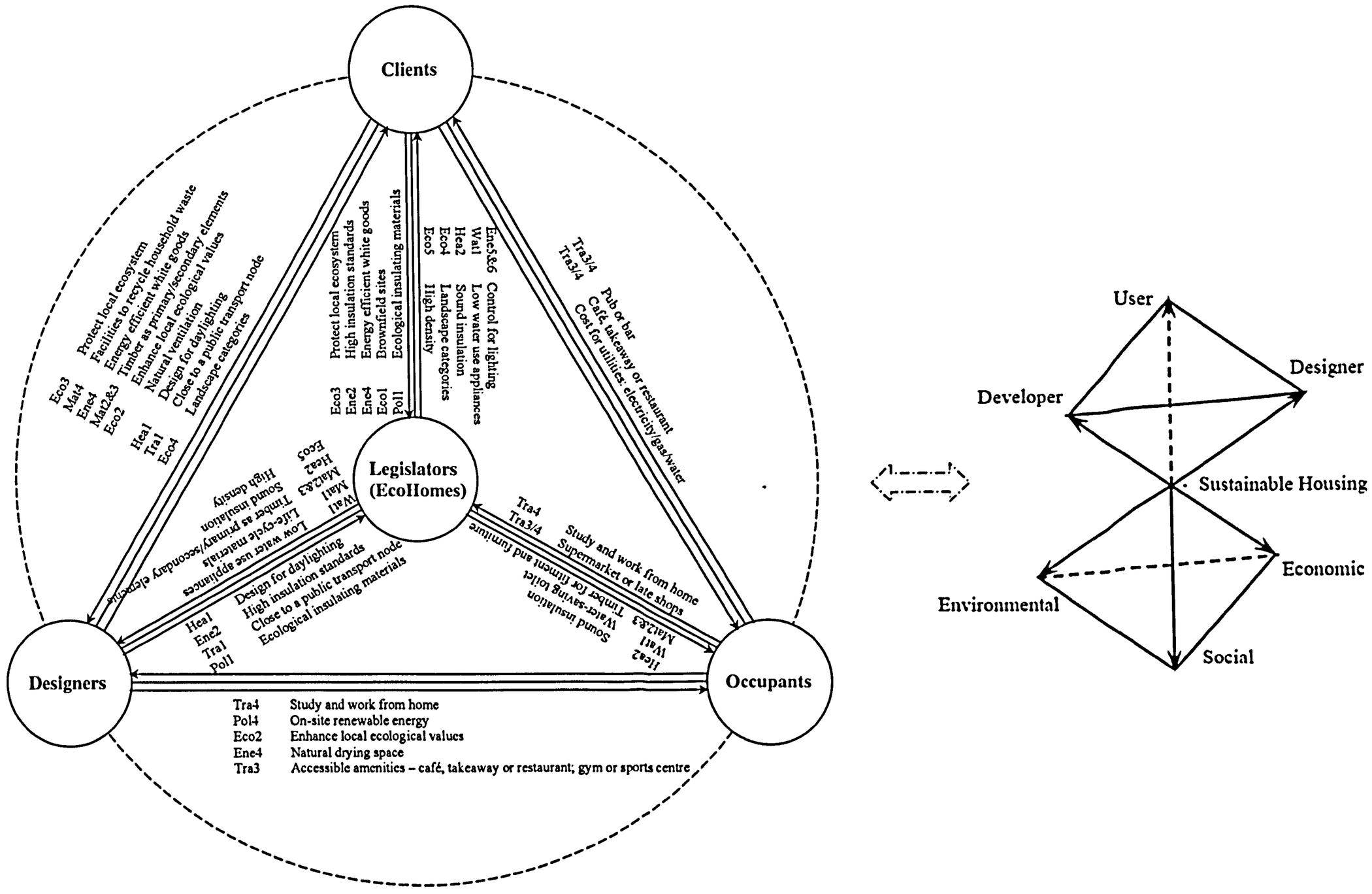


**Figure 10.3: Transparent Graphical Interface to Facilitate Communication between Different Stakeholder Groups**

Significant priority differences (ranking difference > 10) between different stakeholder groups (including findings from Table 6.2, Table 7.2, Table 8.1, Table 9.1, Table 9.5 and Table 9.6) are summarised in this graphical interface. However, it is suggested by the research that this graphical interface should be applied jointly with Figure 9.5 and Table 10.4.

The final multi-criteria framework of the Code for Sustainable Student Accommodation (CSSA) is summarised in Table 10.4 and Figure 10.3. Compared to the format of Table 10.4, which is designed to provide a full picture for process mapping, Figure 10.3 is designed to represent the communication platform in a more graphical way – highlighting issues with significant priority variances between every two stakeholder groups instead of going to detailed data. It is argued that such a format would be perceived as accessible to most designers, clients and occupants (stakeholders often with less specialist knowledge). However, it is suggested by the researcher that this graphical interface (Figure 10.3) should be applied jointly with Figure 9.5 and Table 10.4 to facilitate knowledge transfer.

Rather than providing solid detailed solutions, this output tends to explore the intrinsic problem and help different stakeholders understand the issues lying underneath it. By making the priority variances (priority mismatch between architects' intentions, clients' interests, occupants' awareness and legislators' constraints bearing on housing environmental issues) explicit, this research leaves architects and other decision-makers free space for creative thinking and innovation. In this study, it is argued that conflicts between different stakeholders are not necessarily the problem but parts of the solution. More specifically, the conflicts show potentials for intense cooperation between these stakeholder groups (i.e. designers, occupants, clients and legislators).

To reconcile priorities and resolve conflicts effectively, there is a need to 'get agreement from the disputing parties on a desired model (or process) of decision-making before analysing their problems, thereby legitimizing its use' (Ertel 1991, cited in Sidaway 2005: 66). CSSA is designed for such purpose. To blend stakeholder interests and forge the consensus of opinion needed for a widely accepted rating system, further refining work is needed. Detailed discussions regarding this are beyond this research. However, a potential approach that could facilitate group interaction and decision-making, based on techniques drawn from Delphi Method, is briefly introduced in the following sections.

Although Fischer (1978: 64) argues that 'Delphi is a method of gathering and refining the opinions of *experts* in order to obtain consensus', it is proposed that techniques drawn from such method can be comparably applied in subsequent studies of this research. As points out by Pivo (2008: 23),

> 'Basically, it is structured group interaction that proceeds through "rounds" of opinion collection and feedback. Each round is composed of a written survey followed by feedback to the respondents of the statistical scores for each

> survey question. After each round the respondents are surveyed again to determine whether their opinions have shifted after seeing the statistical results from the prior round(s). As a result of the process there is typically a convergence of opinion. Usually, after three or four rounds the convergence ends and a stabilized group opinion emerges. This group opinion may **reflect agreement, disagreement or some of each.'**

Obviously, besides identifying points of empirical disagreement, the application of such open-end CSSA provides 'a process by which these views can be expressed and evaluated, ultimately as a political act for any given community or jurisdiction' (Robinson 2004: 382). The process enables a trade-off between efficiency and effectiveness to take place in the collaborative decision-making processes, for the purpose of seeking broad participation on ideological grounds or limiting participation for more practical reasons. It is also acknowledged that, in large group processes, it is often not practical to 'reach consensus'; instead one should settle for 'establishing priorities by voting or reaching tacit agreement by informed consent' (Sidaway 2005: 136). Therefore, corresponding with the definition of consensus in 1.6, it is argued that, although 'consensus is a noble ideal', one should be prepared to 'settle for informed, visible, majority public acceptance and support' (Connor 1997: 24), which is at a more practical level.

Although the weighting exercise is different from the one described in BRE's earlier work[lvii], it is believed that this method is effective in impartially determining the priority view within and between groups. Furthermore, considering the time constraints, this method is more suitable for a PhD independent research project. Actually, after the procedure is designed, the weighting system of the Code for Sustainable Student Accommodation (CSSA) can be further modified and developed as more data is collected. For instance, once information about 'natural ventilation' and 'passive solar design' from the Legislator Group is available (see 9.3.4), relevant credits can be awarded to the Code for Sustainable Student Accommodation. Details about how to achieve related credits for different design issues can be further discussed in the future by referring to criteria in *EcoHomes Guidance* (BRE 2006b). On the other hand, levels of total score for the final results can be referred to those used in EcoHomes or the Code for Sustainable Homes.

To a great extent, the results, as shown in Table 10.4, provide a cogent insight into the priorities and expectations of different decision takers. In practice, therefore, this bespoke environmental programme for student accommodation designs can be used by policy-makers as an exploratory study to develop meaningful regulations and incentives, by developers as a

guide to understand market behaviour and modify the project brief, by architects as means to evaluate competing parameters, and by student residents as a handbook to improve or determine living qualities, aiming for getting the message across.

Because consultations and information update are always time-dependent, all assessment systems are designed based on reactive manners and retrospectively. To allow CSSA to be used as a proactive project appraisal that can support decision-making rather than a reactive assessment, application of this assessment method should not follow the usual set of procedures as the rate of social, economic or technological changes would soon leave them behind. Furthermore, issues (significant priority differences between different stakeholder groups) arising in the decision-making processes may vary from case to case, and no one assessment system can truly accommodate all competing parameters in the decision-making processes or be applied to all circumstances of building construction. In terms of practice, therefore, it is emphasized by the researcher that CSSA should be used as a communication platform in the collaborative design processes rather than as a fixed benchmark or a compromise between all levels of decision-makers.

Desired outcomes of application of CSSA are to provide a holistic rational process for thinking about multiple decision criteria and to encourage the selection of appropriate sustainable strategies with respect to different stakeholders' values and objectives. From a communication perspective, this communication platform provides a forum where different stakeholders may share their concerns and findings. By getting the message across, therefore, it has the potential to promote dialogue between different stakeholder groups, facilitate appropriate allocation of risk inherent in a range of design measures, identify suitable incentive schema and ultimately help achieve a close consensus on alternative design solutions. Some important principles related to CSSA's application, such as green building or sustainability, mandatory or voluntary, quantitative or qualitative, complex or simple and so on, are discussed in 4.3.

## 10.5 EVALUATION OF THE CSSA

As argued earlier (see 4.2.3), in order to increase the effectiveness of collaborative decision-making, three key themes should be addressed in constructing a successful communication platform: integration, transparency and accessibility, and collaborative learning. These three issues are then applied to evaluate the new CSSA.

***Integration***: As argued earlier (see 4.3.5), when evaluating building sustainability issues, different stakeholders often prefer to address the underlying problems from different dimensions, by different procedures, through different formats and to different extents, taking into account their intrinsically varying incentives. Findings from previous studies also show that stakeholders are more concerned with issues related to their own benefits and duties or under their control (see 9.4). Therefore, it can be argued that, although all issues in the CSSA are designed against a declared set of environmental criteria, different stakeholders may address the underlying problems from different perspectives in the collaborative decision-making processes. More specifically, the Designer Group may pay more attention to design strategies that can achieve the corresponding credits. However, the Client Group may take into account economic issues when addressing these issues, while the Occupant Group may take into account social (equal) issues. As shown in Figure 10.4, the aggregation of different levels of knowledge by integrating opinions from different stakeholder groups can shift building assessment from environmental aspect only to a broader set of environmental, social and economic building-related issues. Compared with other building environmental assessment methods (e.g. CASBEE in Japan, LEED in the US, NABERS in Australia and BREEAM in the UK), CSSA recognizes the interaction of multi-dimensional design issues and the integration of intangible environmental or social criteria with technical and financial measures. However, as argued by Baker (2004, cited in Kaatz *et al.* 2005: 443) there is a need to recognise that 'initially stakeholder perceptions and values may not in themselves be aligned with the principles of sustainable development'. In practice, therefore, it is important to address the dialogue-based learning through participation and its potential for stakeholders to modify their values.

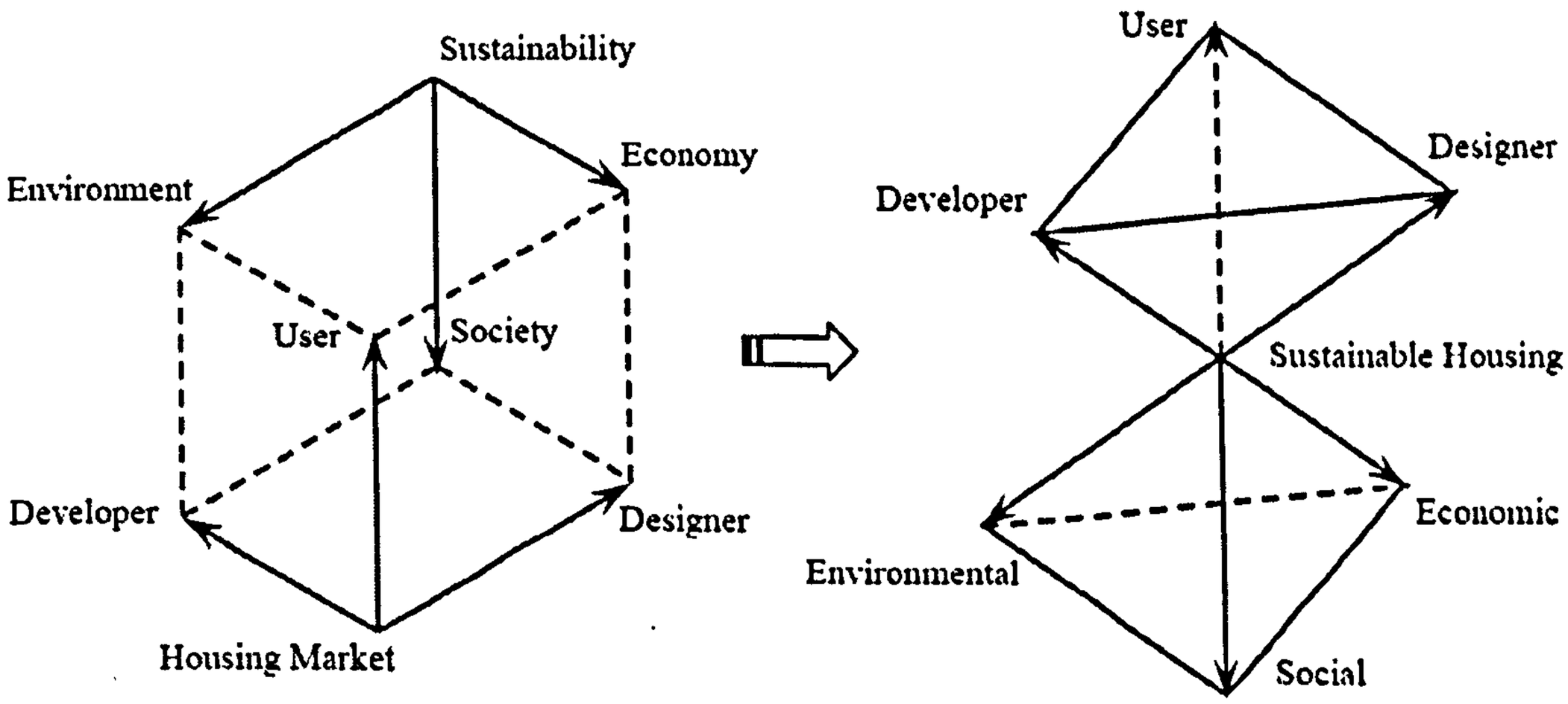


**Figure 10.4: The aggregation of different levels of knowledge** – from environmental issues only to a broader range of sustainability issues

***Transparency and accessibility***: Compared with EcoHomes which is primarily tailored for the Legislator Group or stakeholders at a level with equal knowledge (including legislators, researchers, consultants and assessors and so on), CSSA is more like a communication platform which aims to facilitate knowledge transfer between different stakeholder groups (including the Legislator Group, the Designer Group, the Client Group and the Occupant Group) in the collaborative decision-making processes. Moreover, in CSSA, all competing parameters are re-arranged with regard to issues that mainly occur in different design stages from an architectural outset (see Figure 4.6). Compared with the technical fashion in which issues are structured in EcoHomes, this new mapping procedure (see Figure 4.10) reorganises these issues to be more related to the sequence of decision-making in an architectural project. This graphical interface provides potential opportunities to allow different stakeholders to access information in their own knowledge levels and then make informed decisions.

***Collaborative learning***: Compared with EcoHomes, CSSA pays more attention to educational capacity and related issues, such as 'transfer of knowledge' and 'enhancing commitment and learning' (see 4.2.3). Since all stakeholders are classified according to their knowledge levels and environmental priorities, variances within and between different stakeholder groups can be explored before different levels of knowledge are aggregated. This can help participants from different groups better understand each other. Moreover, through the process of learning from each other and about each other, stakeholders from different groups can educate each other into more genuinely collaborative roles and then re-adjust their intrinsic values and attitudes accordingly. This approach also helps invoke a shift from a collective duty towards individual responsibility among all participants. Differences between EcoHomes scheme and the refined weighting system of CSSA (see Table 10.4) also demonstrate variances between housing design and student accommodation design. The refining process shows how an assessment method can be designed to be flexible to be applied to different circumstances of building construction.

To summarise, the Code for Sustainable Student Accommodation (CSSA) has many advantages in facilitating knowledge transfer in the collaborative decision-making processes. By representing opinions on the weighting of different environmental issues among all levels of decision-makers and acknowledging priority variances within and among them, it is concluded that CSSA is more suitable to guide the sustainable design processes of student accommodation. However, due to time constraints, the effectiveness of this assessment method is not tested in real-life projects. This is left to future work.

## 10.6 CHAPTER SUMMARY

In this chapter, the weighting exercise of EcoHomes is critically reviewed. To represent opinions on different environmental issues among all levels of decision-makers and explore the priority variances within and among them, a Code for Sustainable Student Accommodation is proposed. Method of weighting exercise is specified, in which consultation responses from different stakeholder groups (including the Designer Group, the Client Group and the Occupant Group) are used to inform the framework of EcoHomes (the Legislator Group). This new code (CSSA, see Table 10.4) provides a communication platform for future collaborative decision-making processes for sustainable student accommodation designs. This multi-criteria framework focuses on the sequences and motivations for a range of housing environmental issues in a given decision context and the identification of where stakeholders' objectives align and conflict. Its effectiveness is also evaluated in terms of integration, transparency and accessibility, and collaborative learning. A potential approach to refine and implement CSSA (based on techniques drawn from Delphi Method) is briefed in this chapter.

# CHAPTER 11

# CONCLUSION

## 11.1 CHAPTER OUTLINE

This chapter reviews the research procedure, evaluates the research methodologies, summarises the research findings and makes suggestions for further study. The conceptual framework of this research, constructing a communication platform to get the sustainability message across to different stakeholder groups, is expected to be widely applied in the future.

## 11.2 REVIEW OF THE RESEARCH PROCEDURE

It is widely acknowledged that sustainability principles should be addressed in the housing market to tackle climate change. In this research, particular attention is paid to latent issues related to energy saving and carbon dioxide emissions reductions in the operational phase of house occupation. It is argued that non-professional occupants, often with little specialist knowledge, hold an important role in this study as their awareness of sustainability issues and alternative lifestyle choices will decide how far the campaigns of education, debate, and public participation will progress.

To have a deeper insight into the given phenomenon, university students, especially those studying in relevant disciplines (i.e. Architecture, Landscape, Town and Regional Planning), are selected as the target samples and their lifestyles in the student accommodation are taken as the main research scenario. It is argued that students' experience during the formative years of their adult lives, including lessons learned from both sustainability-related education programmes and sustainably designed living environment, can affect their attitudes and behaviour in later years and instil good citizenship practices.

The multi-strategy research framework can be divided into two major parts. The first part, including Chapter 2, Chapter 3, Chapter 4 and Chapter 5, describes the research context, proposes the research framework and modifies the research methodologies. The idea of constructing a communication platform to facilitate knowledge transfer between different stakeholder groups in collaborative design decision-making processes is explored and some important principles are interpreted. Two sets of questions are designed based on issues addressed in EcoHomes (a prototype of communication platform) to gather responses from stakeholders at different knowledge levels. Then a pilot investigation is carried out within a group of postgraduate architectural students to test and refine the questionnaires. By separately investigating their knowledge of sustainable design issues (considering they are future housing designers) and their awareness of sustainable living issues (considering they are current housing occupants), this pilot study also provides an opportunity to determine

whether these students have been better educated on sustainability issues as the first step to tackling climate change.

The second part, including Chapter 6, Chapter 7, Chapter 8, Chapter 9 and Chapter 10, further explores the priority variances within and between different stakeholder groups. By representing opinions on different environmental issues among all levels of decision-makers and acknowledging the priority variances within and among them, a Code for Sustainable Student Accommodation (CSSA) is developed. As a communication platform, CSSA's framework is developed based on EcoHomes 2006, respecting legislator's and expert's opinions. Opinions from other stakeholder groups, including the Occupant Group, the Client Group and the Designer Group, are taken into account to inform the existing weighting system.

In this research, the principal researcher spends a considerable amount of time and effort collecting and analysing data from different stakeholder groups. Causal explanations are also provided for some issues, though they are mainly in terms of interpretive understanding.

## 11.3 SUMMARY OF THE RESEARCH FINDINGS

In response to research questions arising in 1.3, some important research findings are summarised in the following sections. As argued by Lowe (2006: 412), details of this kind of research are required both to 'support strategic decision-making' and to 'challenge a prevailing climate of opinion'.

- ***The Communication Platform***

Some assessment schemes coexisting in the UK housing market are reviewed and compared. The results (see Table 4.1) can help future decision makers identify the specific features of different assessment schemes, select the most suitable ones and optimise the application according to their relevance.

To avoid the mismatch of information supply and demand, the researcher suggests that it is important to construct a communication platform to explore the priority variances between different stakeholder groups. Two factors are addressed in the process protocol: a common language and a broader collaborative decision-making process. Due to its capability of multi-level knowledge aggregation, the framework of BREEAM EcoHomes (EcoHomes 2006) is suggested to be used as a template to form the communication platform and facilitate knowledge transfer (see Figure 5.23).

As a result, the Code for Sustainable Student Accommodation (CSSA) is developed from a designer's perspective (see Figure 10.2, Table 10.4 and Figure 10.3). Rather than attempting to achieve a broad consensus, it is argued that recognition and highlighting of the variations in priorities is actually of more value in the educational function and the achievement of better designs. A potential approach of using CSSA to facilitate group interaction and decision-making, based on techniques drawn from Delphi Method, is briefly introduced. Besides information from the Legislator Group (referring to EcoHomes scheme), CSSA takes into account opinions from the Occupant Group, the Client Group and the Designer Group, which have not been fully explored or well addressed in previous studies. Compared with conventional assessment methods, it provides a more cogent insight into the priorities and expectations of all levels of decision-makers. Moreover, the aggregation of different levels of knowledge by integrating opinions from different stakeholder groups also provides an opportunity to shift the building assessment from environmental aspect only (such as EcoHomes or the Code for Sustainable Homes) to a broader set of environmental, social and economic building-related issues (such as the CSSA).

However, rather than being applied as a rigid design guideline or a compromise between all levels of decision-makers, the researcher emphasizes that this bespoke environmental programme for student accommodation design should be used as a communication platform in future collaborative decision-making processes. Due to its features of integration, transparency and accessibility, and collaborative learning, CSSA can be used by developers as a guide to modify the project brief, by architects as means to decide between competing parameters, and by student residents as a handbook to improve or determine living qualities. Based on the new method of rating calculation, the weighting system of CSSA can be further refined and developed in the future.

- ***Architectural Education***

To address communication issues in collaborative design decision-making processes, architects' responsibility is re-identified. Architects should abandon the traditional idea that individual designers are dominant in the design processes. Rather, as active facilitators of the design processes, they should have some specialised decision-making skills to offer (multi-dimensional rather than purely technical). This view needs to be addressed in their early education programmes. Specifically, architects (and architectural students) should be equipped with not only sufficient professional knowledge, but also skills to facilitate knowledge transfer and capabilities to educate other stakeholders into more collaborative roles.

To determine whether architectural students have been better educated on such issues as the first step towards tackling climate change, a pilot investigation is carried out within a group of postgraduate architectural students. Due to their dual status as both future housing designers and current housing users, priority-related issues about designers' knowledge of and occupants' awareness of sustainability issues are raised at the same time. It is the first time in a study that architectural students are taken into account as both designers and housing users who contribute to both problems and solutions in tackling climate change.

However, findings are not optimistic. Although these architectural students have a general awareness of sustainability principles, their design protocols or lifestyle choices have had limited impact from it. Their systems for value judgement do not correspond with the one used in EcoHomes (legislators' or experts' constraints). In contrast, they still see EcoHomes (or other building environmental assessment methods) as a reactive assessment rather than a proactive project appraisal. This finding is further validated in a comparative study later (see 6.5.1) which shows that, compared with students from other university departments, students studying in relevant disciplines (including Architecture, Landscape, Town and Regional Planning) have not been educated to have more willingness to change their lifestyles towards greater environmental sensitivity. In summary, the fact that adapting to climate change could involve carbon-intensive actions is frequently overlooked by current architectural education.

Since such problems are probably caused by the separation between design and research in sustainability-related education, they must be envisaged in the future. This researcher argues that architectural students should be trained to understand more about these housing environmental issues even though they are not necessarily going to become EcoHomes assessors or specialists. This is mainly because, although architects can get technical support from experts or specialists in collaborative decision-making processes, they need to have enough knowledge to collaborate with others and intervene at the key decision-points in terms of information flow.

Some suggestions that can help architects increase their familiarity with a systematic consideration of environmental aspects are provided. Specifically, environmental issues addressed in BREEAM EcoHomes are reorganised towards typical design workflows (see Figure 4.6). By comparing the merits of different design options across an agreed set of topics and obtaining a full picture of their relative importance, this new mapping procedure (see Figure 4.10) provides a potential opportunity to allow architects (and architectural students) to convert their decision-making process from a qualitative procedure into a

quantitative one. Based on this graphic interface, architects can undertake analysis of alternative design options consciously.

However, it is important to note that, although the application of EcoHomes can probably provide temporary solutions for the current housing market, it is peoples' awareness of One Planet Living (based on their own Ecological Footprints) that decides how far they want to go to do this in tackling climate change. To achieve the objective of sustainability, therefore, relevant education and training programmes must be carried out in order to equip architects (and architectural students) with not only sufficient knowledge of sustainability strategies but also intrinsic consciousness of collaborative learning and responsible ethics. Worthy debate in this area is important. However, action is imperative.

- ***Priority variances within and between different stakeholder groups***

As a revelatory work, this research provides an opportunity to observe and analyse a phenomenon previously inaccessible to scientific investigation – the existence of priority variances between different stakeholder groups (including the Occupant Group, the Client Group, the Designer Group and the Legislator Group) in the sustainable housing (student accommodation) design processes. It is the first time that opinions from the Occupant Group (stakeholders with little specialist knowledge) are taken into account in sustainable building designs and considered to be important in the weighting exercise.

Based on a communication platform, cross-comparisons in a variety of knowledge levels also become practicable. It is found that the so-called *broad consensus* on the weighting of different housing environmental issues by BRE (DCLG 2007b: 13-14) cannot be achieved among these four key stakeholder groups. The degree of variances varies from issue to issue and there is no clear association between each other (see Figure 9.5). Therefore, it is concluded that, when evaluating building sustainability issues, different stakeholders often prefer to address the underlying problems from different dimensions, by different procedures, through different formats and to different extents, taking into account their intrinsically varying incentives. A complete consensus across all stakeholder groups is unlikely to be achieved in the near future.

To have a deeper insight into this given phenomenon, the Occupant Group (a total of 467 / 43 responses), the Client Group (six successful interviews) and the Designer Group (a total of 26 responses) are investigated separately. Among them, particular attention is paid to the Occupant Group because stakeholders in this group, students from the Faculty of Architecture, are expected to have a positive effect, through changes in their attitudes, social

values and inspirations, over the vast campaigns of education, debate and public participation as the first step towards tackling climate change.

✓ The Occupant Group:

This approach explores the impacts of students' 'education' and 'social group', including factors related to gender, major subject (department), academic year and cultural background (original residence places), on their environmental awareness and social desirability, including their evaluation of EcoHomes housing environmental issues, knowledge of some important living issues and willingness to change their lifestyles towards greater environmental sensitivity.

There are some findings with significant results for students' evaluation of EcoHomes housing environmental issues (see Table 6.13). They can be used to inform related education programmes and design processes of student accommodation. Since a close consensus is achieved on students' evaluation of other issues (those without significant differences), these issues can be evaluated based on samples of relatively smaller sizes in future collaborative design decision-making processes. These issues are 'close to a supermarket or late shops' (related to Tra3 in EcoHomes), 'close to gymnasium or sports centre' (Tra3), 'study and work from home' (Tra4), 'control system for heating and hot water' (Man1), 'facilities for house waste recycling' (Mat4) and 'energy efficient fridge, wash machine' (Ene4). This simplified procedure also helps improve the efficiency of information flow.

It is also found that students' knowledge of some important living issues are much less than expected, though these issues are related to energy saving, carbon reductions and waste recycling in the operational phase of house occupation (see Figure 6.5 and Figure 6.6). This study also shows that the more independently students live, the better understanding of the relevant living issues they have. Education might have a latent effect on their understanding of these living issues while social group (cultural differences in particular) does not have any significant impact on their understanding of these issues. This finding needs to be further validated in the future by comparing the student group with other social groups.

Within the target group, 'education'[lxi] and 'social group' do not have any significant impact on students' willingness to change their lifestyles towards greater environmental sensitivity.

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[lxi] It is important to note that 'education' of different students from this Occupant Group would be considered the same in most surveys (i.e. all surveys in Higher Education sector). In other words, the Occupant Group in this research represents a social group at the Higher Education level.

The generalisation of this study is further validated in a follow-up procedure. Hence all definitive findings can be generalised beyond the confines of the particular context in which the survey is conducted. To a great extent, this study shows that students studying architecture or built environment related disciplines have not been better educated on sustainability issues and it is doubtful whether these poorly informed decision-makers will be able to lead other housing occupants (often with less specialist knowledge) in changing their attitudes and beliefs about lifestyle in future housing designs. By making the problems explicit, this approach provides an insight into the challenges and opportunities for future architectural education and social intervention work. Some findings can also be fed back into the Bayesian Belief Network model proposed by CaRB (see Figure 2.9 and Shipworth 2005). As an exemplifying case, the method for data analysis in this focus group also provides lessons for the likely work in other stakeholder groups.

✓ The Client Group:

This approach explores clients' opinions on sustainable student accommodation designs. Since the Client Group has the opportunity to communicate with both the Designer Group and the Occupant Group in collaborative design decision-making processes, stakeholders in this group should have relevant capabilities to facilitate knowledge transfer.

It is found that some environmental issues in EcoHomes are not considered to be important by the Client Group, both in the accommodation delivering processes and in its later operational phase. These issues, including 'Ene5 External lighting', 'Ene6 Internal lighting', 'Wat1 Internal potable water use' and 'Eco4 Change of ecological value of site' and so on, should be addressed in future collaborative design decision-making processes by getting the related message to the Client Group in particular.

It is also acknowledged by the participants that the objective of sustainability cannot be achieved by efforts from members in the Client Group alone. More specifically, energy saving, carbon reductions and waste recycling require a close collaboration between the Client Group and the Occupant Group in the operational phase of accommodation occupation. Clients believe that there are some effective methods that can encourage student residents to participate in tackling climate change or deliver relevant information, which are 'financial incentive', 'campaign and competition', 'student to student', 'online forums' and 'user's guide'.

✓ The Designer Group:

Since CSSA is designed from an architect's perspective, an approach is provided to explore the opinion variances between experienced architects and postgraduate architectural students. Based on a comparative study, it is found that stakeholders in these two groups share a close consensus on a variety of issues, such as priorities in addressing sustainable building design and using design tools or standards, motivational factors for them to take sustainability measures into account in the design processes, motivational factors that can encourage their clients or practices to take sustainability measures into account in the decision-making processes, and so on.

Although Lawson (1997: 88) argues that the more experience designers have, the more consistently they prefer a strategy of analysis through synthesis, this study finds that this kind of variance is not associated with the designers' understanding of sustainable designs. More specifically, just like what happens to high-level architectural students, although experienced architects have a general awareness of sustainable design tools or standards, it has so far made limited impact on their design protocols. To achieve the objective of sustainable homes (as stated in DCLG 2008b), therefore, relevant architectural education or training programmes must be provided to inform these architects the importance and methods of applying EcoHomes (or other building environmental assessment methods) to support their design decision-making.

- ***Motivational factors and information sources***

To get the message to different stakeholders and encourage them to participate in tackling climate change, this research explores the possible motivational factors and information sources. Based on cross-comparisons, it is found that 'environmental benefits', 'meet clients' or occupants' requirements' and 'compliance with legislation' are important drivers that can encourage both clients and designers to take sustainability principles into account in the design processes, while 'affordability or cost', 'time constraints' and 'lack of awareness' are important barriers that often prevent them from doing so. These issues should be further validated in future collaborative studies by means of 'information on exemplar projects and best practice', 'cost and benefits analysis' and 'publicity and promotion of sustainability'. Moreover, in future campaigns of education, debate and public participation, relevant discussions can be helpful to incentivise investment in energy efficiency and low-carbon technologies and to change behaviour, though the effectiveness of these motivational issues needs to be further validated.

It is interesting to note that 'compliance with legislation' is considered an important driver by both the Client Group and the Designer Group. However, value system from neither group (the order of relative importance of different housing environmental issues) corresponds with the one used by EcoHomes (the Legislator Group). In Addition, neither the Designer Group nor the Occupant Group searches for relevant information from 'government publication' (which may include EcoHomes, the Code for Sustainable Homes, and the Homes Information Pack and so on). Therefore, it is concluded that, since they are either not included in the decision-making processes of EcoHomes weighting system or their opinions are considered to be less important, designers and clients are likely to see EcoHomes (or other building environmental assessment methods) as a reactive assessment rather than a proactive project appraisal that can support decision-making, while occupants see it as an incomprehensible expert tool and an untrustworthy challenge. This finding provides an insight to future development of building environmental assessment methods.

It is also argued in this research that, since the major information sources, separately related to sustainable design (i.e. 'professional or trade body') and sustainable living (i.e. 'general media'), are often different, the wide array of information sources should be acknowledged when developing new assessment methods. The assessment results should be able to be transferred into appropriate communication formats and fit into different levels of aggregation (e.g. energy and building passports, repair and servicing manuals, maintenance plans, the Sellers'/Buyers' Home Energy Report in the Home Information Pack etc.) to facilitate the information exchange between different stakeholders.

***In summary***, this research facilitates knowledge transfer between research and design in the approach of sustainable housing (student accommodation) designs. However, rather than going into further details, all research findings are explored and interpreted to the degree of a designer's knowledge level. Although this is different from the common language as argued earlier (see Figure 4.11), it makes the study more related to design decision-making and reflects the researcher's personal values and experience (a researcher with background in architectural design).

It is important to note that, rather than providing solid detailed solutions, this research tends to explore the intrinsic problem and help different stakeholders understand the issues lying underneath it. By making the cognitive gaps (priority mismatch between architects' intentions, clients' interests, occupants' awareness and legislators' constraints bearing on housing environmental issues) explicit, this research leaves architects and other decision-makers free space for creative thinking and innovation as 'a good design process must

probably be learned rather than taught' (Lawson 1997: 306). As argued by Kaplan and Kaplan (1989: 83, cited in Parnell 2003a: 140), this type of collaborative research 'not only has considerable theoretical interest, it also has the potential to provide the knowledge needed so that more appropriate alternatives can be generated for future uses of the same procedure'.

## 11.4 EVALUATION OF THE RESEARCH METHODOLOGY

The hierarchical research framework is built on the basis of literature review and empirical studies. Since each step of the procurement route has been interpreted explicitly, the research framework can be openly inspected and critically evaluated. The research questions and the relevant contexts are further specified as the research progresses. As a multi-strategy research project, different research methods are introduced in key research stages according to their specific features and desired outcomes. Although the weighting exercise is different from the one described in BRE's earlier work (for details, see Dickie and Howard 2000), it is proved to be effective in impartially determining the priority view within and between stakeholder groups. Furthermore, the framework of this research provides a template for similar studies in this research area. Some important discussions, which are related to motivational factors that can engage people from different stakeholder groups to take sustainability principles into account, also explore the untapped opportunity in social interventions to influence housing development positively towards sustainability in the future.

In terms of data collection and analysis, the principal researcher applies some research methods that have not been fully explored in previous studies. First, a communication platform is constructed to allow for cross-comparisons between different knowledge levels. Since stakeholders from different groups often have different systems for value judgement, their rating scores are only relative within their own context and cross-comparisons between them can only be made in terms of ranks of issues. Second, parametric and non-parametric statistical techniques are viewed as complementary in this research. These two techniques are applied in parallel to explore the maximum variation led by the multiple-indicator (or multiple-item) measures of concepts (for instance, 5-point Likert-type scales in this study) and validate the significant findings. Third, a new method of weighting exercise is designed based on the process view (see Figure 10.2). This new method can impartially determine the priority view within and between groups within time constraints.

It is acknowledged that the researcher's own values (a researcher with background in architectural design) have potential impact on both research design (e.g. proposing the prototype of communication platform and designing questionnaires for different scenarios – see Chapter 5) and interpretations of research findings (e.g. using the results available to inform design decision-making rather than providing in-depth analysis of the causes that lead to such consequences – see Chapter 9 and 10). Certainly people from other backgrounds (e.g. social science, engineering, management, etc.) may come out with different procedures and conclusions.

## 11.5 LIMITATIONS AND FUTURE WORK

As a social research project, this research's findings should be evaluated according to criteria such as reliability, replication and validity and so on (Bryman 2004).

The weighting exercise is inevitably subjective and time-dependent. Values and beliefs that one holds are often considered deeply personal and research participants may feel reluctant to share their thoughts. This can result in research errors related to reliability, especially when interviewees are asked to consider issues from an imaginary perspective. To solve this problem, this project is designed to not contain any private or sensitive questions such as income, age, etc.

This research is designed to be conducted at a single point in time so that opinions from different respondents are comparable. However, exposure to a particular external influence at that time can bias feedback from the participants. Therefore, it would be helpful to confirm the hypothesis and demonstrate that the findings are not an accident or coincidence by replicating the research with different participants (Bailey 1994, cited in Dejesus 2002: 108). Although this is not done strictly in this research, detailed illustrations are provided to minimize external influence and each step of the procurement route is interpreted explicitly to allow for replication in the future. Further, the follow-up investigation in the Occupant Group (a survey carried out outside of the Faculty of Architecture) also provides experience for such work.

Some limitations of this research are due to its generalisation (issues related to validity) created by the use of non-probability sampling methods. People may argue that the whole research can be seen as an exemplifying case study (based on Sheffield student accommodation design), which provides a suitable context for certain research questions to be answered. Nevertheless, because of the hilly terrain of the city, Sheffield does not provide

a suitable circumstance to study every sustainability-related issue. For instance, it is argued that the relative importance some transport-related issues, such as 'close to a public transport node' (related to Tra1 in EcoHomes) and 'secure cycle storage' (Tra2), need to be further verified in a process of generalisation.

However, it is important to note that, within this study, the case is not just an object of interest in its own right and the researcher no longer wants to provide an in-depth elucidation of it, which differs from Bryman's definition of case study (Bryman 2004: 50). In contrast, this research entails a discussion on the basis of theoretical analysis, the quality of which is the central issue of concern. To a great extent, this study provides 'a springboard for further research' and allows 'links to be forged with existing findings in an area' (ibid: 100).

Other limitations related to sampling methods are also specified. Since surveys in the Client Group and the Designer Group are carried out completely based on ethical principles, some members from these two groups feel reluctant to participate. This kind of non-sampling errors[lxii] result in an immediate fact that the means of some issues based on the 5-point measurement are equal and the ranks between them are not precise. Moreover, although the 'snowball' sampling technique (used for data collection from the Client Group) is suggested by Bryman (2004: 334) as 'the only practicable mode of tracing suitable respondents', it is arguable whether such technique, as a kind of purposive sampling method that relies upon the social contacts between individuals to trace additional respondents, can possibly claim to produce a statistically representative sample. On the other hand, although attention is paid to data from the Designer Group, it is important to note that the response rate of this survey is below the acceptable level (50%[lxiii]) and the amount of feedback is fewer than the minimum

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[lxii] 'Non-sampling error: differences between the population and the sample that arise either from deficiencies in the sampling approach, such as an inadequate sampling frame or non-response, or from such problems as poor question wording, poor interviewing, or flawed processing of data.

Non-response: a source of non-sampling error that is particularly likely to happen when individuals are being sampled. It occurs whenever some members of the sample refuse to cooperate, cannot be contacted, or for some reason cannot supply the required data.' (Bryman 2004: 87)

[lxiii] Mangione (1995: 60-1; cited in Bryman 2004: 135) has provided the following classification of bands of response rate to *postal questionnaires*:

Over 85% excellent
70-85% very good
60-70% acceptable
50-60% barely acceptable
Below 50% not acceptable

In a sense, response rates are only like to be an issue with *randomly* selected samples – the lower a response rate, the more questions are likely to be raised about the representativeness of the achieved sample. This is because that the lower the response rate, the more likely it is that sampling bias will affect the subsequent findings.

requirement for statistical analysis (30[lxiv] as outlined in some comparable studies). Since data collection in the Designer Group is no longer under the researcher's supervision, there are some outliers in the aggregated results due to lack of relevant information.

To explore the maximum variation of the given phenomena, therefore, samples of relatively larger sizes or more detailed measurements are required to allow for statistical analysis in the future. Moreover, if possible, further work can be carried out from both a longitudinal perspective (by tracing the same group of stakeholders, e.g. students after graduation) and a comparative perspective (by comparing with other student accommodation designs).

Although the generalisation of some findings needs to be further validated, the researcher concludes that this research contains useful information about the case being examined. The refined research framework can also be widely applied to similar work in this research area in the future. Further work based on findings available in this research is expected. Variances within each stakeholder group should be further explored, carefully verified and regularly updated. Information from other important stakeholder groups in the construction sector, such as the Builder Group, the Manufacturer Group and the Funder Group and so on (see Bakens *et al.* 2005), should also be collected and analysed. Analysis programmes, such as the Delphi method (see Pivo 2008), the Neural Network (see Palaneeswaran *et al.* 2008), the Bayesian Belief Network (see Shipworth 2005), the GAME theory and strategy and so on, should be applied to further formulate and modify the weighting system of the Code for Sustainable Student Accommodation (CSSA). The effectiveness of CSSA should also be tested in real-life projects. Furthermore, based on the method of consensus assessment, likely work is expected to be carried out in a broader scale, the housing market, in the coming future.

**The greatest discovery of any generation is that a human being can alter his life by altering his attitude.**

*– William James*

- End -

[lxiv] In a comparable research, Dejesus (2002: 107) argues that 'around 30 cases seems to be the minimum for studies in which statistical data analysis is to be done, although some techniques can be used with fewer'.

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# APPENDIX 1: FURTHER STATISTICAL ANALYSIS BASED ON CHAPTER 6

This appendix reports the SPSS output from Chapter 6 in detail, focusing on those issues with significant findings in particular.

## APPENDIX 1.1: GROUP FACTORS (QA) * HOUSING ENVIRONMENTAL ISSUES DRAWN FROM ECOHOMES (QC2)

This section explores the priority variation within the target group of students according to their group factors (e.g. gender, major subject, academic year and cultural background).

- ***Gender * QC201-226 – Independent T test***

In Section 6.4.1, the independent t-test (*Independent Samples T test* underneath *Compare Means*) was conducted to compare the means, on the evaluation of the palette of housing environmental issues (from QC201 to QC226), for male and female students in the target group. The aggregated results of the consultations showed that male and female students' opinions were significantly different ($p < .05$) on six environmental issues, which were QC202, QC204, QC206, QC209, QC214 and QC218.

However, as argued by Field (2005: 32 and 294), even though the t-statistic was statistically significant, it did not mean the effect it measured was meaningful or important in practical terms. To discover whether the effect was substantive, it was important to measure the effect sizes. There are many objective ways to do so and the most common of which are Eta squared and Person's correlation coefficient *r* (Field 2005: 32; Pallant 2007: 235). Both of them are based on the similar principles and the results are constrained to lie between 0 (no effect) and 1 (a perfect effect) (Field 2005: 32; Pallant 2007: 235). In this case, Person's correlation coefficient *r* was used to measure the relative magnitude of the differences between means.

Besides the two extremes of the effect sizes, Cohen (1988, 1992; cited in Field 2005: 32) has also made some widely accepted suggestions about what constitutes a large or small effect, according to 'the proportion of variance in the dependent variable that is explained by the independent (group) variable' (Pallant 2007: 235):

- $r = .10$ (small effect): in this case, the effect explains 1% of the total variance
- $r = .30$ (medium effect): the effect accounts for 9% of the total variance
- $r = .50$ (large effect): the effect accounts for 25% of the variance

Since it did not provide effect size statistics for t-tests immediately in the SPSS output, there was a need to convert the *t*-value into the *r*-value according to the following equation (Rosnow & Rosenthal 2005: 328; cited in Field 2005: 32)

$$r = \sqrt{\frac{t^2}{t^2 + df}}$$

Further, since it is often uncertain about whether the population variances are equivalent in the statistic studies, the *Levene's Test for Equality of Variance* was provided by SPSS to test the homogeneity of variances. If the *Sig.* value of Levene's test is bigger than .05 (Sig. > .05), the assumption of equal variances has not been violated and the row in the table labelled *Equal variances assumed* will be used for further analysis. Otherwise, if the assumption of homogeneity of variance is violated (Sig. ≤ .05), data from the row labelled *Equal variances not assumed* will be used.

To understand those consultation results with significant differences ($p < .05$) better, the SPSS outputs from QC202, QC204, QC206, QC209, QC214 and QC218 were reported in the following sections, using mean values ($M$) and standard division ($SD$) for each group:

QC202: On average, the issue related to 'the costs for utilities (electricity / gas / water)' was considered by female students ($M = 3.89$, $SD = 0.81$) to be significantly more important than male students ($M = 3.68$, $SD = 0.86$) in the target group; $t\ (463) = -2.67$, $p < .01$ (2-tailed). However, the relative magnitude of the difference between means was very small and only represented a small size effect ($r = 0.12$).

QC204: On average, the issue related to 'secure area and safe access' was considered by female students ($M = 4.24$, $SD = 0.75$) to be significantly more important than male students ($M = 3.95$, $SD = 0.78$) in the target group; $t\ (465) = -4.07$, $p < .01$ (2-tailed). However, the relative magnitude of the difference between means was very small and only represented a small size effect ($r = 0.19$).

QC206: On average, the issue related to 'close to frequent public transport' was considered by female students ($M = 3.71$, $SD = 0.89$) to be significantly more important than male students ($M = 3.35$, $SD = 0.92$) in the target group; $t\ (465) = -4.31$, $p < .01$ (2-tailed). However, the relative magnitude of the difference between means only represented a small

size effect ($r = 0.20$).

QC209: On average, the issue related to 'close pub or bar' was considered by male students ($M = 3.37$, $SD = 1.05$) to be significantly more important than female students ($M = 3.12$, $SD = 1.04$) in the target group; $t$ (465) = 2.57, $p < .05$ (2-tailed). However, the relative magnitude of the difference between means only represented a small size effect ($r = 0.12$).

QC214: On average, the issue related to 'high insulation standards' was considered by female students ($M = 3.81$, $SD = 0.85$) to be significantly more important than male students ($M = 3.59$, $SD = 0.87$) in the target group; $t$ (465) = -2.79, $p < .01$ (2-tailed). However, the relative magnitude of the difference between means was very small and only represented a small size effect ($r = 0.13$).

QC218: On average, the issue related to 'secure cycle storage' was considered by male students ($M = 2.42$, $SD = 1.23$) to be significantly more important than female students ($M = 2.19$, $SD = 1.13$) in the target group; $t$ (464) = 2.12, $p < .05$ (2-tailed). However, the relative magnitude of the difference between means was very small and only represented a small size effect ($r = 0.10$).

- ***Major Subject (Department) and Academic Year * QC201-226 – Two-way Independent Analysis of Variance (ANOVA)***

In Section 6.4.1, the two-way between-groups analysis of variance (independent ANOVA) was conducted to explore the impact of education, particularly focusing on 'major subject' (department) and 'academic year', on students' evaluation of the palette of housing environmental issues (from QC201 to QC226), as measured by the relative importance on an interval scale.

In SPSS, *Univariate* underneath the *General Linear Model* was used to carry out the factorial ANOVA. The *Descriptive statistics* in the Options was selected to make a general description of the results, together with the *Estimates of effect size*. The *Homogeneity tests* (Levene's test) in the Options was selected to test the assumption that the variances in each sub-group were fairly similar (Field 2005: 403; Pallant 2007: 259). It was expected to achieve a non-significant result (Sig. ≥ .05) in this *Levene's Test for Equality of Error Variance*, which meant the assumption of equal variances had not been violated[i].

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[i] If the assumption of homogeneity of variance was violated (Sig. < .05), it was recommended by Pallant (2007: 261) to set a more stringent significance level ($p < .01$) for evaluating the results, the main effects and

The default setting for Models in SPSS, *Type III sums of squares*, was applied in this unbalanced design as it was invariant to the cell frequencies (Field 2005: 399). A *repeated* contrast was used to break down the main effects and see where the differences between sub-groups lie (Field 2005: 401). Since the sample sizes in each sub-group were unequal and some of them were relatively small, *Bonferroni's* test was conducted to control the Type I error [ii] rate, and *Hochberg's GT2* was used to see the violations of test assumptions in the *post hoc* procedures (Field 2005: 340). It is important to note that, as argued by Pallant (2007: 263), the output of *post-hoc* tests should only be taken into account when there is 'a significant main effect or interaction effect in the overall (omnibus) analysis of variance test'. Further, the *Games-Howell* procedure was run in addition because of the uncertainty of knowing whether the population variances were equivalent (Field 2005: 341).

As argued by Pallant (2007: 242), 'an *F* ratio is calculated, which represents the variance between the groups, divided by the variance within the groups. A large F ratio indicates that there is more variability between the groups (caused by the independent variable) than there is within each group (referred to as the error term)'. In this research, therefore, the *F* ratio from SPSS output was also reported.

ANOVA in SPSS provides the *partial eta squared* as the effect size statistics to indicate 'the proportion of variance of the dependent variable that is explained by the independent variable' (Pallant 2007: 208). Values can range from 0 (no effect) to 1 (a perfect effect). Further, to interpret the strength of the different effect size statistics, Cohen (1988: 22 cited in Pallant 2007: 208) has specified guidelines for *eta squared* to make comparisons between different groups, which can also be used to interpret the strength of *partial eta squared*:

- Eta squared = .01 (small effect): the effect explains 1% of the total variance
- Eta squared = .06 (medium effect): the effect explains 6% of the total variance
- Eta squared = .138 (large effect): the effect accounts for 13.8% of the variance

As argued earlier, students' willingness to live towards greater environmental sensitivity could be reflected from their preferred systems for value judgment in the housing seeking

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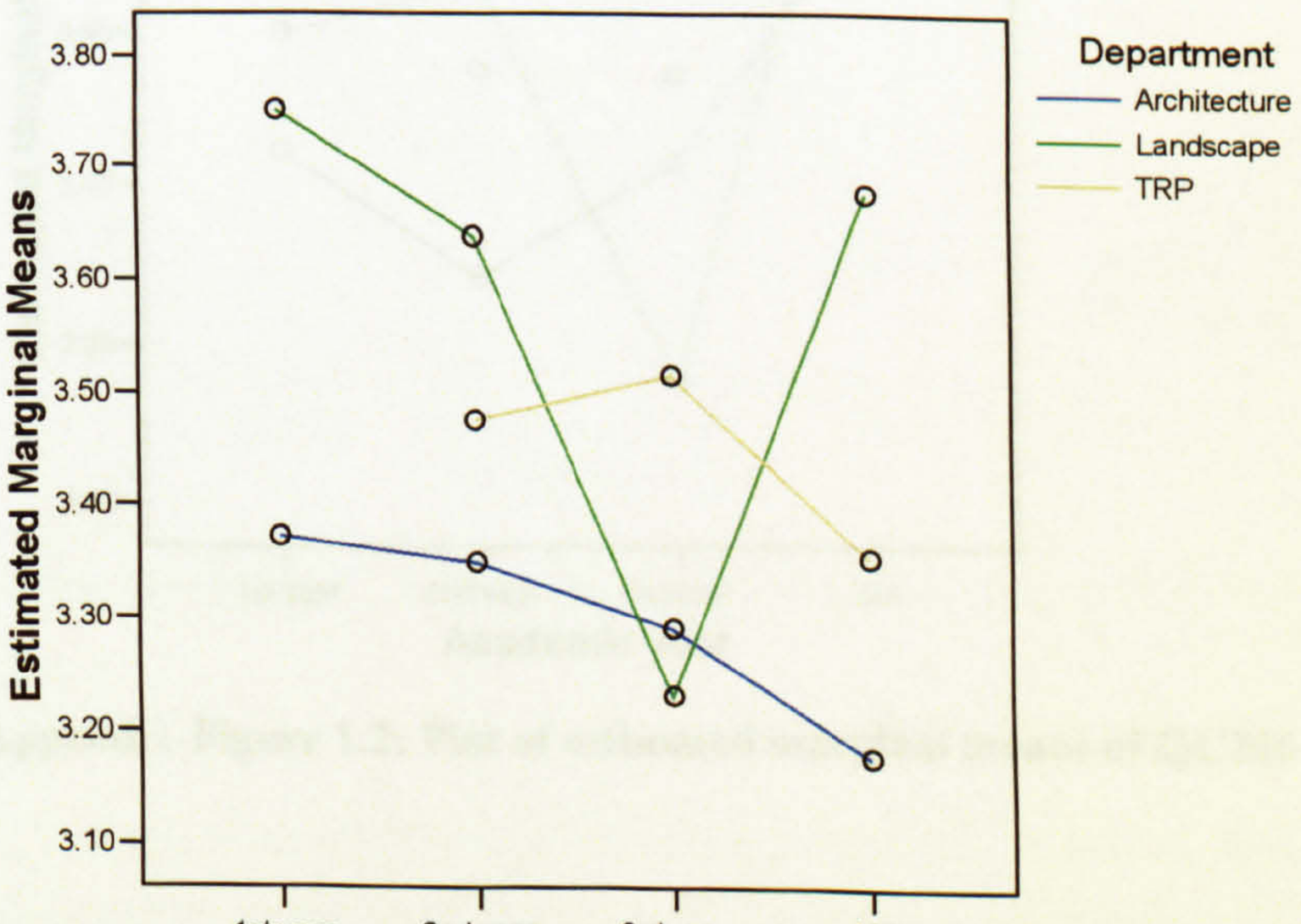
interaction effects, of the two-way ANOVA. ANOVA is reasonably robust to violations of the assumption of homogeneity of variance, provided the sample sizes are equal (Field 2005: 324) or reasonably similar (e.g. largest/smallest = 1.5) (Stevens 1996: 249, cited in Pallant 2007: 204). However, this is clearly not the case here.

[ii] 'A Type I error occurs when we believe that there is a genuine effect in our population, when in fact there isn't. ... The opposite is a Type II error, which occurs when we believe that there is no effect in the population when, in reality, there is.' (Field 2005: 31)

processes. Hence this analysis aimed to explore the interrelationship between current education and students' lifestyle choices. However, it was found that the effects, including both main effects and interaction effects, of independent variables (major subject and academic year) on students' attitudes varied from issue to issue. To understand the variance better, therefore, the statistical analysis procedures are described by issues in the following sections, focusing on those cases with significant differences ($p < .05$) in particular.

QC205: As shown in A-Figure 1.1, it was found that the interaction effect between department and academic year on students' evaluation of the relative importance of QC205 was not statistically significant, $F(5, 456) = .68$, $p = .64$ (> .05). The main effect for students' academic year, $F(3, 456) = .92$, $p = .43$ (> .05), did not reach statistical significance. However, there was a statistically significant main effect for students' department, $F(2, 456) = 3.13$, $p < .05$; although the effect size was small (partial eta squared = .01).

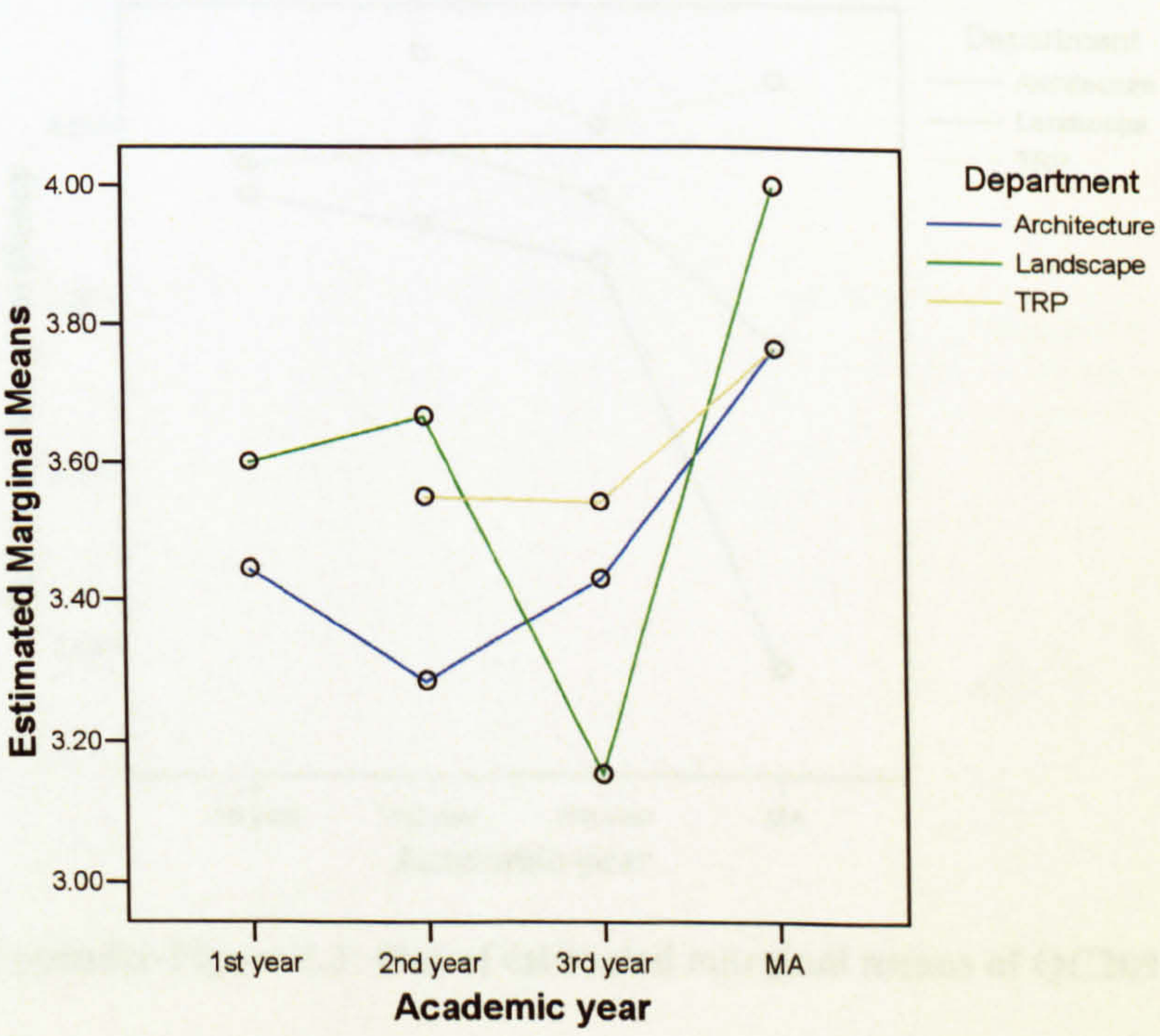
Further, post-hoc comparisons using the Bonferroni and Games-Howell tests indicated that the issue related to 'QC205 friendly surroundings with good ecological system and landscape' was considered by landscape students ($M = 3.62$, $SD = 0.92$) to be significantly more important than architectural students ($M = 3.33$, $SD = 0.82$) in the target group, $p < .05$. While response from TRP (Town and Regional Planning) students ($M = 3.47$, $SD = 0.94$) did not differ significantly from either of the other two groups.




**Appendix-Figure 1.1: Plot of estimated marginal means of QC205**

QC206: As shown in A-Figure 1.2, it was found that the interaction effect between department and academic year on students' evaluation of the relative importance of QC206 was not statistically significant, $F(5, 456) = .91$, $p = .47$ (> .05). The main effect for students' department, $F(2, 456) = .75$, $p = .47$ (> .05), did not reach statistical significance. However, there was a statistically significant main effect for students' academic year, $F(3, 456) = 3.24$, $p < .05$; although the effect size was small (partial eta squared = .02).

Further, post-hoc comparisons using the Bonferroni and Games-Howell tests indicated that the issue related to 'QC206 close to a frequent public transport' was considered by MA students or students at an equal level ($M = 3.89$, $SD = 0.96$) to be significantly more important than undergraduate students from the first year ($M = 3.47$, $SD = 0.83$), from the second year ($M = 3.46$, $SD = 0.91$) and from the third year ($M = 3.43$, $SD = 0.96$) in the target group, $p < .05$. While responses from students in the first year ($M = 3.47$, $SD = 0.83$), in the second year ($M = 3.46$, $SD = 0.91$) and in the third year ($M = 3.43$, $SD = 0.96$) did not differ significantly from each other.

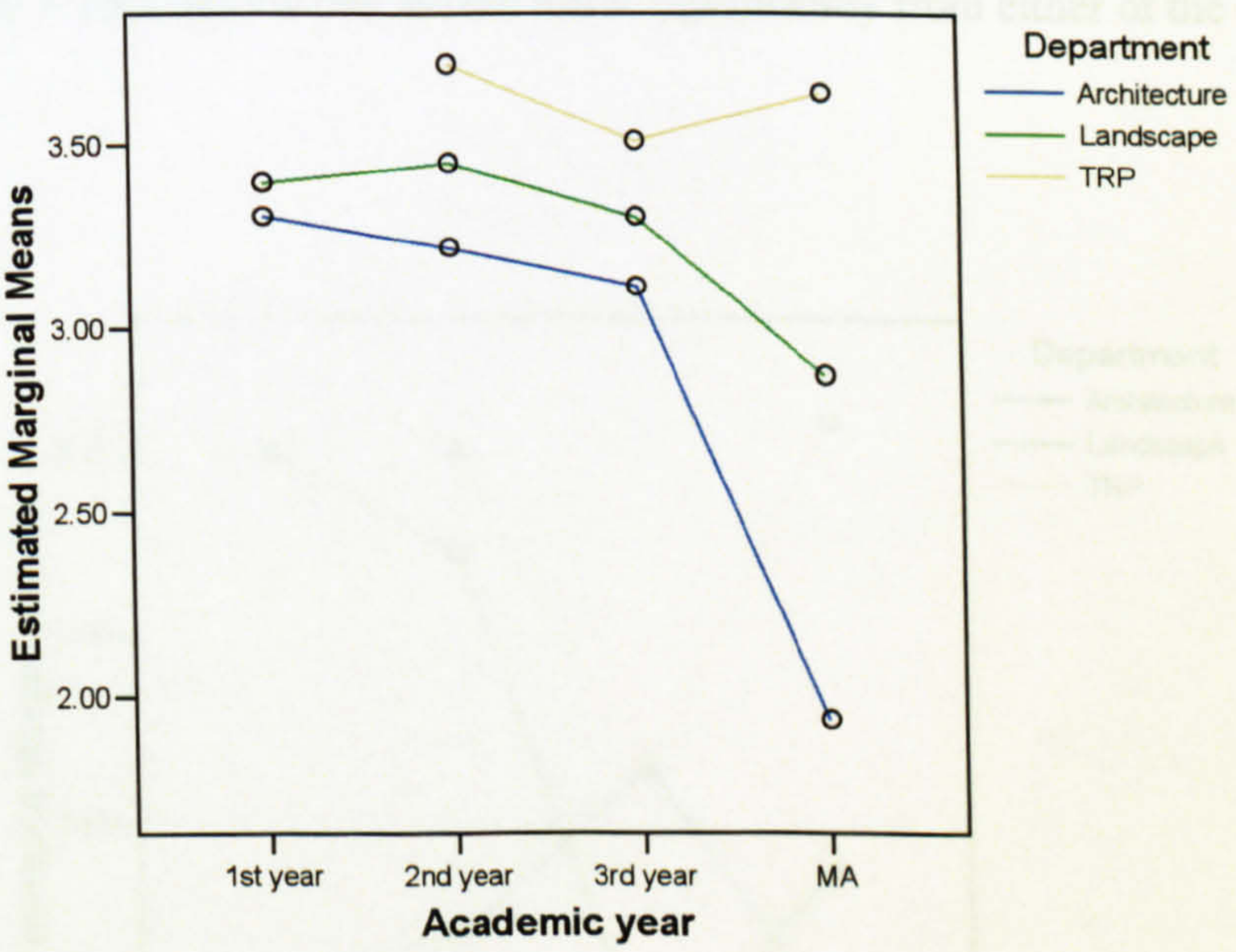



**Appendix-Figure 1.2: Plot of estimated marginal means of QC206**

QC209: As shown in A-Figure 1.3, it was found that the interaction effect between department and academic year on students' evaluation of the relative importance of QC209 was statistically significant, $F(5, 456) = 2.41$, $p < .05$; however, the effect size was small

(partial eta squared = .03). There was a statistically significant main effect for students' department, $F(2, 456) = 16.07$, $p < .01$; and the effect size was medium (partial eta squared = .07). Likewise, there was also a statistically significant main effect for students' academic year, $F(3, 456) = 7.40$, $p < .01$; although the effect size was small (partial eta squared = .05).

Further, post-hoc comparisons using the Bonferroni and Games-Howell tests indicated that the issue related to 'QC209 close to pub or bar' was considered by TRP students ($M = 3.63$, $SD = 1.03$) to be significantly more important than architectural students ($M = 3.15$, $SD = 1.04$) and landscape students ($M = 3.21$, $SD = 1.05$) in the target group, $p < .01$. On the other hand, the Bonferroni and Games-Howell post-hoc tests also revealed that this issue was considered by MA students or students at an equal level ($M = 2.84$, $SD = 1.19$) to be significantly less important than undergraduate students from the first year ($M = 3.32$, $SD = 1.06$), from the second year ($M = 3.43$, $SD = 1.04$) or from the third year ($M = 3.24$, $SD = 0.92$) in the target group, $p < .01$.



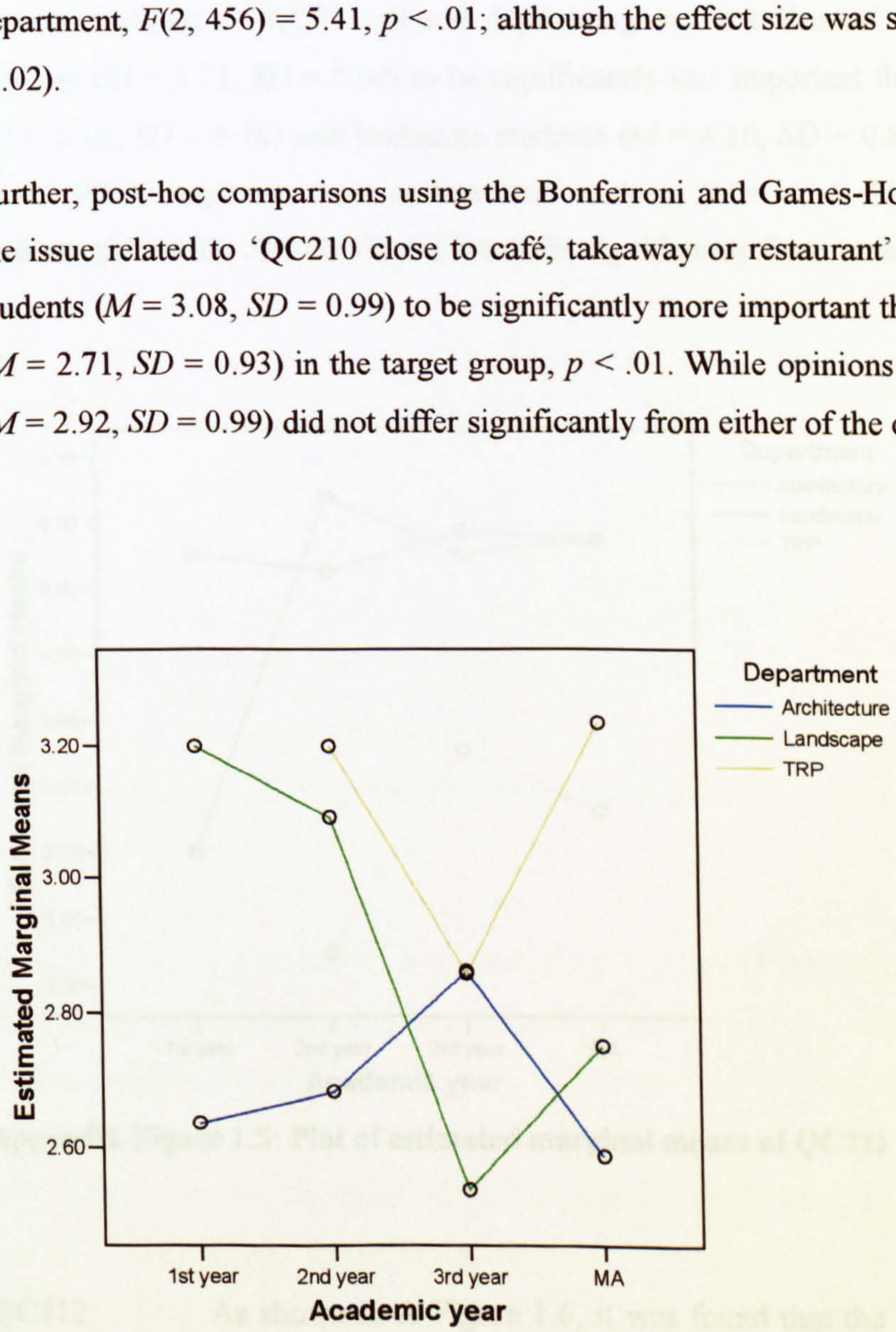

**Appendix-Figure 1.3: Plot of estimated marginal means of QC209**

There was a statistically significant interaction effect between department and academic year on students' evaluation of the relative importance of QC209, $F(5, 456) = 2.41$, $p < .05$. This indicated that students' opinions from different department were affected differently by their academic years. Specifically, as shown in A-Figure 1.3, higher level students were often likely to evaluate such issue as less important. However, TRP students in MA or at an equal

level were often likely to consider it more important than others. This also leaded to the main difference between students in MA or at an equal level: architectural students ($M = 1.94$, $SD = .90$), landscape students ($M = 2.88$, $SD = 1.09$) and TRP students ($M = 3.63$, $SD = 1.03$).

QC210: As shown in A-Figure 1.4, it was found that the interaction effect between department and academic year on students' evaluation of the relative importance of QC210 was not statistically significant, $F(5, 456) = 2.19$, $p = .05$ ($> .05$). The main effect for students' academic year, $F(3, 456) = 1.38$, $p = .25$ ($> .05$), did not reach statistical significance. However, there was a statistically significant main effect for students' department, $F(2, 456) = 5.41$, $p < .01$; although the effect size was small (partial eta squared $= .02$).

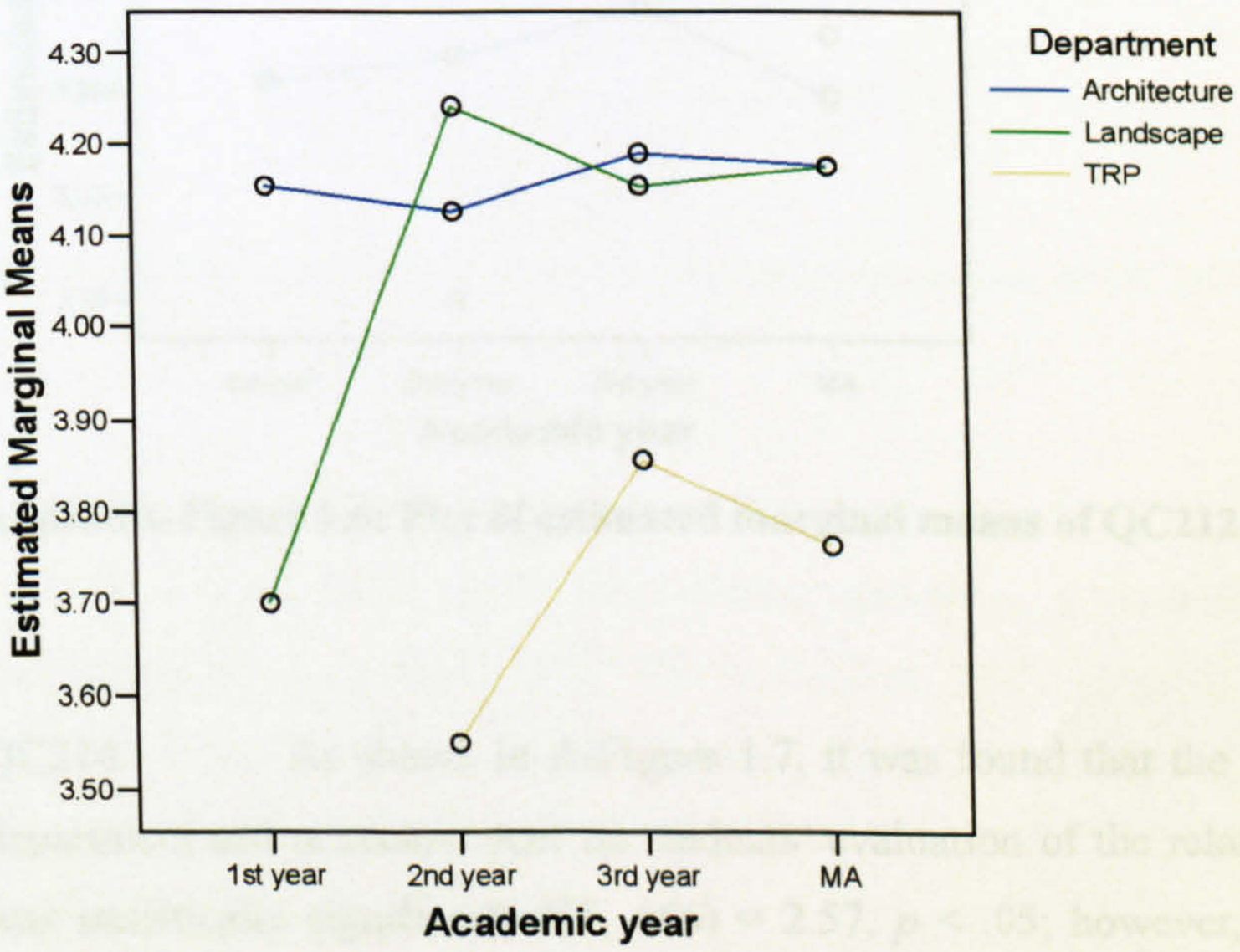
Further, post-hoc comparisons using the Bonferroni and Games-Howell tests indicated that the issue related to 'QC210 close to café, takeaway or restaurant' was considered by TRP students ($M = 3.08$, $SD = 0.99$) to be significantly more important than architectural students ($M = 2.71$, $SD = 0.93$) in the target group, $p < .01$. While opinions from landscape students ($M = 2.92$, $SD = 0.99$) did not differ significantly from either of the other groups.




**Appendix-Figure 1.4: Plot of estimated marginal means of QC210**

QC211: As shown in A-Figure 1.5, it was found that the interaction effect between department and academic year on students' evaluation of the relative importance of QC211 was not statistically significant, $F(5, 456) = 1.37$, $p = .23$ ($> .05$). The main effect for students' academic year, $F(3, 456) = 1.61$, $p = .19$ ($> .05$), did not reach statistical significance. However, there was a statistically significant main effect for students' department, $F(2, 456) = 9.18$, $p < .01$; although the effect size was small (partial eta squared = .04).

Further, post-hoc comparisons using the Bonferroni and Games-Howell tests indicated that the issue related to 'QC211 natural daylighting in the bedroom' was considered by TRP students ($M = 3.71$, $SD = 0.92$) to be significantly less important than architectural students ($M = 4.16$, $SD = 0.76$) and landscape students ($M = 4.10$, $SD = 0.85$) in the target group, $p < .01$. While responses from architectural students ($M = 4.16$, $SD = 0.76$) and landscape students ($M = 4.10$, $SD = 0.85$) did not differ significantly from each other.

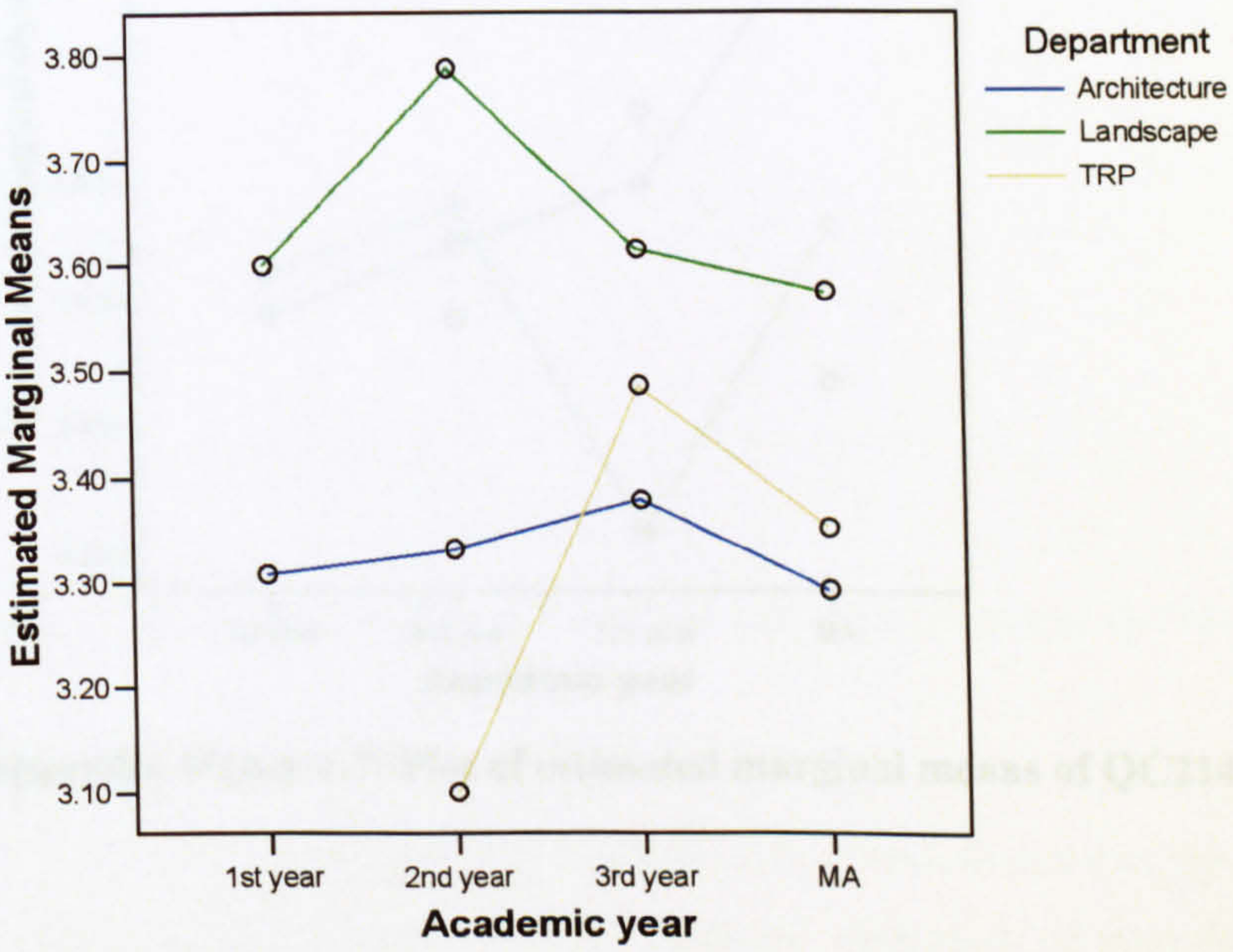



**Appendix-Figure 1.5: Plot of estimated marginal means of QC211**

QC212: As shown in A-Figure 1.6, it was found that the interaction effect between department and academic year on students' evaluation of the relative importance of QC212 was not statistically significant, $F(5, 456) = .77$, $p = .57$ ($> .05$). The main effect for students' academic year, $F(3, 456) = .20$, $p = .89$ ($> .05$), did not reach statistical significance. There was a statistically significant main effect for students' department, $F(2, 456) = 4.57$, $p < .05$;

however, the effect size was small (partial eta squared = .02).

Further, post-hoc comparisons using the Bonferroni and Games-Howell tests indicated that the issue related to 'QC212 drying space for clothes, internal or external' was considered by landscape students ($M$ = 3.65, $SD$ = 0.78) to be significantly more important than architectural students ($M$ = 3.33, $SD$ = 0.88) and TRP students ($M$ = 3.29, $SD$ = 0.94) in the target group, $p < .05$. While responses from architectural students ($M$ = 3.33, $SD$ = 0.88) and TRP students ($M$ = 3.29, $SD$ = 0.94) did not differ significantly from each other.

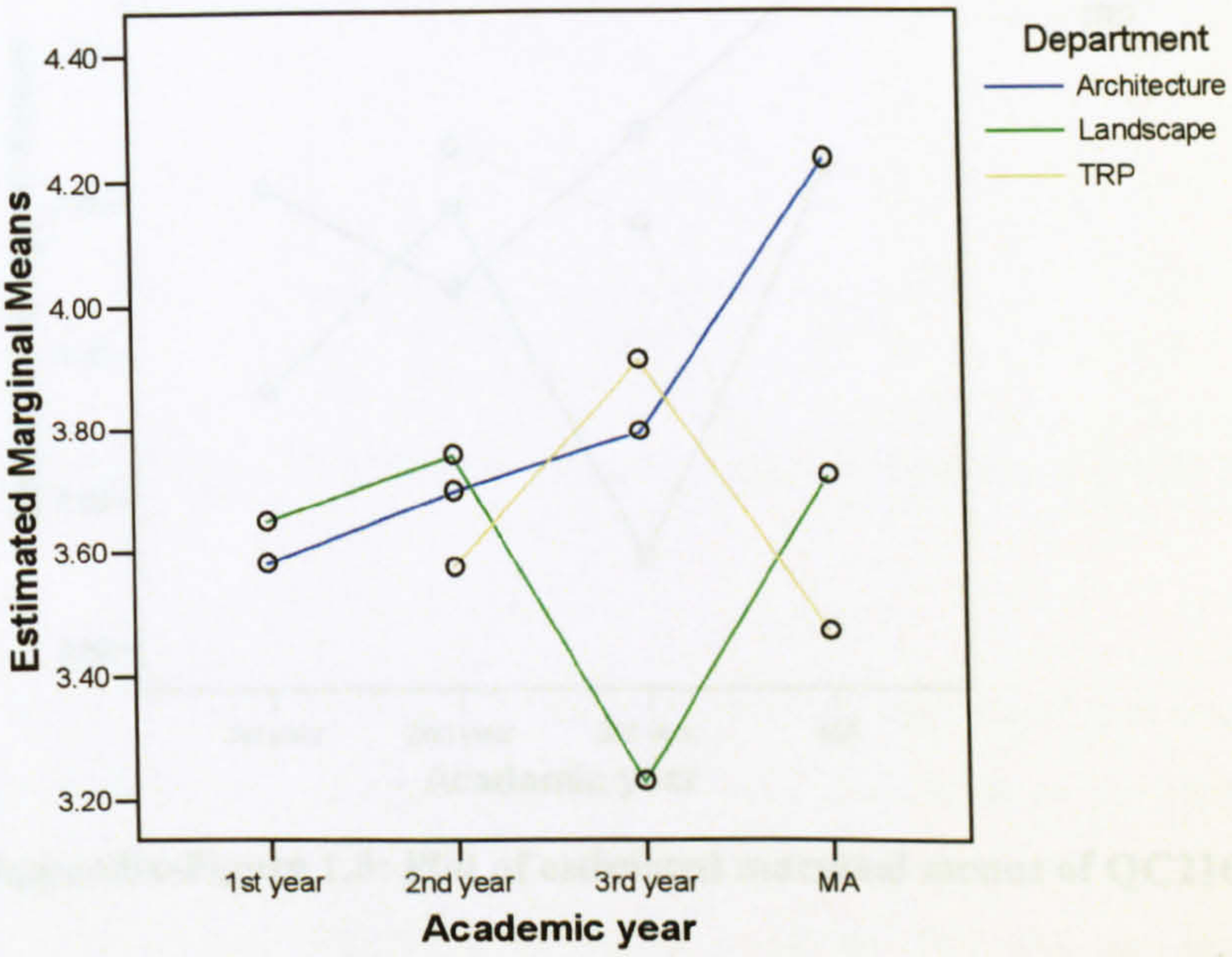



**Appendix-Figure 1.6: Plot of estimated marginal means of QC212**

QC214: As shown in A-Figure 1.7, it was found that the interaction effect between department and academic year on students' evaluation of the relative importance of QC214 was statistically significant, $F(5, 456) = 2.57$, $p < .05$; however, the effect size was small (partial eta squared = .03). Neither the main effect for students' department, $F(2, 456) = 2.66$, $p = .07$ (> .05), nor the main effect for students' academic year, $F(3, 456) = .79$, $p = .50$ (> .05), reached statistical significance.

There was a statistically significant interaction effect between department and academic year on students' evaluation of the relative importance of 'QC214 high insulation standards', $F(5, 456) = 2.57$, $p < .05$. This indicated that students' opinions from different departments were affected differently by their academic years. Specifically, as shown in A-Figure 1.7, this issue

was evaluated as less important by the third year landscape students ($M$ = 3.23, $SD$ = 0.93) than architectural students ($M$ = 3.80, $SD$ = 0.84) or TRP students ($M$ = 3.91, $SD$ = 0.78) in the same level. While in MA or at an equal level, architectural students ($M$ = 4.24, $SD$ = 0.66) were often likely to address this issue as more important than landscape students ($M$ = 3.73, $SD$ = 0.93) and TRP students ($M$ = 3.47, $SD$ = 1.01).

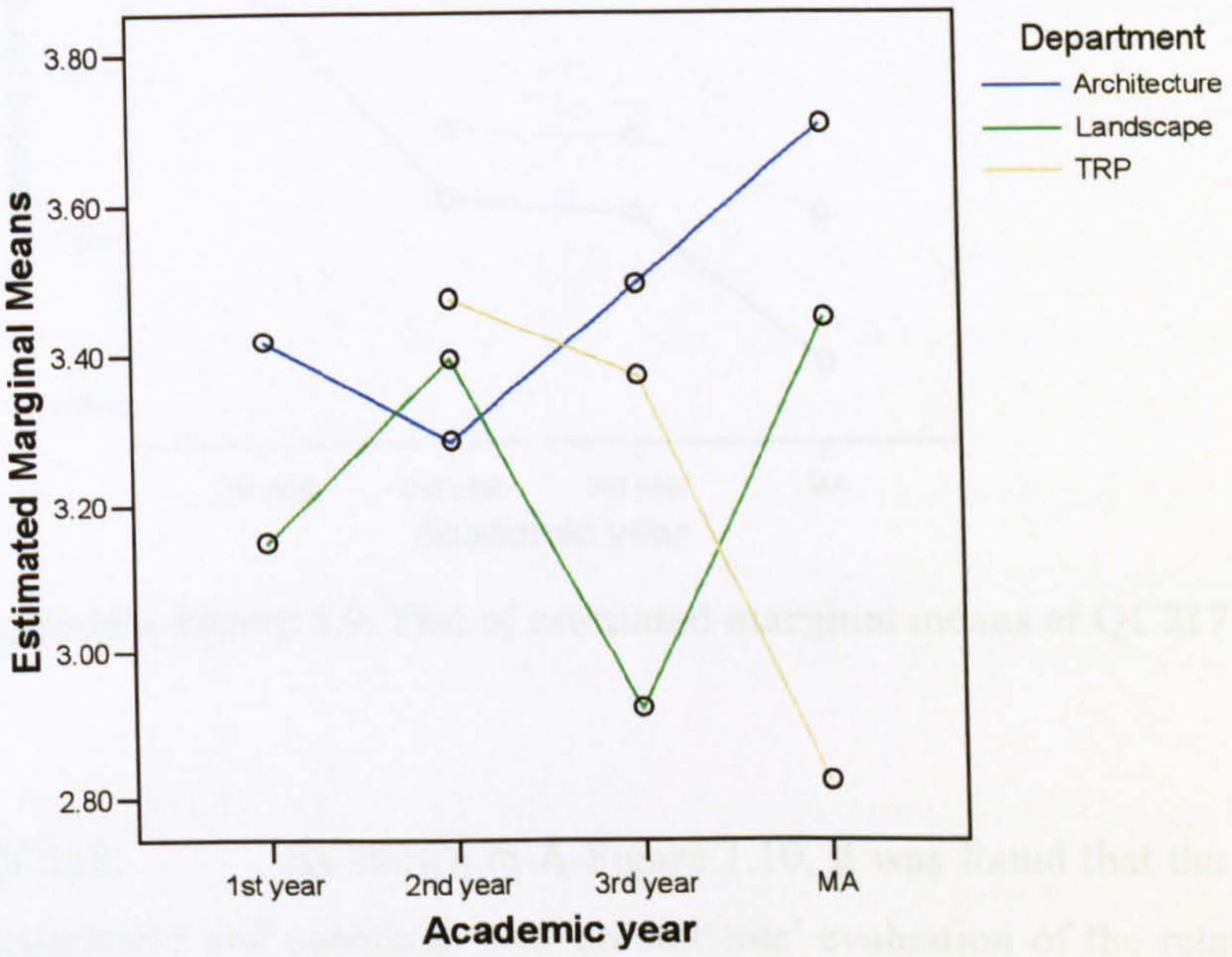



**Appendix-Figure 1.7: Plot of estimated marginal means of QC214**

QC216: As shown in A-Figure 1.8, it was found that the interaction effect between department and academic year on students' evaluation of the relative importance of QC216 was statistically significant, $F(5, 456) = 2.41$, $p < .05$; however, the effect size was small (partial eta squared = .03). Neither the main effect for students' department, $F(2, 456) = 2.77$, $p = .06$ (> .05), nor the main effect for students' academic year, $F(3, 456) = .45$, $p = .72$ (> .05), reached statistical significance.

There was a statistically significant interaction effect between department and academic year on students' evaluation of the relative importance of 'QC216 sound insulation between adjacent rooms or floors', $F(5, 456) = 2.41$, $p < .05$. This indicated that students' opinions from different departments were affected differently by their academic years. Specifically, as shown in A-Figure 1.8, this issue was evaluated as less important by the third year landscape students ($M$ = 2.92, $SD$ = 0.76) than architectural students ($M$ = 3.49, $SD$ = 0.80) or TRP students ($M$ = 3.37, $SD$ = 0.97) in the same level. While in MA or at an equal level,

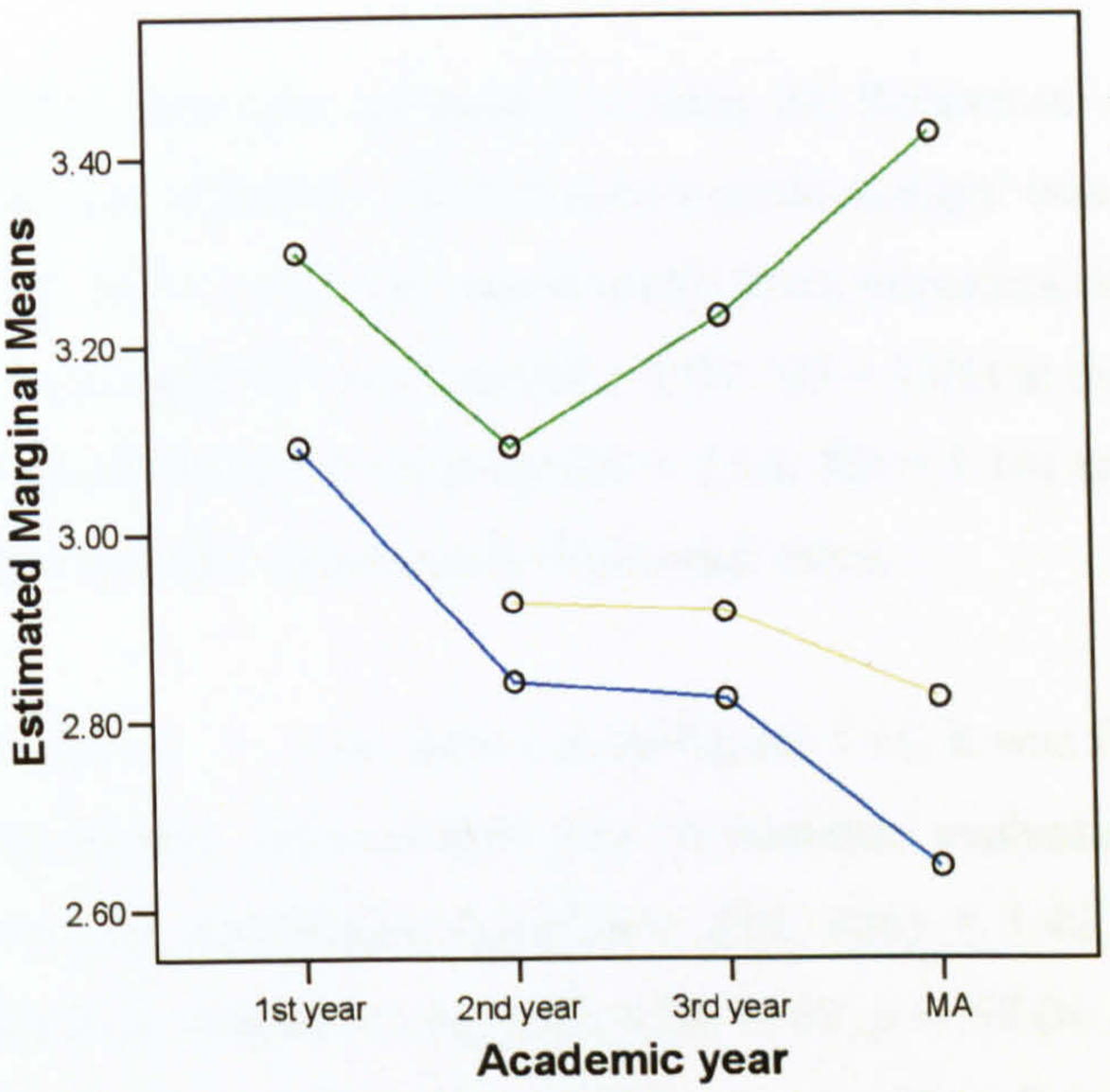
architectural students ($M = 3.71$, $SD = 0.85$) and landscape students ($M = 3.45$, $SD = 0.90$) were often likely to address this issue as more important than TRP students ($M = 2.82$, $SD = 1.07$).




**Appendix-Figure 1.8: Plot of estimated marginal means of QC216**

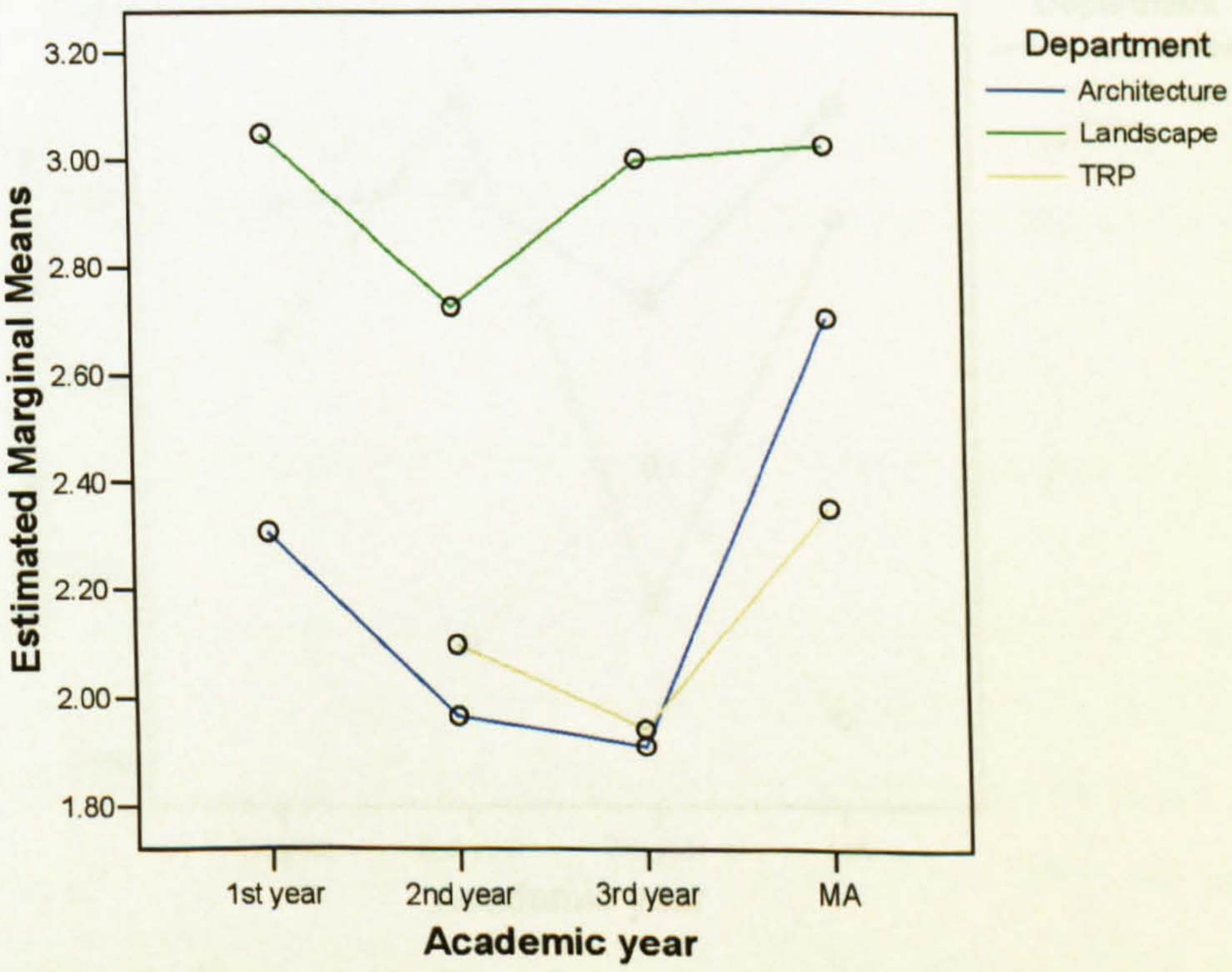
QC217: As shown in A-Figure 1.9, it was found that the interaction effect between department and academic year on students' evaluation of the relative importance of QC217 was not statistically significant, $F(5, 456) = .65$, $p = .66$ ($> .05$). The main effect for students' academic year, $F(3, 456) = .61$, $p = .61$ ($> .05$), did not reach statistical significance. However, there was a statistically significant main effect for students' department, $F(2, 456) = 5.00$, $p < .01$; although the effect size was small (partial eta squared = .02).

Further, post-hoc comparisons using the Bonferroni and Games-Howell tests indicated that the issue related to 'QC217 private outdoor space, like back-garden or balcony' was considered by landscape students ($M = 3.27$, $SD = 0.95$) to be significantly more important than architectural students ($M = 2.93$, $SD = 1.01$) and TRP students ($M = 2.90$, $SD = 1.03$) in the target group, $p < .01$. While responses from architectural students ($M = 2.93$, $SD = 1.01$) and TRP students ($M = 2.90$, $SD = 1.03$) did not differ significantly from each other.




**Appendix-Figure 1.9: Plot of estimated marginal means of QC217**

QC218: As shown in A-Figure 1.10, it was found that the interaction effect between department and academic year on students' evaluation of the relative importance of QC218 was not statistically significant, $F(5, 456) = .61$, $p = .69$ ($> .05$). The main effect for students' academic year, $F(3, 456) = 2.52$, $p = .06$ ($> .05$), did not reach statistical significance. However, there was a statistically significant main effect for students' department, $F(2, 456) = 14.41$, $p < .01$; and the effect size was medium (partial eta squared = .06).

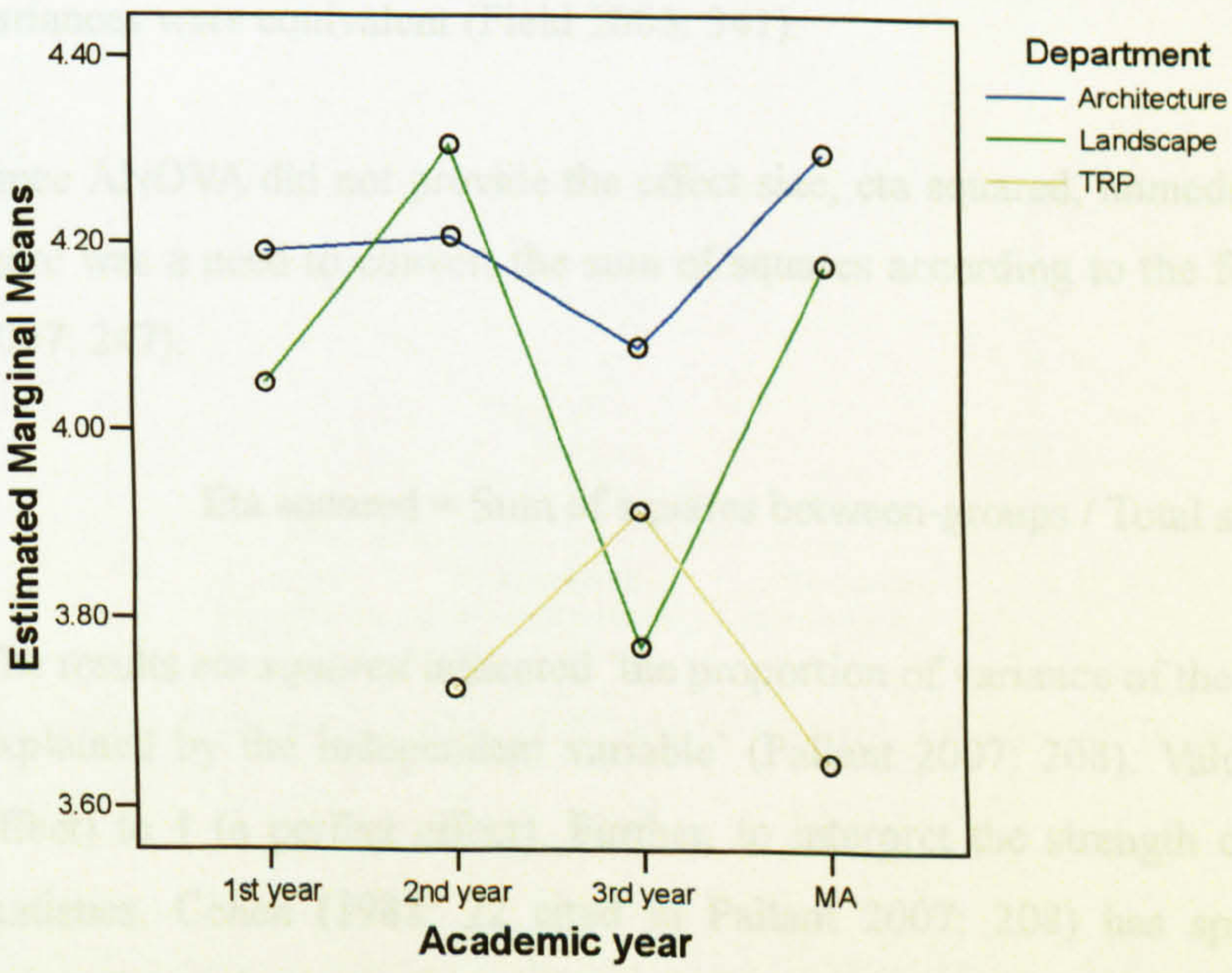



**Appendix-Figure 1.10: Plot of estimated marginal means of QC218**

Further, post-hoc comparisons using the Bonferroni and Games-Howell tests indicated that the issue related to 'QC218 secure cycle storage' was considered by landscape students ($M$ = 2.93, $SD$ = 1.20) to be significantly more important than architectural students ($M$ = 2.14, $SD$ = 1.14) and TRP students ($M$ = 2.09, $SD$ = 1.06) in the target group, $p < .01$. While responses from architectural students ($M$ = 2.14, $SD$ = 1.14) and TRP students ($M$ = 2.09, $SD$ = 1.06) did not differ significantly from each other.

QC220: As shown in A-Figure 1.11, it was found that the interaction effect between department and academic year on students' evaluation of the relative importance of QC220 was not statistically significant, $F(5, 456) = 1.42$, $p = .22$ (> .05). The main effect for students' academic year, $F(3, 456) = .68$, $p = .57$ (> .05), did not reach statistical significance. There was a statistically significant main effect for students' department, $F(2, 456) = 7.65$, $p < .01$; although the effect size was small (partial eta squared = .03).

Further, post-hoc comparisons using the Bonferroni and Games-Howell tests indicated that the issue related to 'QC220 operable windows and airflow to improve interior air conditions' was considered by TRP students ($M$ = 3.78, $SD$ = .90) to be significantly less important than architectural students ($M$ = 4.17, $SD$ = .73) and TRP students ($M$ = 4.14, $SD$ = .76) in the target group, $p < .01$. While responses from architectural students ($M$ = 4.17, $SD$ = .73) and TRP students ($M$ = 4.14, $SD$ = .76) did not differ significantly from each other.




**Appendix-Figure 1.11: Plot of estimated marginal means of QC220**

- ***Cultural Background (Original Residence Places) * QC201-226 – One-way Independent Analysis of Variance (ANOVA)***

In Section 6.4.1, the one-way between-groups analysis of variance (independent ANOVA) was conducted to explore the impact of students' cultural background ('students' residence places') on students' evaluation of the palette of housing environmental issues (from QC201 to QC226), as measured by the relative importance on an interval scale.

In SPSS, *One-way ANOVA* underneath the *Compare Means* was used to compare means. The *Descriptive statistics* in the Options was selected to make a general description of the results. Then the Homogeneity of variance test (*Levene's test*) in the Options was selected to test the assumption that the variances of the groups were fairly similar (Field 2005: 346; Pallant 2007: 246). It was expected to achieve a non-significant result (Sig. $\geq$ .05) in this *Levene's Test of Homogeneity of Variance*, which meant the assumption of equal variances had not been violated. If the assumption of homogeneity of variance was violated (Sig. < .05), the output from table headed as *Robust Tests of Equality of Means* needed to be reported. To achieve the related results, the Brown-Forsythe and Welch in the Options were also selected in addition.

Since the sample sizes in each sub-group were very different, *Bonferroni's* test was conducted to control the Type I error rate, and *Hochberg's GT2* was used to see the violations of test assumptions in the *post hoc* procedures (Field 2005: 340). Further, the *Games-Howell* procedure was run in addition because of the uncertainty of knowing whether the population variances were equivalent (Field 2005: 341).

Since ANOVA did not provide the effect size, eta squared, immediately in the SPSS output, there was a need to convert the sum of squares according to the following formula (Pallant 2007: 247):

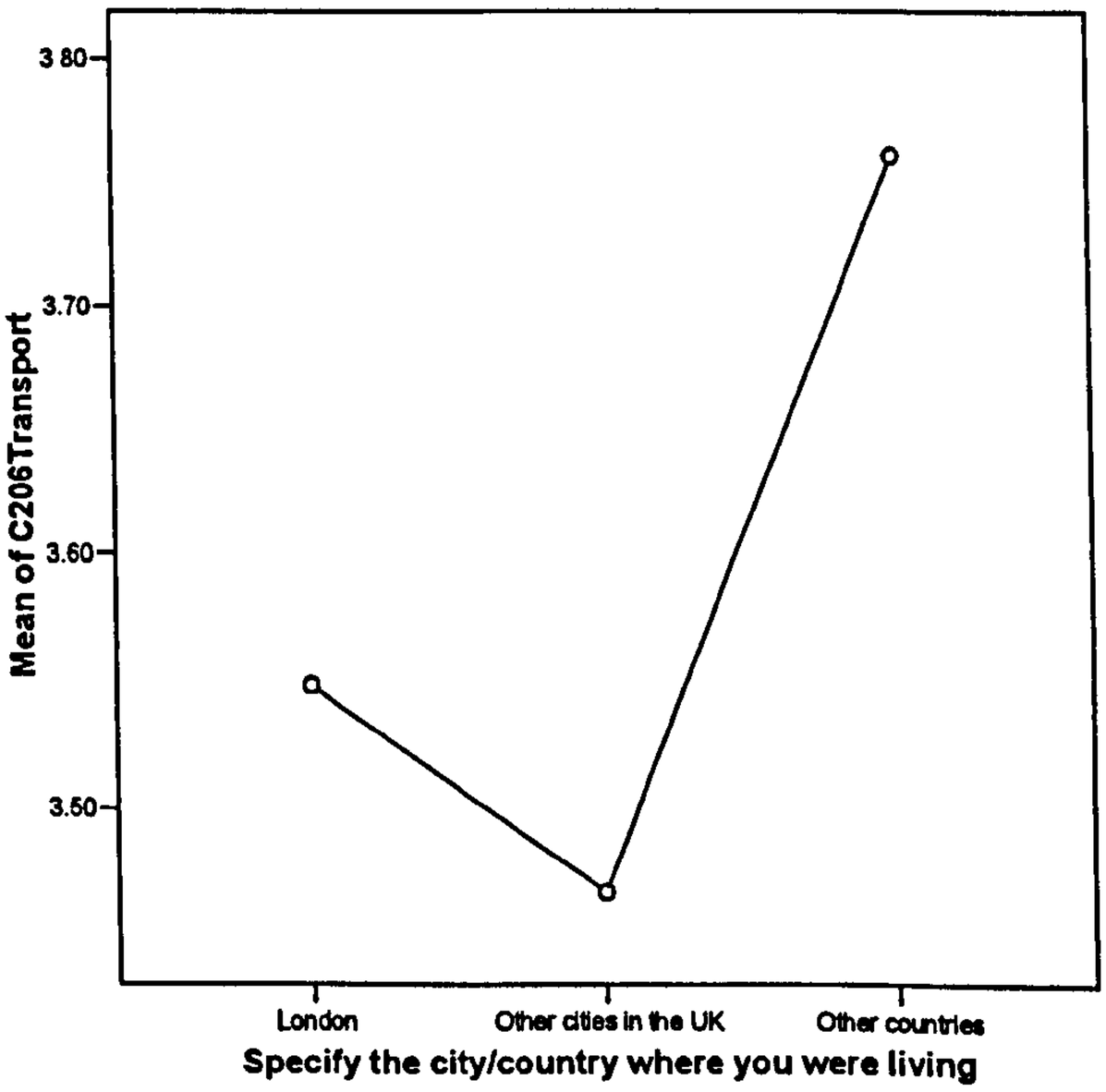
Eta squared = Sum of squares between-groups / Total sum of squares

The results *eta squared* indicated 'the proportion of variance of the dependent variable that is explained by the independent variable' (Pallant 2007: 208). Values can range from 0 (no effect) to 1 (a perfect effect). Further, to interpret the strength of the different effect size statistics, Cohen (1988: 22 cited in Pallant 2007: 208) has specified guidelines for eta squared to make comparisons between different groups (Pallant 2007: 208):

- Eta squared = .01 (small effect): the effect explains 1% of the total variance
- Eta squared = .06 (medium effect): the effect explains 6% of the total variance
- Eta squared = .138 (large effect): the effect accounts for 13.8% of the variance

As argued earlier, students' evaluation of different housing environmental issues might vary due to their original residence places. However, it was found that the results varied from issue to issue. To understand the variance better, the statistical analysis procedures are described by issues in the following sections, focusing on those cases with significant differences ($p < .05$) in particular.

QC206: As shown in A-Figure 1.12, it was found that there was a statistically significant effect (Welch and Brown-Forsythe Sig < .05) of students' original residence places on their evaluation of the relative importance of QC206, $F(2, 464) = 3.02$, $p < .05$. However, despite reaching statistical significance, the actual difference in mean scores between the sub-groups was quite small. The effect size, calculated using eta squared, was .01.



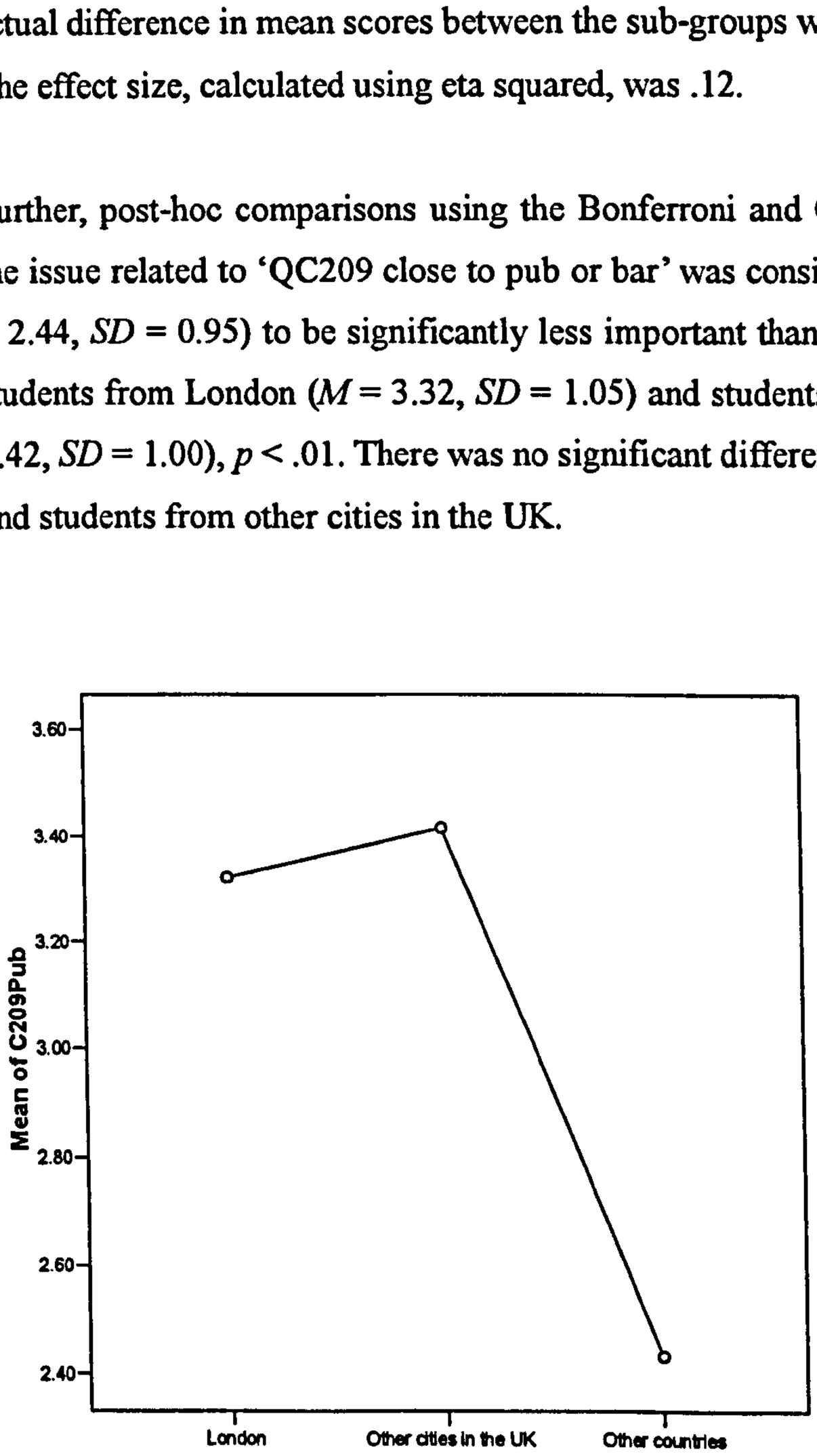

**Appendix-Figure 1.12: Plot of estimated marginal means of QC206**

Further, post-hoc comparisons using the Bonferroni and Games-Howell tests indicated that the issue related to 'QC206 close to a frequent public transport' was considered by

international students (students from other countries) ($M$ = 3.76, $SD$ = 0.75) to be significantly more important than students from other cities in the UK ($M$ = 3.47, $SD$ = 0.96) in the target group, $p < .05$. Responses from students from London ($M$ = 3.55, $SD$ = 0.86) did not differ significantly from either of them.

QC 209: As shown in A-Figure 1.13, it was found that there was a statistically significant effect (ANOVA Sig < .05) of students' original residence places on their evaluation of the relative importance of QC209, $F(2, 464) = 28.37$, $p < .01$. Further, the actual difference in mean scores between the sub-groups was medium and very close to large. The effect size, calculated using eta squared, was .12.

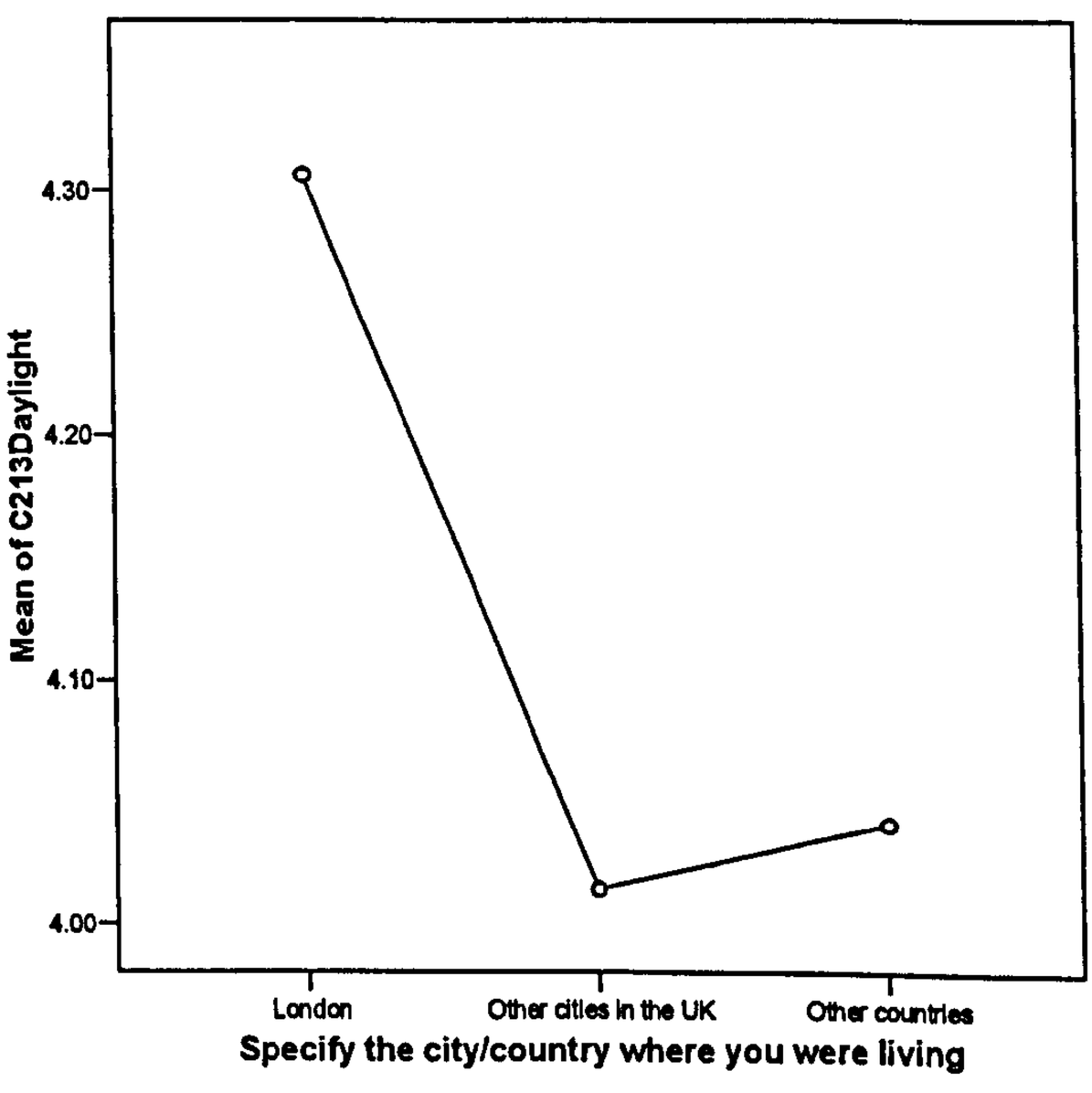
Further, post-hoc comparisons using the Bonferroni and Games-Howell tests indicated that the issue related to 'QC209 close to pub or bar' was considered by international students ($M$ = 2.44, $SD$ = 0.95) to be significantly less important than local students in the target group, students from London ($M$ = 3.32, $SD$ = 1.05) and students from other cities in the UK ($M$ = 3.42, $SD$ = 1.00), $p < .01$. There was no significant difference between students from London and students from other cities in the UK.




**Appendix-Figure 1.13: Plot of estimated marginal means of QC209**

QC211: As shown in A-Figure 1.14, it was found that there was a statistically significant effect (ANOVA Sig < .05) of students' original residence places on their evaluation of the relative importance of QC211, $F(2, 464) = 3.25$, $p < .05$. However, despite reaching statistical significance, the actual difference in mean scores between the sub-groups was quite small. The effect size, calculated using eta squared, was .01.

Further, post-hoc comparisons using the Bonferroni and Games-Howell tests indicated that the issue related to 'QC211 natural daylighting in the bedroom' was considered by students from London ($M = 4.31$, $SD = 0.80$) to be significantly more important than students from other cities in the UK ($M = 4.02$, $SD = 0.86$), $p < .05$. Responses from international students ($M = 4.04$, $SD = 0.71$) did not differ significantly from either of them.

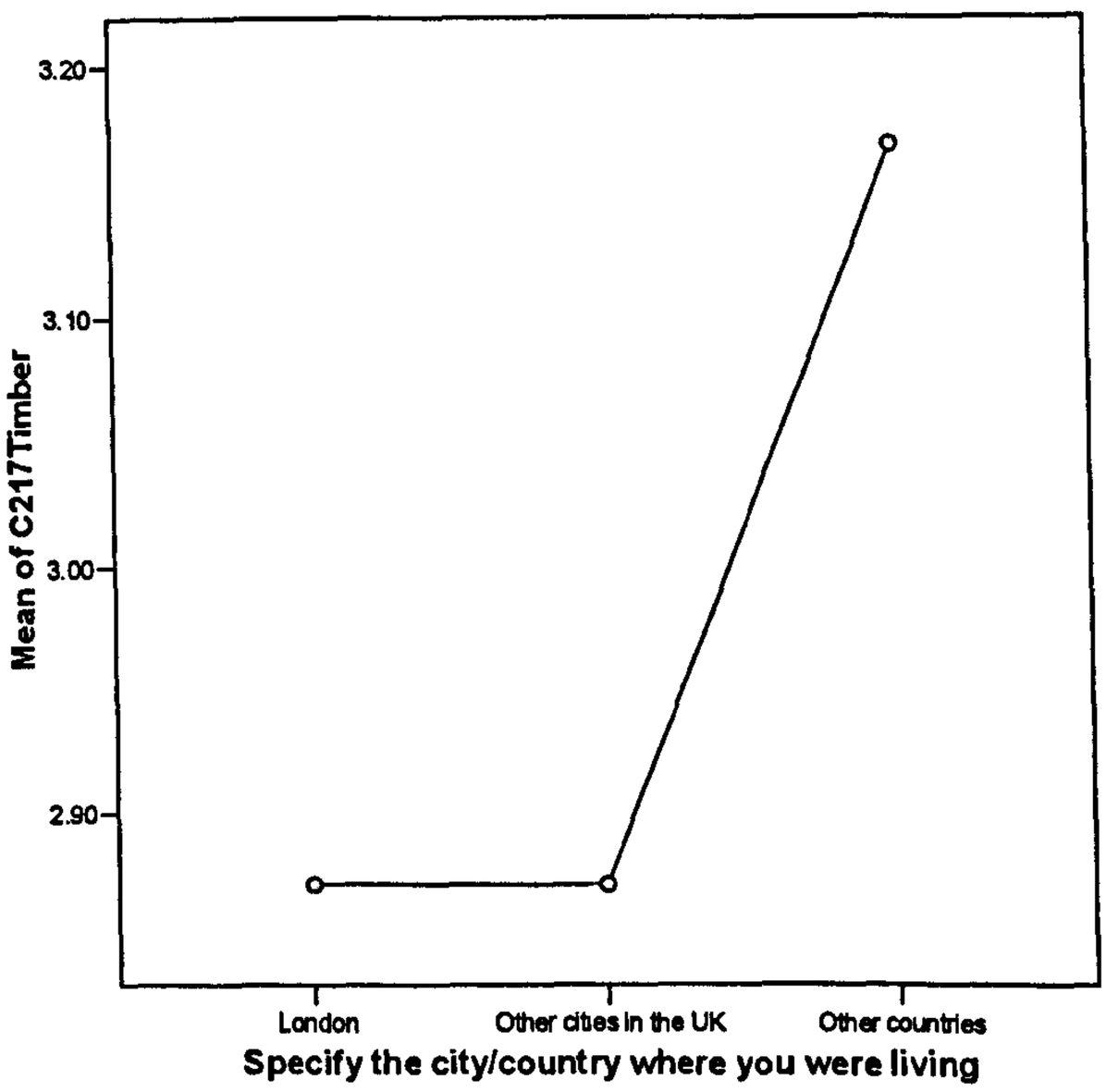



**Appendix-Figure 1.14: Plot of estimated marginal means of QC211**

QC215: As shown in A-Figure 1.15, it was found that there was a statistically significant effect (ANOVA Sig < .05) of students' original residence places on their evaluation of the relative importance of QC215, $F(2, 464) = 3.33$, $p < .05$. However, despite reaching statistical significance, the actual difference in mean scores between the sub-groups was quite small. The effect size, calculated using eta squared, was .01.

Further, post-hoc comparisons using the Bonferroni and Games-Howell tests indicated that

the issue related to 'QC215 fitment and furniture with timber or environmentally friendly appearance' was considered by international students ($M$ = 3.17, $SD$ = 0.79) to be significantly more important than local students, students from London ($M$ = 2.87, $SD$ = 0.91) and students from other cities in the UK ($M$ = 2.87, $SD$ = 0.91), $p < .05$. There was no significant difference between students from London and students from other cities in the UK. In contrast, as shown in A-Figure 1.15, students from London and students from other cities in the UK had almost the same opinions on this issue.

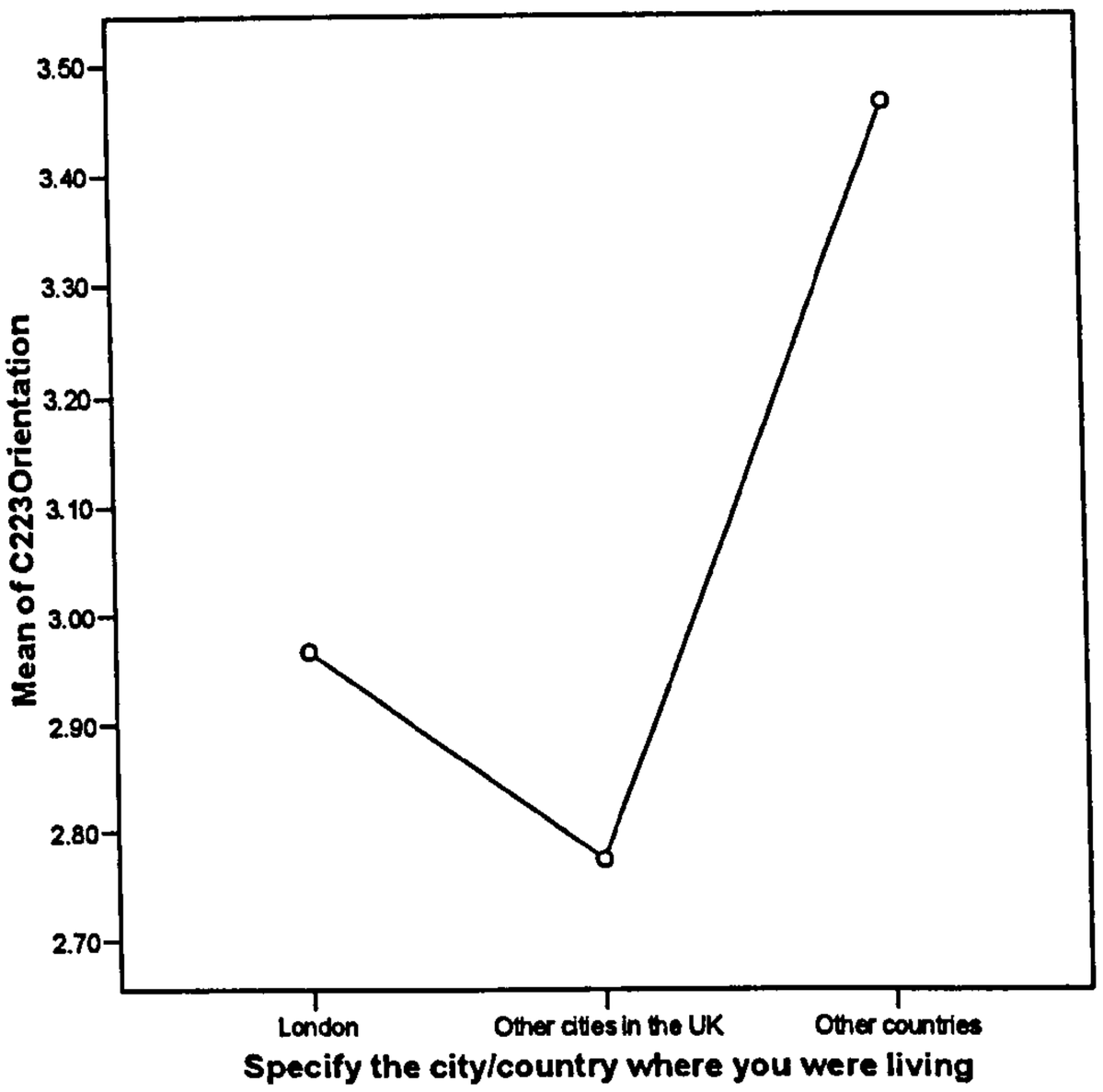



**Appendix-Figure 1.15: Plot of estimated marginal means of QC215**

QC221: As shown in A-Figure 1.16, it was found that there was a statistically significant effect (ANOVA Sig < .05) of students' original residence places on their evaluation of the relative importance of QC211, $F(2, 464) = 15.46$, $p < .01$. Further, the actual difference in mean scores between the sub-groups was medium. The effect size, calculated using eta squared, was .07.

Further, post-hoc comparisons using the Bonferroni and Games-Howell tests indicated that the issue related to 'QC221 southern orientation of the bedroom for interior warmth' was considered by international students ($M$ = 3.46, $SD$ = 0.88) to be significantly more important than local students, students from London ($M$ = 2.97, $SD$ = 0.90) and students from other cities in the UK ($M$ = 2.78, $SD$ = 0.98), $p < .01$. There was no significant

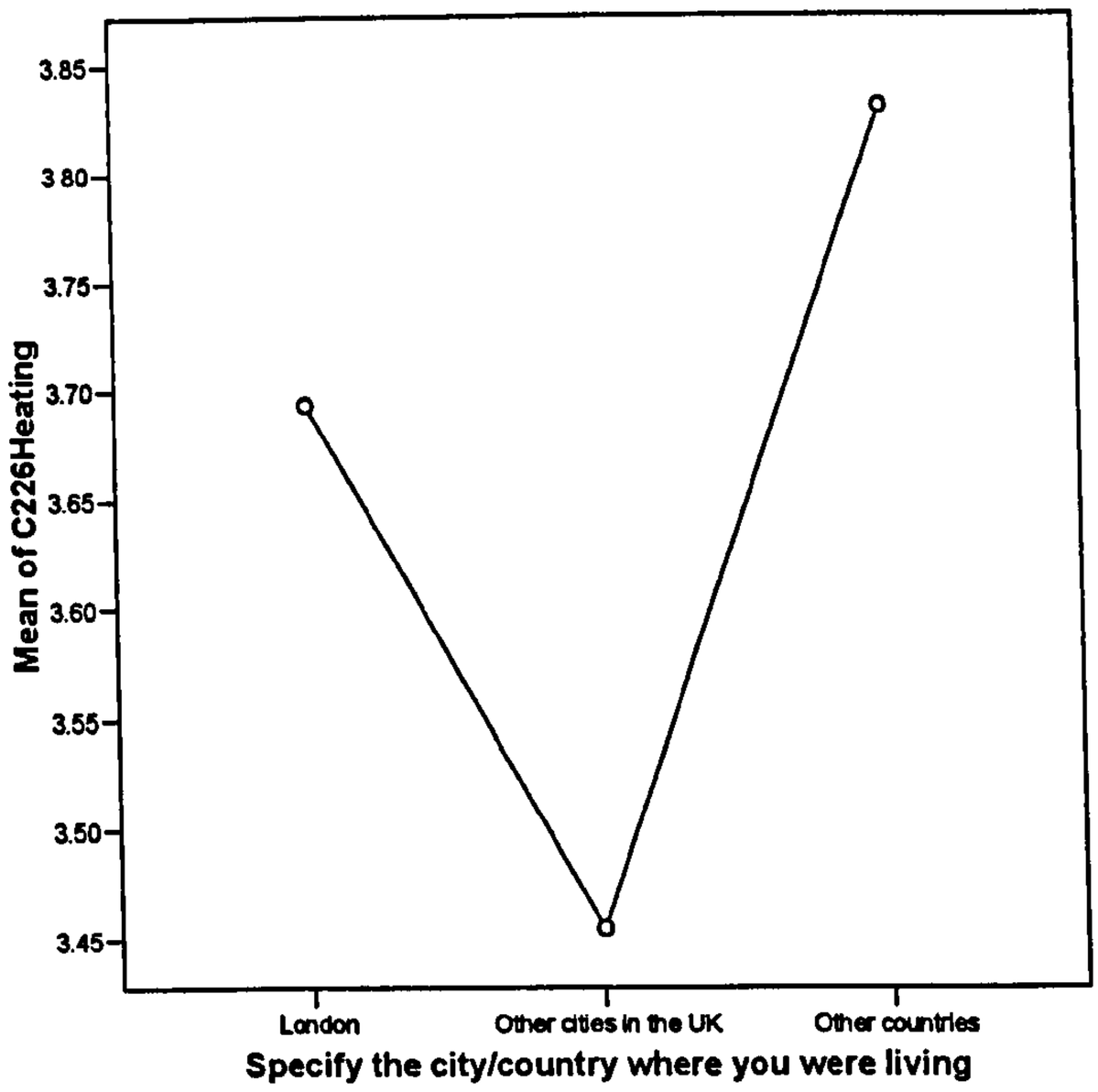
difference between students from London and students from other cities in the UK on the evaluation of the relative importance of this issue.




**Appendix-Figure 1.16: Plot of estimated marginal means of QC221**

QC224: As shown in A-Figure 1.17, it was found that there was a statistically significant effect (Welch and Brown-Forsythe Sig < .05) of students' original residence places on their evaluation of the relative importance of QC224, $F(2, 464) = 6.06$, $p < .01$. However, despite reaching statistical significance, the actual difference in mean scores between the sub-groups was quite small. The effect size, calculated using eta squared, was .03.

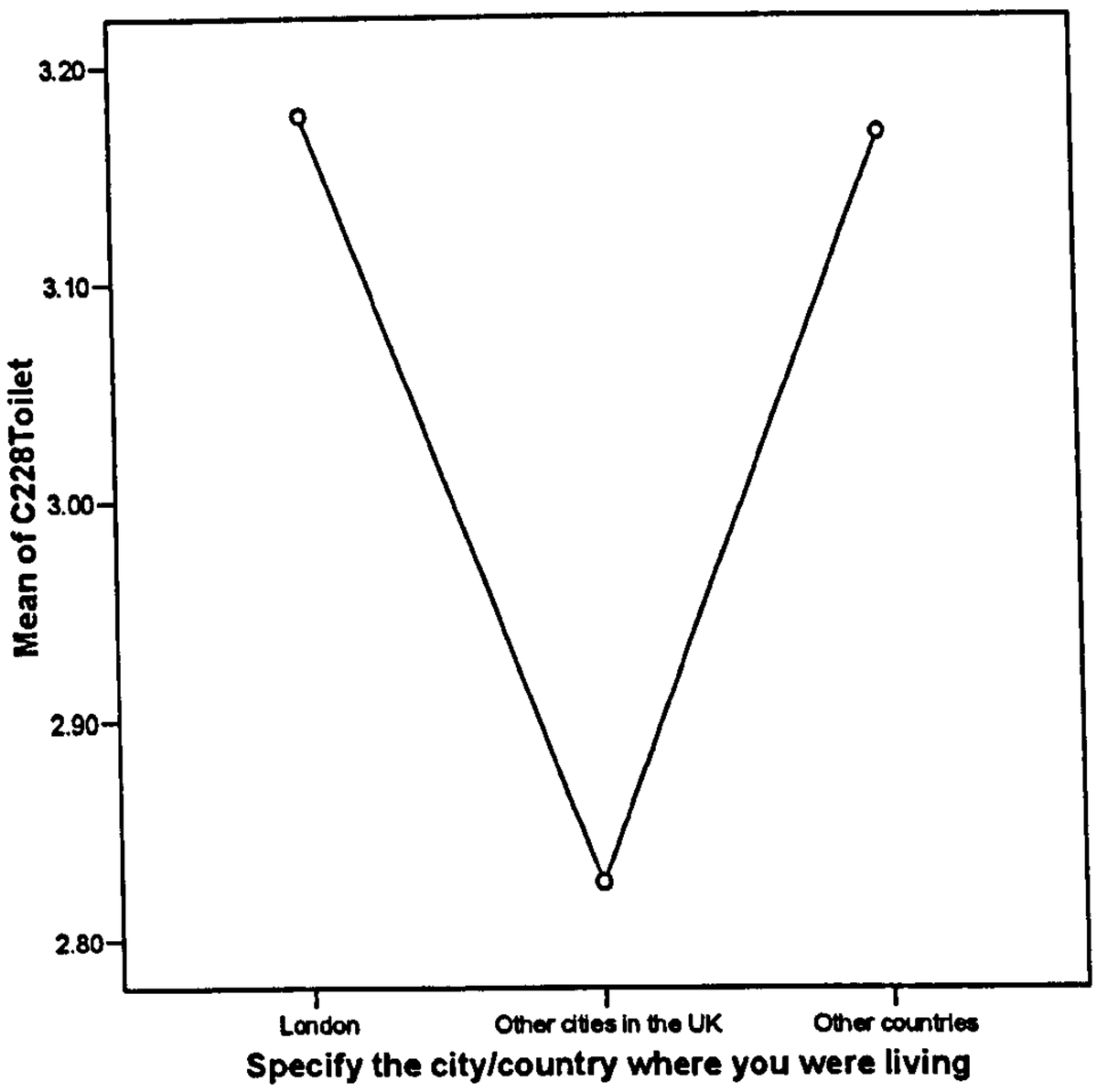
Further, post-hoc comparisons using the Bonferroni and Games-Howell tests indicated that the issue related to 'QC224 energy efficient heating and lighting appliances' was considered by international students ($M = 3.83$, $SD = 0.76$) to be significantly more important than students from other cities in the UK ($M = 3.46$, $SD = 0.92$) in the target group, $p < .01$. Responses from students from London ($M = 3.69$, $SD = 0.93$) did not differ significantly from either of them.




**Appendix-Figure 1.17: Plot of estimated marginal means of QC224**

QC226: As shown in A-Figure 1.18, it was found that there was a statistically significant effect (ANOVA Sig < .05) of students' original residence places on their evaluation of the relative importance of QC226, $F(2, 464) = 5.29$, $p < .01$. However, despite reaching statistical significance, the actual difference in mean scores between the sub-groups was quite small. The effect size, calculated using eta squared, was .02.

Further, post-hoc comparisons using the Bonferroni and Games-Howell tests indicated that the issue related to 'QC226 water-saving toilet' was considered by students from other cities in the UK ($M = 2.83$, $SD = 1.05$) to be significantly less important than students from London ($M = 3.18$, $SD = 1.06$) and students from other countries ($M = 3.17$, $SD = 0.96$), $p < .01$. There was no significant difference between students from London and students from other countries. In contrast, as shown in A-Figure 1.18, students from London and students from other cities in the UK had almost the same opinions on this issue.




**Appendix-Figure 1.18: Plot of estimated marginal means of QC226**

## APPENDIX 1.2: GROUP FACTORS (QA AND QB) * KNOWLEDGE OF LIFESTYLE ISSUES (QD)

This section intends to explore the knowledge variation within the target group of students according to their group factors (i.e. gender, major subject, academic year and cultural background).

- ***Gender * QD101-107 – Mann-Whitney U test***

In Section 6.4.2, the Mann-Whitney U test (*2 Independent Samples* underneath *Nonparametric Tests*) was conducted to compare the differences between male and female students' knowledge of some living issues (QD101-107). The aggregated consultation results showed that male and female students' knowledge were significantly different on QD104 ($p < .05$) and QD106 ($p < .01$).

To discover whether the effect was substantive, it was important to measure the effect sizes. Since SPSS did not provide an effect size statistic for the Mann-Whitney U test immediately, there was a need to convert the *z*-score into the *r*-value according to the following equation (Rosenthal 1991: 19, cited in Field 2005: 532; Pallant 2007: 223):

$$r = \frac{Z}{\sqrt{N}} \quad \text{(N = total number of cases)}$$

The results were constrained to lie between 0 (no effect) and 1 (a perfect effect) (Field 2005: 32; Pallant 2007: 235). Cohen (1988, 1992; cited in Field 2005: 32) also set criteria to consider different effect sizes according to 'the proportion of variance in the dependent variable that is explained by the independent (group) variable' (Pallant 2007: 235):

- r = .10 (small effect): in this case, the effect explains 1% of the total variance
- r = .30 (medium effect): the effect accounts for 9% of the total variance
- r = .50 (large effect): the effect accounts for 25% of the variance

To understand those consultation results with significant differences ($p < .05$) better, the SPSS outputs of QD104 and QD106 were reported in the following sections, using median values (*Md*) for each group:

QD104: Female students' knowledge ($Md = 4$, $n = 220$) of 'the distance and frequency of service at the nearest public transport' was significantly better than male students' ($Md = 4$, $n = 247$), $U = 23711$, $z = -2.51$, $p < .05$. However, the relative magnitude of the difference was very small and only represented a small size effect ($r = 0.12$)

QD106: Female students' knowledge ($Md = 3$, $n = 220$) of 'recycling household waste' was significantly better than male students' ($Md = 3$, $n = 247$), $U = 23508$, $z = -2.58$, $p < .01$. However, the relative magnitude of the difference was very small and only represented a small size effect ($r = 0.12$)

- ***Major Subject (Department) * QD101-107 – The Kruskal-Wallis Test***

In Section 6.4.2, the non-parametric counterpart of one-way ANOVA, the Kruskal-Wallis test (*K Independent Samples* underneath *Nonparametric Tests*), was conducted to explore the impact of students' 'department' on their knowledge of the palette of living issues (QD101-107). The aggregated consultation results showed that there were statistically significant differences between students from different departments on QD101, QD102 and QD105 at the level of $p < .01$ and on QD103 at the level of $p < .05$.

To verify the main differences, some follow-up Mann-Whitney U tests between pairs of groups were conducted to do the *post hoc* tests. To control for Type I errors, a *Bonferroni correction* was applied to adjust the critical value for significance, where the alpha value .05 was divided by the number of tests needed to be done. In this case, the stricter alpha level was .05/3 = .017, so all effects were reported at a .017 level of significance, as shown in A-

Table 1.1.

**Appendix-Table 1.1: Post hoc test – Mann-Whitney U test**

| | Mann-Whitney U | Wilcoxon W | Z | Asymnp. Sig. (2-tailed) |
|---|---|---|---|---|
| QD101 | | | | |
| Architecture vs. Landscape | 10632.500 | 46947.500 | -3.937 | .000(*) |
| Architecture vs. TRP | 8747.000 | 45062.000 | -4.312 | .000(*) |
| Landscape vs. TRP | 4544.500 | 10215.500 | -.848 | .397 |
| QD102 | | | | |
| Architecture vs. Landscape | 10427.500 | 46742.500 | -4.277 | .000(*) |
| Architecture vs. TRP | 9109.000 | 45424.000 | -3.996 | .000(*) |
| Landscape vs. TRP | 4757.000 | 10428.000 | -.305 | .760 |
| QD103 | | | | |
| Architecture vs. Landscape | 13005.500 | 49320.500 | -1.361 | .173 |
| Architecture vs. TRP | 10032.000 | 46347.000 | -2.788 | .005(*) |
| Landscape vs. TRP | 4401.500 | 10072.500 | -1.216 | .224 |
| QD105 | | | | |
| Architecture vs. Landscape | 11160.500 | 47475.500 | -3.380 | .001(*) |
| Architecture vs. TRP | 10277.000 | 46592.000 | -2.509 | .012(*) |
| Landscape vs. TRP | 4587.500 | 8865.500 | -.741 | .459 |

* significant difference at level of $p < .017$

The effect size could be calculated by using the following equation and evaluated according to the criteria mentioned earlier (Rosenthal 1991: 19, cited in Field 2005: 532; Pallant 2007: 223):

$$r = \frac{Z}{\sqrt{N}} \quad \text{(N = total number of cases)}$$

Since the results varied from issue to issue, statistical findings were summarised by issues in the following sections:

QD101: Students' knowledge of 'cost of utility bills (gas, electricity and water)' was significantly affected by their departments ($H(2) = 27.00$, $p < .01$). Architectural students ($Md = 2$, $n = 269$) had significantly less knowledge on this issue than landscape students ($Md = 3$, $n = 106$; $U = 10632.50$, $z = -3.937$, $p < .017$) and TRP students ($Md = 3$, $n = 92$; $U = 8747$, $z = -4.312$, $p < .017$); although the relative magnitude of both differences were small and only represented a small size effect ($r = 0.20$ between architectural students and landscape students; $r = 0.23$ between architectural students and TRP students). However, there was no statistically significant difference between landscape students and town and

regional planning students on the evaluation of this issue.

QD102: Students' knowledge of 'the difference between energy companies' was significantly affected by their departments (H(2) = 26.64, $p < .01$). Architectural students ($Md = 2$, $n = 269$) had significantly less knowledge on this issue than landscape students ($Md = 2.5$, $n = 106$; $U = 10427.50$, $z = -4.277$, $p < .017$) and TRP students ($Md = 2$, $n = 92$; $U = 9109$, $z = -3.996$, $p < .017$), though the relative magnitude of both differences were small and only represented a small size effect ($r = 0.22$ between architectural students and landscape students; $r = 0.21$ between architectural students and TRP students). However, there was no statistically significant difference between landscape students and town and regional planning students on the evaluation of this issue.

QD103: Students' knowledge of 'the control or setting of heating system' was significantly affected by their departments (H(2) = 8.12, $p < .05$). TRP students ($Md = 4$, $n = 92$) had significantly better understanding of this issue than architectural students ($Md = 3$, $n = 269$), $U = 10032$, $z = -2.788$, $p < .017$. However, the relative magnitude of the difference was small and only represented a small size effect ($r = 0.20$). Landscape students' understanding of this issue ($Md = 3$, $n = 106$) was not significantly different from either of them.

QD105: Students' knowledge of 'low energy lighting appliances' was significantly affected by their departments (H(2) = 14.26, $p < .01$). Architectural students ($Md = 2$, $n = 269$) had significantly less knowledge on this issue than landscape students ($Md = 3$, $n = 106$; $U = 11160.50$, $z = -3.380$, $p < .017$) and TRP students ($Md = 3$, $n = 92$; $U = 10277$, $z = -2.509$, $p < .017$), though the relative magnitude of both differences was small and only represented a small size effect ($r = 0.17$ between architectural students and landscape students; $r = 0.13$ between architectural students and TRP students). However, there was no statistically significant difference between landscape students and TRP students on the evaluation of this issue.

- ***Academic Year * QD101-107 – The Kruskal-Wallis Test***

In Section 6.4.2, the Kruskal-Wallis test (*K Independent Samples* underneath *Nonparametric Tests*), was also conducted to explore the impact of students' 'academic year' on their knowledge of some living issues (QD101-107). The aggregated consultation results showed that there were statistically significant differences between students from different academic years on all issues from QD101 to QD107 ($p < .01$).

To verify the main differences, some follow-up Mann-Whitney U tests between pairs of groups were conducted to do the *post hoc* tests. To control for Type I errors, a *Bonferroni correction* was applied to adjust the critical value for significance, where the alpha value .05 was divided by the number of tests needed to be done. In this case, it was planned to compare the differences between each adjacent academic year and the difference between the lowest academic year and the highest one (considering the postponement effects). Therefore, the stricter alpha level was .05/4 = .013 and all effects were reported at a .013 level of significance, as shown in A-Table 1.2.

**Appendix-Table 1.2: Post hoc test – Mann-Whitney U test**

| | Mann-Whitney U | Wilcoxon W | Z | Asymnp. Sig. (2-tailed) |
|---|---|---|---|---|
| QD101 | | | | |
| 1st year vs. 2nd year | 7875.000 | 16390.000 | -1.613 | .107 |
| 2nd year vs. 3rd year | 4272.000 | 13588.000 | -7.265 | .000(*) |
| 3rd year vs. MA | 4359.500 | 7134.500 | -.890 | .374 |
| 1st year vs. MA | 2026.000 | 10541.000 | -7.062 | .000(*) |
| QD102 | | | | |
| 1st year vs. 2nd year | 7111.000 | 15626.000 | -3.082 | .002(*) |
| 2nd year vs. 3rd year | 5241.000 | 14557.000 | -5.715 | .000(*) |
| 3rd year vs. MA | 4649.500 | 7424.500 | -.129 | .898 |
| 1st year vs. MA | 2203.000 | 10718.000 | -6.923 | .000(*) |
| QD103 | | | | |
| 1st year vs. 2nd year | 7737.000 | 17053.000 | -1.805 | .071 |
| 2nd year vs. 3rd year | 5259.000 | 14575.000 | -5.617 | .000(*) |
| 3rd year vs. MA | 4539.000 | 12667.000 | -.421 | .674 |
| 1st year vs. MA | 3193.000 | 11708.000 | -4.122 | .000(*) |
| QD104 | | | | |
| 1st year vs. 2nd year | 6033.500 | 15349.500 | -4.732 | .000(*) |
| 2nd year vs. 3rd year | 7555.500 | 16871.500 | -1.856 | .063 |
| 3rd year vs. MA | 4299.500 | 12427.500 | -1.055 | .291 |
| 1st year vs. MA | 4332.000 | 7107.000 | -1.247 | .212 |
| QD105 | | | | |
| 1st year vs. 2nd year | 8467.500 | 16982.500 | -.616 | .538 |
| 2nd year vs. 3rd year | 6022.000 | 15338.000 | -4.374 | .000(*) |
| 3rd year vs. MA | 4576.000 | 7351.000 | -.321 | .748 |
| 1st year vs. MA | 3240.000 | 11755.000 | -4.003 | .000(*) |
| QD106 | | | | |
| 1st year vs. 2nd year | 7783.500 | 17099.500 | -1.725 | .084 |
| 2nd year vs. 3rd year | 5655.500 | 14971.500 | -4.955 | .000(*) |
| 3rd year vs. MA | 4168.500 | 6943.500 | -1.379 | .168 |
| 1st year vs. MA | 4114.000 | 12629.000 | -1.764 | .078 |
| QD107 | | | | |
| 1st year vs. 2nd year | 7570.500 | 16886.500 | -2.127 | .033 |
| 2nd year vs. 3rd year | 6339.000 | 15655.000 | -3.878 | .000(*) |
| 3rd year vs. MA | 4384.500 | 7159.500 | -.816 | .414 |
| 1st year vs. MA | 4566.000 | 13081.000 | -.624 | .532 |

* significant difference at level of $p < .013$

And the effect size could be calculated by using the following equation and evaluated according to the criteria mentioned earlier (Rosenthal 1991: 19, cited in Field 2005: 532; Pallant 2007: 223):

$$r = \frac{Z}{\sqrt{N}} \quad \text{(N = total number of cases)}$$

Since the results varied from issue to issue, statistical findings were summarised by issues in the following sections:

QD101: Students' knowledge of 'cost of utility bills (gas, electricity and water)' was significantly affected by their academic years ($H(3) = 108.46$, $p < .01$). By comparing the differences between each adjacent academic year and the difference between the lowest academic year and the highest one, it was found that students in the 3rd year ($Md = 4$, $n = 127$) had significantly more knowledge on this issue than students in the 2nd year ($Md = 2$, $n = 136$), $U = 4272$, $z = -7.265$, $p < .013$. The relative magnitude of the difference was medium, very close to large, and represented a medium size effect ($r = 0.45$). Students in the MA or at an equal level ($Md = 3$, $n = 74$) also had significantly better understanding of this issue than students in the 1st year ($Md = 2$, $n = 130$), $U = 2026$, $z = -7.062$, $p < .013$. The relative magnitude of the difference was medium, very close to large, and represented a medium size effect ($r = 0.49$).

QD102: Students' knowledge of 'the difference between energy companies' was significantly affected by their academic years ($H(3) = 90.26$, $p < .01$). By comparing the differences between each adjacent academic year and the difference between the lowest academic year and the highest one, it was found that students in the 2nd year ($Md = 2$, $n = 136$) had significantly more knowledge on this issue than students in the 1st year ($Md = 1$, $n = 130$), $U = 7111$, $z = -3.082$, $p < .013$, although the effect size was small ($r = 0.19$). Students in the 3rd year ($Md = 3$, $n = 127$) had significantly more knowledge on this issue than students in the 2nd year ($Md = 2$, $n = 136$), $U = 5241$, $z = -5.715$, $p < .013$; and the effect size was medium ($r = 0.35$). Students in the MA or at an equal level ($Md = 3$, $n = 74$) had significantly better understanding of this issue than students in the 1st year ($Md = 1$, $n = 130$), $U = 2203$, $z = -6.923$, $p < .013$; and the effect size was medium, very close to large ($r = 0.48$). However, no statistically significant difference was found between students in the 3rd year ($Md = 3$, $n = 127$) and students in the MA or at an equal level ($Md = 3$, $n = 74$). Generally speaking, there was a linear association between students' education (academic year) and their knowledge of 'the difference between energy companies'.

QD103: Students' knowledge of 'the control or setting of heating system' was significantly affected by their academic years (H(3) = 49.34, $p < .01$). By comparing the differences between each adjacent academic year and the difference between the lowest academic year and the highest one, it was found that students in the 3rd year ($Md = 4$, $n = 127$) had significantly more knowledge on this issue than students in the 2nd year ($Md = 3$, $n = 136$), $U = 5259$, $z = -5.617$, $p < .013$, and the effect size was medium ($r = 0.35$). Students in the MA or at an equal level ($Md = 4$, $n = 74$) also had significantly better understanding of this issue than students in the 1st year ($Md = 3$, $n = 130$), $U = 3193$, $z = -4.122$, $p < .013$, although the effect size was small, very close to medium ($r = 0.29$).

QD104: Students' knowledge of 'the distance and frequency of service at the nearest public transport' was significantly affected by their academic years (H(3) = 23.28, $p < .01$). By comparing the differences between each adjacent academic year and the difference between the lowest academic year and the highest one, it was found that students in the 1st year ($Md = 4$, $n = 130$) had significantly more knowledge on this issue than students in the 2nd year ($Md = 4$, $n = 136$), $U = 6033.50$, $z = -4.732$, $p < .013$; although the effect size was small, very close to medium ($r = 0.29$).

QD105: Students' knowledge of 'low energy lighting appliance' was significantly affected by their academic years (H(3) = 37.06, $p < .01$). By comparing the differences between each adjacent academic year and the difference between the lowest academic year and the highest one, it was found that students in the 3rd year ($Md = 3$, $n = 127$) had significantly more knowledge on this issue than students in the 2nd year ($Md = 2$, $n = 136$), $U = 6022$, $z = -4.374$, $p < .013$; although the effect size was small ($r = 0.27$). Students in the MA or at an equal level ($Md = 3$, $n = 74$) also had significantly better understanding of this issue than students in the 1st year ($Md = 2$, $n = 130$), $U = 3240$, $z = -4.003$, $p < .013$, and the effect size was small, very close to medium ($r = 0.28$).

QD106: Students' knowledge of 'recycling household waste' was significantly affected by their academic years (H(3) = 28.94, $p < .01$). By comparing the differences between each adjacent academic year and the difference between the lowest academic year and the highest one, it was found that students in the 3rd year ($Md = 4$, $n = 127$) had significantly more knowledge on this issue than students in the 2nd year ($Md = 3$, $n = 136$), $U = 5655.50$, $z = -4.955$, $p < .013$; and the effect size was medium ($r = 0.31$).

QD107: Students' knowledge of 'Ecological Footprint of the current lifestyle' was

significantly affected by their academic years (H(3) = 15.72, $p < .01$). By comparing the differences between each adjacent academic year and the difference between the lowest academic year and the highest one, it was found that students in the 3rd year ($Md = 2$, $n = 127$) had significantly more knowledge on this issue than students in the 2nd year ($Md = 2$, $n = 136$), $U = 6339$, $z = -3.878$, $p < .013$; although the effect size was small ($r = 0.24$).

- ***Accommodation Types * QD101-107 – The Kruskal-Wallis Test***

In Section 6.4.2, the Kruskal-Wallis test (*K Independent Samples* underneath *Nonparametric Tests*) was conducted again to explore the impact of students' 'accommodation types' on their knowledge of some living issues (QD101-107). The aggregated consultation results showed that there were statistically significant differences between students living in different accommodation types on issues from QD101 to QD106 ($p < .01$).

**Appendix-Table 1.3: Post hoc test – Mann-Whitney U test**

| | Mann-Whitney U | Wilcoxon W | Z | Asymnp. Sig. (2-tailed) |
|---|---|---|---|---|
| QD101 | | | | |
| University vs. private rented | 10674.500 | 21259.500 | -8.724 | .000(*) |
| University vs. personally own | 1130.000 | 11715.000 | -3.914 | .000(*) |
| Private rented vs. personally own | 3995.500 | 4401.500 | -.263 | .792 |
| QD102 | | | | |
| University vs. private rented | 12057.500 | 22642.500 | -7.774 | .000(*) |
| University vs. personally own | 1172.000 | 11757.000 | -4.051 | .000(*) |
| Private rented vs. personally own | 3801.000 | 47166.000 | -.691 | .489 |
| QD103 | | | | |
| University vs. private rented | 16845.500 | 27430.500 | -3.677 | .000(*) |
| University vs. personally own | 1024.000 | 11609.000 | -4.254 | .000(*) |
| Private rented vs. personally own | 2839.500 | 46204.500 | -2.794 | .005(*) |
| QD104 | | | | |
| University vs. private rented | 17755.000 | 61120.000 | -3.000 | .003(*) |
| University vs. personally own | 1758.000 | 12343.000 | -1.190 | .234 |
| Private rented vs. personally own | 2919.500 | 46284.500 | -2.676 | .007(*) |
| QD105 | | | | |
| University vs. private rented | 15903.500 | 26488.500 | -4.470 | .000(*) |
| University vs. personally own | 1207.500 | 11792.500 | -3.514 | .000(*) |
| Private rented vs. personally own | 3403.500 | 46768.500 | -1.561 | .118 |
| QD106 | | | | |
| University vs. private rented | 18722.500 | 29307.500 | -2.128 | .033 |
| University vs. personally own | 1117.500 | 11702.500 | -3.860 | .000(*) |
| Private rented vs. personally own | 2776.500 | 46141.500 | -2.919 | .004(*) |

* significant difference at level of $p < .017$

To verify the main differences, some follow-up Mann-Whitney U tests between pairs of groups were conducted to do the *post hoc* tests. To control for Type I errors, a *Bonferroni*

*correction* was applied to adjust the critical value for significance, where the alpha value .05 was divided by the number of tests needed to be done. In this case, the stricter alpha level was .05/3 = .017, so all effects were reported at a .017 level of significance, as shown in A-Table 1.3.

The effect size could be calculated by using the following equation and evaluated according to the criteria mentioned earlier (Rosenthal 1991: 19, cited in Field 2005: 532; Pallant 2007: 223):

$$r = \frac{Z}{\sqrt{N}} \quad \text{(N = total number of cases)}$$

Since the results varied from issue to issue, statistical findings were summarised by issues in the following sections:

QD101: Students' knowledge of 'cost of utility bills (gas, electricity and water)' was significantly affected by the accommodation types ($H(2) = 76.96$, $p < .01$). Students living in private rented properties ($Md = 3$, $n = 294$) had significantly more knowledge on this issue than students living in the university or university partnership properties ($Md = 2$, $n = 145$), $U = 10674.50$, $z = -8.724$, $p < .017$; and the effect size was medium ($r = 0.42$). Further, Students living in personally owned properties or living with relatives ($Md = 3$, $n = 28$) also had significantly more knowledge on this issue than students living in the university or university partnership properties ($Md = 2$, $n = 145$), $U = 11300$, $z = -3.914$, $p < .017$; and the effect size was medium ($r = 0.30$). However, no significant difference was found between students living in private rented properties and students living in personally owned properties.

QD102: Students' knowledge of 'the difference between energy companies' was significantly affected by the accommodation types ($H(2) = 61.97$, $p < .01$). Students living in private rented properties ($Md = 2$, $n = 294$) had significantly more knowledge on this issue than students living in the university or university partnership properties ($Md = 1$, $n = 145$), $U = 12057.50$, $z = -7.774$, $p < .017$; and the effect size was medium ($r = 0.37$). Further, Students living in personally owned properties or living with relatives ($Md = 3$, $n = 28$) also had significantly more knowledge on this issue than students living in the university or university partnership properties ($Md = 1$, $n = 145$), $U = 1172$, $z = -4.051$, $p < .017$; and the effect size was medium ($r = 0.31$). However, no significant difference was found between students living in private rented properties and students living in personally owned properties.

QD103: Students' knowledge of 'the control or setting of heating system' was significantly affected by the accommodation types (H(2) = 24.81, $p < .01$). Students living in private rented properties ($Md = 3$, $n = 294$) had significantly more knowledge on this issue than students living in the university or university partnership properties ($Md = 3$, $n = 145$), $U = 16845.50$, $z = -3.677$, $p < .017$; although the effect size was small ($r = 0.18$). Further, students living in personally owned properties or living with relatives ($Md = 4$, $n = 28$) also had significantly more knowledge on this issue than students living in the university or university partnership properties ($Md = 3$, $n = 145$), $U = 1024$, $z = -4.254$, $p < .017$; although the effect size was small, close to medium ($r = 0.28$). Students living in personally owned properties or living with relatives ($Md = 4$, $n = 28$) had significantly more knowledge on this issue than students living in private rented properties ($Md = 3$, $n = 294$), $U = 2839.50$, $z = -2.794$, $p < .017$; although the effect size was small ($r = 0.16$).

QD104: Students' knowledge of 'the distance and frequency of service at the nearest public transport' was significantly affected by the accommodation types (H(2) = 13.95, $p < .01$). Students living in private rented properties ($Md = 4$, $n = 294$) had significantly more knowledge on this issue than students living in the university or university partnership properties ($Md = 4$, $n = 145$), $U = 17755$, $z = -3.000$, $p < .017$; although the effect size was small ($r = 0.14$). Further, students living in private rented properties ($Md = 4$, $n = 294$) also had significantly more knowledge on this issue than students living in personally owned properties or living with relatives ($Md = 4$, $n = 28$), $U = 2919.5$, $z = -2.676$, $p < .017$; although the effect size was small ($r = 0.20$). However, no significant difference was found between students living in the university or university partnership properties and students living in personally owned properties.

QD105: Students' knowledge of 'low energy lighting appliance' was significantly affected by the accommodation types (H(2) = 24.97, $p < .01$). Students living in private rented properties ($Md = 3$, $n = 294$) had significantly more knowledge on this issue than students living in the university or university partnership properties ($Md = 2$, $n = 145$), $U = 15903.50$, $z = -4.470$, $p < .017$; although the effect size was small ($r = 0.21$). Further, students living in personally owned properties or living with relatives ($Md = 3$, $n = 28$) also had significantly more knowledge on this issue than students living in the university or university partnership properties ($Md = 2$, $n = 145$), $U = 1207.50$, $z = -3.514$, $p < .017$; and the effect size was small, close to medium ($r = 0.27$). However, no significant difference was found between students living in private rented properties and students living in the personally owned properties.

QD106: Students' knowledge of 'recycling household waste' was significantly affected by the accommodation types (H(2) = 15.66, $p < .01$). Students living in personally owned properties or living with relatives ($Md = 4$, $n = 28$) had significantly more knowledge on this issue than students living in the university or university partnership properties ($Md = 3$, $n = 145$), $U = 1117.50$, $z = -3.860$, $p < .017$; although the effect size was small ($r = 0.29$). Students living in personally owned properties or living with relatives ($Md = 4$, $n = 28$) also had significantly more knowledge on this issue than students living in private rented properties ($Md = 3$, $n = 294$), $U = 2776.50$, $z = -2.919$, $p < .017$; although the effect size was small ($r = 0.16$). However, no significant difference was found between students living in the university or university partnership properties and students living in private rented properties.

## APPENDIX 1.3: WILLINGNESS TO LIFESTYLE CHANGE (QD401) * KNOWLEDGE OF LIFESTYLE ISSUES (QD101-107)

This section intends to explore the impact of students' willingness to look for sustainability-related information on their knowledge of the living issues addressed in QD101-107.

- ***Willingness to Lifestyle Change (QD401) * QD101-107 – Mann-Whitney U test***

In Section 6.4.4, the Mann-Whitney U test (*2 Independent Samples* underneath *Nonparametric Tests*) was conducted to compare the knowledge differences of some living issues (QD101-107) between students who were looking for information about living in a more sustainable way and those who were not. The aggregated consultation results showed that there were significant knowledge differences of almost all the issues addressed in QD101-107 between students who were concerned about sustainable lifestyle (those who would look for information about living in a more sustainable way) and those who were not ($p < .01$), except QD104 (awareness of information related to local public transport).

To understand those consultation results with significant differences ($p < .05$) better, the SPSS outputs of QD101, QD102, QD103, QD105, QD106 and QD107 were reported in the following sections, using median values (*Md*) for each group:

QD101: For the issue of 'cost of utility bills', students who would look for information about living in a more sustainable way ($Md = 3$, $n = 265$) had significantly more knowledge of this issue than those students who would not ($Md = 2$, $n = 202$), $U = 21767.5$, $z = -3.55$, $p < .01$. However, the relative magnitude of the difference was very small and only represented a small size effect ($r = 0.16$).

QD102: For the issue of 'the difference between energy companies', students who would look for information about living in a more sustainable way ($Md = 2$, $n = 265$) had significantly more knowledge of this issue than those students who would not ($Md = 2$, $n = 202$), $U = 22420.5$, $z = -3.15$, $p < .01$. However, the relative magnitude of the difference was very small and only represented a small size effect ($r = 0.15$).

QD103: For the issue of 'the control or setting of heating system', students who would look for information about living in a more sustainable way ($Md = 3$, $n = 265$) had significantly more knowledge of this issue than those students who would not ($Md = 3$, $n = 202$), $U = 22521.5$, $z = -3.02$, $p < .01$. However, the relative magnitude of the difference was very small and only represented a small size effect ($r = 0.14$).

QD105: For the issue of 'low energy lighting appliance', students who would look for information about living in a more sustainable way ($Md = 3$, $n = 265$) had significantly more knowledge of this issue than those students who would not ($Md = 2$, $n = 202$), $U = 18459$, $z = -5.93$, $p < .01$. However, the relative magnitude of the difference was small and represented a small size effect ($r = 0.27$) though it was close to medium (.30).

QD106: For the issue of 'recycling household waste', students who would look for information about living in a more sustainable way ($Md = 4$, $n = 265$) had significantly more knowledge of this issue than those students who would not ($Md = 3$, $n = 202$), $U = 15895$, $z = -7.72$, $p < .01$. Further, the relative magnitude of the difference was medium and represented a medium size effect ($r = 0.36$).

QD107: For the issue of 'Ecological Footprint', students who would look for information about living in a more sustainable way ($Md = 2$, $n = 265$) had significantly more knowledge of this issue than those students who would not ($Md = 2$, $n = 202$), $U = 18347.5$, $z = -6.05$, $p < .01$. However, the relative magnitude of the difference was small and represented a small size effect ($r = 0.28$) though it was close to medium (.30).

## APPENDIX 1.4: A FOLLOW-UP PROCEDURE – COMPARATIVE DESIGN

The follow-up procedure intended to validate the generalisation of the study carried out in the Faculty of Architecture.

- ***Two Student Groups * QC201-226 – Independent T test***

In Section 6.5.1, the independent t-test (*Independent Samples T test* underneath *Compare*

*Means*) was conducted to compare the means, on the evaluation of the palette of housing environmental issues drawn from EcoHomes (from QC201 to QC226), for students from the Faculty of Architecture and students from other departments in the university. The aggregated consultation results showed that there were significant differences ($p < .05$) between the two groups of variables on the evaluation of the relative importance of four housing environmental issues, which were QC202, QC203, QC210 and QC225.

Then the effect size were calculated according to the following equation and evaluated according to the criteria mentioned earlier (Rosnow & Rosenthal 2005: 328; cited in Field 2005: 32)

$$r = \sqrt{\frac{t^2}{t^2 + df}}$$

To understand those consultation results with significant differences ($p < .05$) better, the SPSS outputs from QC202, QC203, QC210 and QC225 were reported in the following sections, using mean values ($M$) and standard division ($SD$) for each group:

QC202: On average, the issue related to 'the costs for utilities (electricity / gas / water)' was considered by students from other departments ($M = 4.12$, $SD = 0.82$) to be significantly more important than students from the Faculty of Architecture ($M = 3.78$, $SD = 0.84$) in the target group; $t$ (508) = -2.50, $p < .05$ (2-tailed). However, the relative magnitude of the difference between means was very small and only represented a small size effect ($r = 0.11$).

QC203: On average, the issue related to 'other expenditure' was considered by students from other departments ($M = 3.79$, $SD = 0.83$) to be significantly more important than students from the Faculty of Architecture ($M = 3.52$, $SD = 0.85$) in the target group; $t$ (508) = -2.00, $p < .05$ (2-tailed). However, the relative magnitude of the difference between means was very small and only represented a very small size effect ($r = 0.09$).

QC210: On average, the issue related to 'close to café, takeaway or restaurant' was considered by students from other departments ($M = 3.14$, $SD = 1.01$) to be significantly more important than students from the Faculty of Architecture ($M = 2.83$, $SD = 0.96$) in the target group; $t$ (508) = -2.00, $p < .05$ (2-tailed). However, the relative magnitude of the difference between means was very small and only represented a very small size effect ($r =$

0.09).

QC225: On average, the issue related to 'energy efficient fridge and wash machine with white goods label' was considered by students from other departments ($M = 3.63$, $SD = 1.05$) to be significantly more important than students from the Faculty of Architecture ($M = 3.39$, $SD = 0.95$) in the target group; $t$ (508) = -1.99, $p < .05$ (2-tailed). However, the relative magnitude of the difference between means was very small and only represented a very small size effect ($r = 0.09$).

- ***Two Student Groups * QD101-107 – Mann-Whitney U test***

In Section 6.5.1, the Mann-Whitney U test (*2 Independent Samples* underneath *Nonparametric Tests*) was then conducted to compare the differences between these two groups of students' knowledge of some living issues (QD101-107). The aggregated consultation results showed that there was only one significant difference ($p < .05$) between the two groups of students, which was students' knowledge of QD103.

To discover whether the effect was substantive, the effect size could be calculated according to the following equation and evaluated according to the criteria mentioned earlier (Rosenthal 1991: 19, cited in Field 2005: 532; Pallant 2007: 223):

$$r = \frac{Z}{\sqrt{N}} \quad \text{(N = total number of cases)}$$

Then the SPSS output of QD103 was reported in the following sections, using median values (*Md*) for each group:

QD103: Students from the Faculty of Architecture ($Md = 3$, $n = 467$) had significantly more knowledge of 'the control or setting of heating system' than students from other departments ($Md = 3$, $n = 43$), $U = 8221.5$, $z = -2.02$, $p < .05$. However, the relative magnitude of the difference was very small and only represented a small size effect ($r = 0.09$).

# APPENDIX 2: SURVEY DOCUMENTS

## APPENDIX 2.1: APPROVAL FROM THE DEPARTMENT'S ETHICS REVIEW PANEL

**THE UNIVERSITY OF SHEFFIELD**

**School of Architecture**

*Judith Torrington*
*Direct line 0114 2220346*
*j.m.torrington@sheffield.ac.uk*

Mr Bing Chen
School of architecture
University of Sheffield
The Arts Tower
Western Bank
Sheffield
S10 2TN

Sunday, 24 September 2006

Dear Bing Chen,

**Constructing a communication platform for sustainable housing development**

I am pleased to inform you that on 7 December 2005 the Department's Ethic Reviewers approved the above named project on ethics grounds, on the basis that you will adhere to and use the following documents that you submitted for ethics review:

- Research ethics application form
- Participant information sheet
- Participant consent form

However the ethics reviewers have made the following suggestion:
You should consult with your supervisor about the most secure way to store the data you collect

If during the course of the project you need to deviate from the above approved documents please inform me. The written approval of the Department's Ethics Review Panel will be required for significant deviations from or significant changes to the above approved documents. If you decide to terminate the project prematurely please inform me.

Yours sincerely

Judith Torrington.

Ethics Administrator

# APPENDIX 2.2: COVER LETTER / PARTICIPANT INFORMATION SHEET

THE UNIVERSITY OF SHEFFIELD

School of Architecture

The Arts Tower
Western Bank
Sheffield S10 2TN
Tel: (0114) 222 20360

## PLEASE COULD YOU HELP WITH THIS RESEARCH?

### Your views about STUDENT ACCOMMODATION & SUSTAINABLE LIFESTYLE

Dear Sir or Madam,

You are being invited to participate in an independent research project about student accommodation. This research aims to help people understand the issues of energy saving and carbon reductions, getting the message across in their daily lives. So the researcher is mainly concerned with sustainability and the related lifestyle change. Currently all participants have been divided into three groups: developers, designers and occupants. And you have been regarded as one of the representatives. The outcome and experience will be used in the future student accommodation design and related housing development to achieve higher sustainable qualities.

Along with this letter there is a questionnaire which forms part of this work. You have been asked to do me the favour – please look through the questionnaire and, if you would like to do so, complete it and give me some feed back. This will only take you about 10-15 minutes. Your contribution to this research will be extremely valuable and will lead to specific recommendations to improve the collaboration in current student accommodation development and housing market, should you wish to help.

Please note that all survey data are completely anonymous and will be held in accordance with the **Data Protection Act**. (*There will be no individual being identified.*) All information that you provide will be completely confidential and used only for research into sustainable design as part of a PhD work at the School of Architecture, University of Sheffield.

I would be very grateful if you would kindly return the completed questionnaire or participate in the following programmes like interviews and recruitments. Any suggestions about this work will also be welcome.

Many thanks for your time.

Yours Sincerely,

Bing Chen (Principal researcher)

*This project has been reviewed by the University Research Ethics Committee/Departmental Ethics Review Procedure. If you have any question please contact me freely at the address above or phone on the daytime number given. Thanks again for your participation and help.*

C1. What type of accommodation do you think will be suitable to students? (*Mark all that apply*)

☐ Flat ☐ Terrace ☐ Semi-detached ☐ Detached ☐ Bungalows

C2. When you look for a new accommodation, please rate the importance of the following

**1 Not at all important; 2 Less important; 3 Equal/Neutral; 4 Important; 5 Very important**

| | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| ***1. Economic aspect*** | | | | | |
| Charges for rent and deposit | ☐ | ☐ | ☐ | ☐ | ☐ |
| How much it costs for utilities: electricity / gas / water | ☐ | ☐ | ☐ | ☐ | ☐ |
| Other expenditure for additional furniture or appliances, or travel expense | ☐ | ☐ | ☐ | ☐ | ☐ |
| ***2. Location*** | | | | | |
| Secure area and safe access | ☐ | ☐ | ☐ | ☐ | ☐ |
| Friendly surroundings with good ecological system and landscape | ☐ | ☐ | ☐ | ☐ | ☐ |
| Close to a frequent public transport, such as bus stop, tram stop, etc. | ☐ | ☐ | ☐ | ☐ | ☐ |
| Close to local accessible amenities: | | | | | |
| Supermarket or late shops | ☐ | ☐ | ☐ | ☐ | ☐ |
| Gymnasium or sports centre | ☐ | ☐ | ☐ | ☐ | ☐ |
| Pub or bar | ☐ | ☐ | ☐ | ☐ | ☐ |
| Cafe, takeaway or restaurant | ☐ | ☐ | ☐ | ☐ | ☐ |
| Others, please specify: _____ | ☐ | ☐ | ☐ | ☐ | ☐ |
| ***3. Internal & External Requirements*** | | | | | |
| Natural daylighting in the bedroom | ☐ | ☐ | ☐ | ☐ | ☐ |
| Drying space for clothes, internal or external | ☐ | ☐ | ☐ | ☐ | ☐ |
| Space and service for studying or working from home, like internet access | ☐ | ☐ | ☐ | ☐ | ☐ |
| High insulation standards, like double glazing | ☐ | ☐ | ☐ | ☐ | ☐ |
| Fitment and furniture with timber or environmentally friendly appearance | ☐ | ☐ | ☐ | ☐ | ☐ |
| Sound insulation between adjacent rooms or floors | ☐ | ☐ | ☐ | ☐ | ☐ |
| Private outdoor space, like back-garden | ☐ | ☐ | ☐ | ☐ | ☐ |
| Secure cycle storage | ☐ | ☐ | ☐ | ☐ | ☐ |
| Private car parking | ☐ | ☐ | ☐ | ☐ | ☐ |
| Openable windows & airflow to improve interior air conditions | ☐ | ☐ | ☐ | ☐ | ☐ |
| Southern orientation of the bedroom for interior warmth | ☐ | ☐ | ☐ | ☐ | ☐ |
| Efficient control system for central heating and hot water | ☐ | ☐ | ☐ | ☐ | ☐ |
| Facilities for disposing separately or recycling household wastes in kitchen | ☐ | ☐ | ☐ | ☐ | ☐ |
| ***4. Energy efficiency for money saving*** | | | | | |
| Energy efficient heating and lighting appliances | ☐ | ☐ | ☐ | ☐ | ☐ |
| Energy efficient fridge and wash machine with white goods label | ☐ | ☐ | ☐ | ☐ | ☐ |
| Water-saving toilet | ☐ | ☐ | ☐ | ☐ | ☐ |
| ***5. Other details, please specify:*** _____ | ☐ | ☐ | ☐ | ☐ | ☐ |

**C. Your opinions for house finding**

**D. Your options for house running and relevant lifestyle**

D1. When you lived in your accommodation during the last semester, please rate your understanding (or knowledge) of the following items as:

| **1 Very poor; 2 Poor; 3 Equal; 4 Good; 5 Very good** | **1** | **2** | **3** | **4** | **5** |
|---|---|---|---|---|---|
| Cost of utility bills (gas/electricity/water) | ☐ | ☐ | ☐ | ☐ | ☐ |
| The difference between energy companies, like PowerGen, NPower, etc. | ☐ | ☐ | ☐ | ☐ | ☐ |
| The control or setting of heating system | ☐ | ☐ | ☐ | ☐ | ☐ |
| The distance and frequency of service at the nearest bus stop or tram stop | ☐ | ☐ | ☐ | ☐ | ☐ |
| Low energy lighting appliance: illumination (W) and cost | ☐ | ☐ | ☐ | ☐ | ☐ |
| Recycling household wastes (segregated bins) | ☐ | ☐ | ☐ | ☐ | ☐ |
| Ecological Footprint of your current lifestyle: www.myfootprint.org | ☐ | ☐ | ☐ | ☐ | ☐ |

D2. In the student village, which kind of accommodation package would you prefer to?

☐ Rent 260 + Utility Bills 40 / month ☐ Rent 280 + Utility Bills 20 / month

☐ Rent 300 / month, utility bills inclusive ☐ No difference ☐ Don't care

D3. What kind of transport do you use generally?

☐ Public transport ☐ Private car ☐ Shared car ☐ Motorbike ☐ Bike ☐ Walk

D4. Do you look for information about living in a more sustainable way? ☐ Yes ☐ No

If yes, please specify where you usually get the information from. (*Mark all that apply*)

☐ Professional / trade body ☐ Government publication

☐ Research organisations ☐ Information Booklet from University Accommodation

☐ Friends / colleagues / tutors ☐ Professional journal / publication

☐ General media like TV, radio or newspaper ☐ Other, please specify: _____

**E. About yourself (OPTIONAL)**

E1. *OPEN QUESTION*: As a university student, do you have any *special* interests when you look for a new accommodation? Compared with your other housemates or friends, how would you like to change your current lifestyle towards greater environmental sensitivity?

E2. Personal Information (*OPTIONAL*): *if you would like to take part in a follow-up programme like interview or interest group discussion, please give you email below, otherwise leave it blank.*

Email: _____

*(Comments – if you have any other comments you would like to make regarding sustainable lifestyles or the survey itself, please also do so in the blank above or on the back of this page.)*

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All information that you provide will be strictly confidential and used only for the research into sustainable housing design process as part of a PhD work at the School of Architecture, University of Sheffield. No personal records will be kept of the replies unless the section for email contact – and then, that information will only be used in possible follow-up programmes. I would be very grateful if you would participate in the following programmes like interviews or discussion. Any suggestions or discussions about this work are also welcome. [*All papers will be recycled.*]

Many thanks for your time.

Yours Sincerely,

Bing CHEN (Principal Researcher)

*If you have any question please contact me freely at the address below or phone on the daytime number given.*

*Thanks again for your participation and help.*

*Address: Office 18.3, The Arts Tower, Sheffield, S10 2TN*

*Tel: (0114) 222 0360 Email: Bing.Chen@sheffield.ac.uk*

# APPENDIX 2.4: INTERVIEW GUIDE TO THE CLIENT GROUP (ACS)

A. When proposing or developing a new student accommodation towards sustainability standards, please rate the relative importance of the following items in your decision making process:

**1 Not at all important; 2 Less important; 3 Equal/Neutral; 4 Important; 5 Very important**

| ***1. Project Scheme and Management*** | **1** | **2** | **3** | **4** | **5** |
|---|---|---|---|---|---|
| Use brownfield sites in preference to greenfield | ☐ | ☐ | ☐ | ☐ | ☐ |
| Plan to include local accessible amenities | ☐ | ☐ | ☐ | ☐ | ☐ |
| Protect local ecosystem & reduce site impacts during construction process | ☐ | ☐ | ☐ | ☐ | ☐ |
| ***2. Master Plan*** | | | | | |
| Enhance local ecological values | ☐ | ☐ | ☐ | ☐ | ☐ |
| Close to a public transport node like bus stop, tram stop, etc. | ☐ | ☐ | ☐ | ☐ | ☐ |
| High density (*like the ratio requirement between Floor Area and Footprint*) | ☐ | ☐ | ☐ | ☐ | ☐ |
| Site layout for natural daylighting and view | ☐ | ☐ | ☐ | ☐ | ☐ |
| Decide landscape categories according to the typology of surrounding sites | ☐ | ☐ | ☐ | ☐ | ☐ |
| ***3. Plan / Elevation / Section / Interior Design*** | | | | | |
| Room and window design for daylighting | ☐ | ☐ | ☐ | ☐ | ☐ |
| Provision of internal or external naturally drying space for clothes | ☐ | ☐ | ☐ | ☐ | ☐ |
| Space and services for working from home | ☐ | ☐ | ☐ | ☐ | ☐ |
| High insulation standards | ☐ | ☐ | ☐ | ☐ | ☐ |
| Use of ecological materials or environmentally friendly materials | ☐ | ☐ | ☐ | ☐ | ☐ |
| Use sustainably sourced timber as primary/secondary elements | ☐ | ☐ | ☐ | ☐ | ☐ |
| Select materials based on their full life-cycle rating | ☐ | ☐ | ☐ | ☐ | ☐ |
| Design and testing for sound insulation | ☐ | ☐ | ☐ | ☐ | ☐ |
| Private outdoor space | ☐ | ☐ | ☐ | ☐ | ☐ |
| Efficient control for external lighting & internal lighting appliances | ☐ | ☐ | ☐ | ☐ | ☐ |
| Secure cycle storage | ☐ | ☐ | ☐ | ☐ | ☐ |
| Natural ventilation | ☐ | ☐ | ☐ | ☐ | ☐ |
| Passive solar design, like buffer zone (conservatory), thermal mass, etc. | ☐ | ☐ | ☐ | ☐ | ☐ |
| ***4. Supply & Reuse for Energy and Water*** | | | | | |
| On-site renewable energy / green energy supply system | ☐ | ☐ | ☐ | ☐ | ☐ |
| Energy efficient heating/lighting appliances | ☐ | ☐ | ☐ | ☐ | ☐ |
| Use low-emission fossil fuel boilers/appliances | ☐ | ☐ | ☐ | ☐ | ☐ |
| Rainwater collection / sustainable drainage system | ☐ | ☐ | ☐ | ☐ | ☐ |
| Low water use appliances | ☐ | ☐ | ☐ | ☐ | ☐ |
| Facilities to recycle rainwater | ☐ | ☐ | ☐ | ☐ | ☐ |
| Facilities to recycle household waste, i.e. segregated bins | ☐ | ☐ | ☐ | ☐ | ☐ |
| ***5. Other Details*** | | | | | |
| Provide energy efficient white goods (fridge, etc.) and relevant information | ☐ | ☐ | ☐ | ☐ | ☐ |
| Accommodation users' guide | ☐ | ☐ | ☐ | ☐ | ☐ |
| Others, Please specify:_____ | ☐ | ☐ | ☐ | ☐ | ☐ |

**A. Knowledge and application about services, technologies and products from EcoHomes**

-1-

B. In terms of the Student Village project or any new student accommodation, please rate the importance of the following items from a student's perspective:

**1 Not at all important; 2 Less important; 3 Equal/Neutral; 4 Important; 5 Very important**

| | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| ***1. Economic aspect*** | | | | | |
| Charges for rent and deposit | ☐ | ☐ | ☐ | ☐ | ☐ |
| How much it costs for utilities: electricity / gas / water | ☐ | ☐ | ☐ | ☐ | ☐ |
| Other expenditure for additional furniture or appliances, or travel expense | ☐ | ☐ | ☐ | ☐ | ☐ |
| ***2. Location*** | | | | | |
| Secure area and safe access | ☐ | ☐ | ☐ | ☐ | ☐ |
| Friendly surroundings with good ecological system and landscape | ☐ | ☐ | ☐ | ☐ | ☐ |
| Close to a frequent public transport, such as bus stop, tram stop, etc. | ☐ | ☐ | ☐ | ☐ | ☐ |
| Close to local accessible amenities: | | | | | |
| Supermarket or late shops | ☐ | ☐ | ☐ | ☐ | ☐ |
| Gymnasium or sports centre | ☐ | ☐ | ☐ | ☐ | ☐ |
| Pub or bar | ☐ | ☐ | ☐ | ☐ | ☐ |
| Cafe, takeaway or restaurant | ☐ | ☐ | ☐ | ☐ | ☐ |
| Others, please specify: _____ | ☐ | ☐ | ☐ | ☐ | ☐ |
| ***3. Internal & External Requirements*** | | | | | |
| Natural daylighting in the bedroom | ☐ | ☐ | ☐ | ☐ | ☐ |
| Drying space for clothes, internal or external | ☐ | ☐ | ☐ | ☐ | ☐ |
| Space and service for studying or working from home, like internet access | ☐ | ☐ | ☐ | ☐ | ☐ |
| High insulation standards, like double glazing | ☐ | ☐ | ☐ | ☐ | ☐ |
| Fitment and furniture with timber or environmentally friendly appearance | ☐ | ☐ | ☐ | ☐ | ☐ |
| Sound insulation between adjacent rooms or floors | ☐ | ☐ | ☐ | ☐ | ☐ |
| Private outdoor space, like back-garden | ☐ | ☐ | ☐ | ☐ | ☐ |
| Secure cycle storage | ☐ | ☐ | ☐ | ☐ | ☐ |
| Private car parking | ☐ | ☐ | ☐ | ☐ | ☐ |
| Openable windows & airflow to improve interior air conditions | ☐ | ☐ | ☐ | ☐ | ☐ |
| Southern orientation of the bedroom for interior warmth | ☐ | ☐ | ☐ | ☐ | ☐ |
| Efficient control system for central heating and hot water | ☐ | ☐ | ☐ | ☐ | ☐ |
| Facilities for disposing separately or recycling household wastes in kitchen | ☐ | ☐ | ☐ | ☐ | ☐ |
| ***4. Energy efficiency for money saving*** | | | | | |
| Energy efficient heating and lighting appliances | ☐ | ☐ | ☐ | ☐ | ☐ |
| Energy efficient fridge and wash machine (*with white goods label*) | ☐ | ☐ | ☐ | ☐ | ☐ |
| Water-saving toilet | ☐ | ☐ | ☐ | ☐ | ☐ |
| ***5. Other details*** | | | | | |
| Understandable accommodation users' guide with relevant information | ☐ | ☐ | ☐ | ☐ | ☐ |
| Others, please specify: _____ | ☐ | ☐ | ☐ | ☐ | ☐ |

**B. Your opinions of a good student accommodation**

C1. What would be your top 5 drivers to engage the project team to take sustainability into account in the Student Village project? *(Mark 5 only)*

- ☐ Competitive edge
- ☐ Reducing waste
- ☐ Enhanced reputation
- ☐ Economic benefits
- ☐ Environmental benefits
- ☐ Government initiatives
- ☐ Championing innovation
- ☐ Doing the 'right thing'
- ☐ Compliance with legislation
- ☐ Demonstrating best practice
- ☐ Meeting student requirement
- ☐ Local Authority planning policy
- ☐ Other, please specify: _____

C2. Likewise, what would be your top 5 barriers? *(Mark 5 only)*

- ☐ Lack of awareness
- ☐ Lack of information and relevant training
- ☐ Lack of evidence or background data
- ☐ Lack of local availability of services/products
- ☐ Lack of interest from students
- ☐ Lack of understanding/proof of the business case
- ☐ Affordability / Cost
- ☐ Perceived risk
- ☐ Poor perception of sustainability
- ☐ Time constraints
- ☐ Procurement barriers
- ☐ Other, please specify: _____

C3. Please indicate 5 of the following you think would encourage your colleagues to increase their awareness or interests on sustainable measures/strategies? *(Mark 5 only)*

- ☐ Directory of suppliers of services and products
- ☐ Information about the latest suitable R&D
- ☐ Information on exemplar projects and best practice
- ☐ Example specifications
- ☐ Publicity / promotion of sustainability
- ☐ Forums / networks for sharing information
- ☐ Cost and benefits analysis
- ☐ Information about funding
- ☐ Award / recognition scheme
- ☐ Training
- ☐ Advisory / guidance service
- ☐ Other, please specify: _____

**C. Motivational factors**

D1. Your job title and job summary:

D2. Do you think it is necessary to improve students' awareness and understanding on sustainable living? Do you think 'change students' lifestyles towards sustainability (especially for energy saving and carbon reductions)' should be part of the new Student Residences Strategy?

D3. Which method do you think will be most effective in motivating students to change their existing attitudes and behaviour towards energy saving and carbon reductions? Which method do you think will be most effective to delivery the relevant information and knowledge?

D4. As a staff working in the Department of Accommodation Campus Services, do you have any *special* interests when you look for a new accommodation? Compared with your friends, how would you like to change your current lifestyle towards sustainability?

D5. Personal Information (*OPTIONAL*): *if you would like to take part in a follow-up programme like interview or interest group discussion, please give you email below, otherwise leave it blank.*
Email: _____

**D. Open Questions & Personal Information**

*(Comments – if you have any other comments you would like to make regarding lifestyle change towards sustainability or the survey itself, please also do so in the blank above or on the back of this page.)*



*All papers will be recycled.*

# APPENDIX 2.5: QUESTIONNAIRE TO THE DESIGNER GROUP

THE UNIVERSITY OF SHEFFIELD
School of Architecture
Bing.Chen@Sheffield.ac.uk

## YOUR VIEWS ABOUT SUSTAINABLE HOUSING DESIGN

Sustainable issues are very important for the future in building design. For housing schemes it is also particularly important that the designers of the buildings communicate well with the future occupants to make sure the optimum solution can be achieved. This questionnaire is designed to help understand some of the important issues. I would be grateful if you can spend a little time answering as many of the following questions as possible. ***Participation is entirely voluntary and please be assured that no personal information is collected or stored that could be linked to any individual.*** **This research has been approved by the University Ethics Review Procedure.**

**A. Background of design experience**

A1. Please specify your job/position title?

_____

A2. How long have you been working as a designer (not including education time)?

☐ 1 – 2 years ☐ 2 – 5 years ☐ 5 – 8 years ☐ More than 8 years

☐ Any other related experience or training, please specify: _____

A3. Have you done any design related to Student Accommodation before? ☐ Yes ☐ No

A4. Are you interested in the topic of sustainability or sustainable design? ☐ Yes ☐ No

If yes, in which of the following building type(s) do you think sustainable measures are important? (*Mark top 5 only*)

☐ Civic Buildings ☐ Commercial Offices ☐ Educational ☐ Entertainment
☐ Healthcare ☐ Hotel & Catering ☐ Housing (Private) ☐ Housing (Social)
☐ Manufacturing ☐ Retail ☐ Sport ☐ Warehouse/storage
☐ Other, please specify: _____

**B. Make sustainable housing design according to …**

B1. In terms of a building design process, please indicate which of the following tools/standards you would like to work with or according to (*Mark all that apply*)

☐ Software Simulation, like ECOTECT ☐ Assessment Standards, like BREEAM
☐ Government Building Regulations ☐ Successful cases studies or examples
☐ Similar personal experience before ☐ Other, please specify: _____

B2. In terms of housing design, rate your knowledge and use of the following tools/standards:

**1 Very poor; 2 Poor; 3 Neutral/Equal; 4 Good; 5 Very good**

| | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| BREDEM | ☐ | ☐ | ☐ | ☐ | ☐ |
| BREEAM / EcoHomes | ☐ | ☐ | ☐ | ☐ | ☐ |
| Building Regulations Part L | ☐ | ☐ | ☐ | ☐ | ☐ |
| Envest | ☐ | ☐ | ☐ | ☐ | ☐ |
| The Green Guide to Housing Specification | ☐ | ☐ | ☐ | ☐ | ☐ |
| Housing Quality Indicators (HQI) | ☐ | ☐ | ☐ | ☐ | ☐ |
| Life Cycle Assessment (LCA) | ☐ | ☐ | ☐ | ☐ | ☐ |
| Standard Assessment Procedure (SAP) | ☐ | ☐ | ☐ | ☐ | ☐ |
| Others, please specify: _____ | ☐ | ☐ | ☐ | ☐ | ☐ |

C1. When designing a housing project towards sustainability standards, or student accommodation in particular, please rate the importance of the following items in your decision-making process:

**1 Not at all important; 2 Less important; 3 Equal/Neutral; 4 Important; 5 Very important**

| | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| ***1. Project Scheme and Management*** | | | | | |
| Use brownfield sites in preference to greenfield | ☐ | ☐ | ☐ | ☐ | ☐ |
| Plan to include local accessible amenities | ☐ | ☐ | ☐ | ☐ | ☐ |
| Protect local ecosystem during construction process | ☐ | ☐ | ☐ | ☐ | ☐ |
| ***2. Master Plan*** | | | | | |
| Enhance local ecological values | ☐ | ☐ | ☐ | ☐ | ☐ |
| Close to a public transport node like bus stop, tram stop, etc. | ☐ | ☐ | ☐ | ☐ | ☐ |
| High density (*like the ratio requirement between Floor Area and Footprint*) | ☐ | ☐ | ☐ | ☐ | ☐ |
| Site layout for natural daylighting and view | ☐ | ☐ | ☐ | ☐ | ☐ |
| Decide landscape categories according to the typology of surrounding sites | ☐ | ☐ | ☐ | ☐ | ☐ |
| ***3. Plan / Elevation / Section / Interior Design*** | | | | | |
| Room and window design for daylighting | ☐ | ☐ | ☐ | ☐ | ☐ |
| Provision of internal or external naturally drying space for clothes | ☐ | ☐ | ☐ | ☐ | ☐ |
| Space and services for working from home | ☐ | ☐ | ☐ | ☐ | ☐ |
| High insulation standards | ☐ | ☐ | ☐ | ☐ | ☐ |
| Use of ecological materials or environmentally friendly materials | ☐ | ☐ | ☐ | ☐ | ☐ |
| Use sustainably sourced timber as primary/secondary elements | ☐ | ☐ | ☐ | ☐ | ☐ |
| Select materials based on their full life-cycle rating | ☐ | ☐ | ☐ | ☐ | ☐ |
| Design and testing for sound insulation | ☐ | ☐ | ☐ | ☐ | ☐ |
| Private outdoor space | ☐ | ☐ | ☐ | ☐ | ☐ |
| Efficient control for external lighting & internal lighting appliances | ☐ | ☐ | ☐ | ☐ | ☐ |
| Secure cycle storage | ☐ | ☐ | ☐ | ☐ | ☐ |
| Natural ventilation | ☐ | ☐ | ☐ | ☐ | ☐ |
| Passive solar design, like buffer zone (conservatory), thermal mass, etc. | ☐ | ☐ | ☐ | ☐ | ☐ |
| ***4. Supply & Reuse for Energy and Water*** | | | | | |
| On-site renewable energy / green energy supply system | ☐ | ☐ | ☐ | ☐ | ☐ |
| Energy efficient heating/lighting appliances | ☐ | ☐ | ☐ | ☐ | ☐ |
| Use low-emission fossil fuel boilers/appliances | ☐ | ☐ | ☐ | ☐ | ☐ |
| Rainwater collection / sustainable drainage system | ☐ | ☐ | ☐ | ☐ | ☐ |
| Low water use appliances | ☐ | ☐ | ☐ | ☐ | ☐ |
| Facilities to recycle rainwater | ☐ | ☐ | ☐ | ☐ | ☐ |
| Knowledge about renewable energy (*like PV, wind turbines, CHP, etc.*) | ☐ | ☐ | ☐ | ☐ | ☐ |
| ***5. Other Details*** | | | | | |
| Provide energy efficient white goods (fridge, etc.) and relevant information | ☐ | ☐ | ☐ | ☐ | ☐ |
| Facilities to recycle household waste, i e. segregated bins | ☐ | ☐ | ☐ | ☐ | ☐ |
| Others, Please specify:_____ | ☐ | ☐ | ☐ | ☐ | ☐ |

**C. Knowledge and application of services, technologies and products from EcoHomes**

**D. Motivational factors and information sources**

D1. If you were looking for information about standards, services, technologies and products relating to construction and the built environment, where would you search? (*Mark all that apply*)

☐ Professional / trade body ☐ Government publication ☐ Research organisations
☐ Project team members / colleagues / tutors ☐ Professional journal / publication
☐ General media like TV, radio or newspaper ☐ Other, please specify: _____

D2. If you were designing, what would be *your* top 5 drivers to take these sustainable measures into account? (*Mark 5 only*)

☐ Competitive edge ☐ Environmental benefits ☐ Compliance with legislation
☐ Reducing waste ☐ Government initiatives ☐ Demonstrating best practice
☐ Enhanced reputation ☐ Championing innovation ☐ Meeting client requirement
☐ Economic benefits ☐ Doing the 'right thing' ☐ Local authority planning policy

D3. Likewise, what would be your top 5 barriers? (*Mark 5 only*)

☐ Lack of awareness ☐ Affordability / Cost
☐ Lack of information and relevant training ☐ Perceived risk
☐ Lack of evidence or background data ☐ Poor perception of sustainability
☐ Lack of local availability of services/products ☐ Time constraints
☐ Lack of interest from developers/clients ☐ Procurement barriers
☐ Lack of understanding/proof of the business case ☐ Lack of requirements from purchasers
☐ Construction industry culture *e.g. inertia, fear of change* Other, please specify: _____

**E. Motivational factors to other stakeholders**

E1. If you were contacting with **Developers/Clients**, what would be your top 5 drivers to engage them to take sustainability into account in construction/development projects? (*Mark 5 only*)

☐ Competitive edge ☐ Environmental benefits ☐ Compliance with legislation
☐ Reducing waste ☐ Government initiatives ☐ Demonstrating best practice
☐ Enhanced reputation ☐ Championing innovation ☐ Meeting client requirement
☐ Economic benefits ☐ Doing the 'right thing' ☐ Local Authority planning policy

E2. Please indicate 5 of the following you think would encourage your future practices to increase their application of sustainable measures in their design processes? (*Mark 5 only*)

☐ Directory of suppliers of services and products ☐ Cost and benefits analysis
☐ Information about the latest suitable R&D ☐ Information about funding
☐ Information on exemplar projects and best practice ☐ Award / recognition scheme
☐ Example specifications ☐ Training
☐ Publicity / promotion of sustainability ☐ Advisory / guidance service
☐ Forums / networks for sharing information ☐ Other, please specify: _____

E3. Will you try to encourage with the future housing users to make a lifestyle change towards greater environmental sensitivity? (*Mark 1 only*)

☐ Yes, their behaviour/habit change is important, especially in the house's operational term
☐ Not necessary, the sustainability aim can be reached by the application of technical strategies
☐ Not sure, the message about sustainability is hard to get across in the decision-making process
☐ Other comments, please specify: _____

**F1 . Are you?**

☐ Male ☐ Female

**F2. Personal Information (*OPTIONAL*): *if you would like to take part in a follow-up programme like interview or interest group discussion, please give your email below, otherwise leave blank.***

Email: _____

Comments – if you have any other comments you would like to make regarding sustainable design issues or the survey itself, please do so in the blank below:

**F. About yourself (OPTIONAL)**

All information that you provide will be strictly confidential and used only for the research into sustainable housing design process as part of a PhD work at the School of Architecture, University of Sheffield. No personal records will be kept of the replies unless the section for email contact – and then, that information will only be used in possible follow-up programmes.

I would be very grateful if you would participate in the following programmes like interviews or interest group discussion. Any suggestions or discussions about this work are also welcome.
[*All papers will be recycled.*]

Many thanks for your time.

Yours Sincerely,

Bing CHEN (Principal Researcher)

*If you have any question please contact me freely at the address below or phone on the daytime number given. Thanks again for your participation and help.*

*Address: Office 1&3, The Arts Tower, Sheffield, S10 2TN*
*Tel: (0114) 222 0360 Email: Bing.Chen@sheffield.ac.uk*

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# APPENDIX 2.6: QUESTIONNAIRE SAMPLE FROM THE DESIGNER GROUP

THE UNIVERSITY OF SHEFFIELD
School of Architecture
*Bing.Chen@Sheffield.ac.uk*

## YOUR VIEWS ABOUT SUSTAINABLE HOUSING DESIGN

Sustainable issues are very important for the future in building design. For housing schemes it is also particularly important that the designers of the buildings communicate well with the future occupants to make sure the optimum solution can be achieved. This questionnaire is designed to help understand some of the important issues. I would be grateful if you can spend a little time answering as many of the following questions as possible. ***Participation is entirely voluntary and please be assured that no personal information is collected or stored that could be linked to any individual.*** **This research has been approved by the Departmental Ethics Review Procedure.**

**A. Background of design practice**

A1. Please specify your job/position title?
Manager D. Recr

A2. How long have you been working for housing development?
☐ 1 – 2 years ☐ 2 – 5 years ☐ 5 – 8 years ☑ More than 8 years
☐ Any other related experience or training, please specify: Arch Tect ·

A3. Have you done any design related to Student Accommodation before? ☑ Yes ☐ No

A4. Are you interested in the topic of sustainability or sustainable design? ☑ Yes ☐ No

If yes, in which of the following building type(s) do you think sustainable measures are important? (*Mark top 5 only*)

| | | | |
|---|---|---|---|
| ☑ Civic Buildings | ☑ Commercial Offices | ☑ Educational | ☐ Entertainment |
| ☐ Healthcare | ☐ Hotel & Catering | ☑ Housing (Private) | ☑ Housing (Social) |
| ☐ Manufacturing | ☐ Retail | ☐ Sport | ☐ Warehouse/storage |

☐ Other, please specify: _____

**B. Make sustainable housing design according to ...**

B1. In terms of a building design process, please indicate which of the following tools/standards you would like to work with or according to ... (*Mark all that apply*)

| | |
|---|---|
| ☐ Software Simulation, like ECOTECT | ☑ Assessment Standards, like BREEAM |
| ☑ Government Building Regulations | ☑ Successful cases studies or examples |
| ☑ Similar personal experience before | ☐ Other, please specify: _____ |

B2. In terms of housing design, rate your knowledge and use of the following tools/standards:

**1 Have Awareness; 2 Outline knowledge; 3 Fully understand; 4 Apply in design; 5 Know how to optimise it**

| | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| BREDEM | ☐ | ☐ | ☐ | ☐ | ☐ |
| BREEAM / EcoHomes | ☐ | ☐ | ☐ | ☐ | ☑ |
| Building Regulations Part L | ☐ | ☐ | ☐ | ☐ | ☑ |
| Envest | ☐ | ☐ | ☐ | ☐ | ☐ |
| The Green Guide to Housing Specification | ☐ | ☐ | ☑ | ☐ | ☐ |
| Housing Quality Indicators (HQI) | ☐ | ☐ | ☐ | ☐ | ☐ |
| Life Cycle Assessment (LCA) | ☐ | ☐ | ☑ | ☐ | ☐ |
| Standard Assessment Procedure (SAP) | ☐ | ☐ | ☑ | ☐ | ☐ |
| Others, please specify: _____ | ☐ | ☐ | ☐ | ☐ | ☐ |

C1. When designing a housing project towards sustainability standards, or student accommodation in particular, please rate the importance of the following items in your decision making process:

**1 Not at all important; 2 Less important; 3 Equal/Neutral; 4 Important; 5 Very important**

| | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| ***1. Project Scheme and Management*** | | | | | |
| Use brownfield sites in preference to greenfield | ☐ | ☐ | ☐ | ☐ | ☑ |
| Plan to include local accessible amenities | ☐ | ☐ | ☐ | ☐ | ☑ |
| Protect local ecosystem during construction process | ☐ | ☐ | ☐ | ☐ | ☑ |
| ***2. Master Plan*** | | | | | |
| Enhance local ecological values | ☐ | ☐ | ☐ | ☐ | ☑ |
| Close to a public transport node like bus stop, tram stop, etc. | ☐ | ☐ | ☐ | ☐ | ☑ |
| High density (*like the ratio requirement between Floor Area and Footprint*) | ☐ | ☐ | ☐ | ☐ | ☑ |
| Site layout for natural daylighting and view | ☐ | ☐ | ☐ | ☐ | ☑ |
| Decide landscape categories according to the typology of surrounding sites | ☐ | ☐ | ☐ | ☐ | ☑ |
| ***3. Plan / Elevation / Section / Interior Design*** | | | | | |
| Room and window design for daylighting | ☐ | ☐ | ☐ | ☐ | ☑ |
| Provision of internal or external naturally drying space for clothes | ☐ | ☐ | ☑ | ☐ | ☐ |
| Space and services for working from home | ☐ | ☐ | ☑ | ☐ | ☐ |
| High insulation standards | ☐ | ☐ | ☐ | ☐ | ☑ |
| Use of ecological materials or environmentally friendly materials | ☐ | ☐ | ☑ | ☐ | ☐ |
| Use sustainably sourced timber as primary/secondary elements | ☐ | ☑ | ☐ | ☐ | ☐ |
| Select materials based on their full life-cycle rating | ☐ | ☐ | ☐ | ☑ | ☐ |
| Design and testing for sound insulation | ☐ | ☐ | ☐ | ☐ | ☑ |
| Private outdoor space | ☐ | ☐ | ☑ | ☐ | ☐ |
| Efficient control for external lighting & internal lighting appliances | ☐ | ☐ | ☐ | ☐ | ☑ |
| Secure cycle storage | ☐ | ☐ | ☑ | ☐ | ☐ |
| Natural ventilation | ☐ | ☐ | ☐ | ☐ | ☑ |
| Passive solar design, like buffer zone (conservatory), thermal mass, etc. | ☐ | ☐ | ☑ | ☐ | ☐ |
| ***4. Supply & Reuse for Energy and Water*** | | | | | |
| On-site renewable energy / green energy supply system | ☐ | ☐ | ☐ | ☑ | ☐ |
| Energy efficient heating/lighting appliances | ☐ | ☐ | ☐ | ☐ | ☑ |
| Use low-emission fossil fuel boilers/appliances | ☐ | ☐ | ☐ | ☐ | ☑ |
| Rainwater collection / sustainable drainage system | ☐ | ☐ | ☑ | ☐ | ☐ |
| Low water use appliances | ☐ | ☑ | ☐ | ☐ | ☐ |
| Facilities to recycle rainwater | ☐ | ☐ | ☑ | ☐ | ☐ |
| Knowledge about renewable energy (*like PV, wind turbines, CHP, etc.*) | ☐ | ☐ | ☐ | ☑ | ☐ |
| ***5. Other Details*** | | | | | |
| Provide energy efficient white goods (fridge, etc.) and relevant information | ☐ | ☐ | ☐ | ☑ | ☐ |
| Facilities to recycle household waste, i.e. segregated bins | ☐ | ☐ | ☐ | ☑ | ☐ |
| Others, Please specify:_____ | ☐ | ☐ | ☐ | ☐ | ☐ |

**C. Knowledge and application of services, technologies and products from EcoHomes**

**D. Motivational factors and information sources**

D1. If you were looking for information about standards, services, technologies and products relating to construction and the built environment, where would you search? (*Mark all that apply*)

- ☑ Professional / trade body
- ☑ Government publication
- ☐ Research organisations
- ☐ Project team members / colleagues / tutors
- ☐ Professional journal / publication
- ☐ General media like TV, radio or newspaper
- ☐ Other, please specify: _____

D2. If you were designing, what would be *your* top 5 drivers to take these sustainable measures into account? (*Mark 5 only*)

- ☑ Competitive edge
- ☑ Environmental benefits
- ☑ Compliance with legislation
- ☐ Reducing waste
- ☑ Government initiatives
- ☐ Demonstrating best practice
- ☐ Enhanced reputation
- ☐ Championing innovation
- ☑ Meeting client requirement
- ☐ Economic benefits
- ☐ Doing the 'right thing'
- ☐ Local authority planning policy

D3. Likewise, what would be your top 5 barriers? (*Mark 5 only*)

- ☑ Lack of awareness
- ☐ Affordability / Cost
- ☐ Lack of information and relevant training
- ☐ Perceived risk
- ☐ Lack of evidence or background data
- ☑ Poor perception of sustainability
- ☐ Lack of local availability of services/products
- ☐ Time constraints
- ☑ Lack of interest from developers/clients
- ☐ Procurement barriers
- ☑ Lack of understanding/proof of the business case
- ☐ Lack of requirements from purchasers
- ☑ Construction industry culture *e.g. Inertia, fear of change*
- Other, please specify: _____

**E. Motivational factors to other stakeholders**

E1. If you were contacting with **other stakeholders**, what would be your top 5 drivers to engage them to take sustainability into account in construction/development projects? (*Mark 5 only*)

- ☑ Competitive edge
- ☑ Environmental benefits
- ☑ Compliance with legislation
- ☐ Reducing waste
- ☑ Government initiatives
- ☐ Demonstrating best practice
- ☐ Enhanced reputation
- ☐ Championing innovation
- ☐ Meeting client requirement
- ☐ Economic benefits
- ☐ Doing the 'right thing'
- ☑ Local Authority planning policy

E2. Please indicate 5 of the following you think would encourage your future practices to increase their application of sustainable measures in their design processes? (*Mark 5 only*)

- ☐ Directory of suppliers of services and products
- ☑ Cost and benefits analysis
- ☐ Information about the latest suitable R&D
- ☑ Information about funding
- ☐ Information on exemplar projects and best practice
- ☐ Award / recognition scheme
- ☐ Example specifications
- ☐ Training
- ☐ Publicity / promotion of sustainability
- ☐ Advisory / guidance service
- ☐ Forums / networks for sharing information
- ☐ Other, please specify: _____

E3. Will you try to engage with the future housing users to make a lifestyle change towards sustainability? (*Mark 1 only*)

- ☑ Yes, their behaviour/habit change is important, especially in the house's operational term
- ☐ Not necessary, the sustainability aim can be reached by the application of technical strategies
- ☐ Not sure, the message about sustainability is hard to get across in the decision making process
- ☐ Other comments, please specify: _____

F1 Are you?

☑ Male ☐ Female

F2. Personal Information (***OPTIONAL***): *if you would like to take part in a follow-up programme like interview or interest group discussion, please give your email below, otherwise leave blank.*

Email: _____

Comments – if you have any other comments you would like to make regarding sustainable design issues or the survey itself, please do so in the blank below:

**F. About yourself (OPTIONAL)**

---

All information that you provide will be strictly confidential and used only for the research into sustainable housing design process as part of a PhD work at the School of Architecture, University of Sheffield. No personal records will be kept of the replies unless the section for email contact – and then, that information will only be used in possible follow-up programmes.

I would be very grateful if you would participate in the following programmes like interviews or interest group discussion. Any suggestions or discussions about this work are also welcome.
[*All papers will be recycled.*]

Many thanks for your time.

Yours Sincerely,

Bing CHEN (Principal Researcher)

*If you have any question please contact me freely at the address below or phone on the daytime number given. Thanks again for your participation and help.*

*Address: Office 15.7, The Arts Tower, Sheffield, S10 2TN*
*Tel: (0114) 222 0360 Email: Bing.Chen@sheffield.ac.uk*

# APPENDIX 3: DOCUMENTS OF THE *CODE FOR SUSTAINABLE HOMES*

## APPENDIX 3.1: EXAMPLE OF A CODE CERTIFICATE (Source: DCLG 2008a)

# Example Code Certificate

THE CODE FOR SUSTAINABLE HOMES

FINAL CERTIFICATE
(Issued at the Post Construction Stage)

THE CODE FOR SUSTAINABLE HOMES™

**ISSUED TO:**

**Test House, 1 Test Street,**
**Test Town, Test Country**
**TE1 ST1**

The sustainability of this home has been independently assessed at the Post Construction Stage and has achieved a Code rating of 5 out of 6 stars under the April 2007 version.

★ ★ ★ ★ ★ ☆

Above Regulatory Standards

Current Best Practice

Highly Sustainable and Zero Carbon

The next page sets out how this home achieved its rating in the nine categories.

| | |
|---|---|
| Licensed Assessor<br>**Mr L Assessor** | Assessor Organisation<br>**The Assessors** |
| Client<br>**C L lent Ltd** | Developer<br>**D E Veloper Inc** |
| Architect<br>**Arc I Tects** | Certificate Number<br>**TEST – Certificate No 1** |
| Date<br>**12 Never 2008** | Signed for and on behalf of BRE Global Ltd |

Communities and Local Government

This certificate remains the property of [Code Service Provider] and is issued subject to terms and conditions. Copies can be made for the purposes of the Home Information Packs. It is produced from data supplied by the licensed Code assessor. To check the authenticity of this certificate please contact BRE Global Ltd.

Code Service Provider logo

**(Front)**

# THE CODE FOR SUSTAINABLE HOMES

## FINAL CERTIFICATE

(Issued at the Post Construction Stage)

**Certificate Number: TEST – Certificate No 1** **Score: 150**

### What Your Code Star Rating Means

| Combined Score | 36-47 | 48-56 | 57-67 | 68-83 | 84-89 | 90-100 |
|---|---|---|---|---|---|---|
| Stars | 1 | 2 | 3 | 4 | 5 | 6 |

The Code for Sustainable Homes considers the effects on the environment caused by the development and occupation of a home. To achieve a star rating a home must perform better than a new home built to minimum legal standards, and much better than an average existing home.

### How this home scored

| Category | Percentage of Category Score attained (0 10 20 30 40 50 60 70 80 90 100) | What is covered in the category |
|---|---|---|
| Energy | 50 | Energy efficiency and $CO_2$ saving measures |
| Water | 25 | Internal and external water saving measures |
| Materials | 66 | The sourcing and environmental impact of materials used to build the home |
| Surface Water Run-off | 43 | Measures to reduce the risk of flooding and surface water run-off, which can pollute rivers |
| Waste | 100 | Storage for recyclable waste and compost, and care taken to reduce, reuse and recycle construction materials |
| Pollution | 77 | The use of insulation materials and heating systems that do not add to global warming |
| Health & Wellbeing | 16 | Provision of good daylight quality, sound insulation, private space, accessibility and adaptability |
| Management | 59 | A Home User Guide, designing in security, and reducing the impact of construction |
| Ecology | 37 | Protection and enhancement of the ecology of the area and efficient use of building land |

Further detailed information regarding The Code for Sustainable Homes can be found at www.communities.gov.uk/thecode

Communities and Local Government

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(Back)

## APPENDIX 3.2: EXAMPLE OF A NIL RATED CERTIFICATE (Source: DCLG 2008a)

# Nil-Rated Certificate

THE CODE FOR SUSTAINABLE HOMES

THE CODE FOR SUSTAINABLE HOMES™

This Home

**Address**
**Address**

This home is designed to meet the requirements of current building regulations.

It is not assessed against the Code for Sustainable Homes. The Code sets higher standards for a range of environmental sustainability features than current Building Regulations. It covers issues such as energy/carbon dioxide emissions, water efficiency and the use of materials.

As this home is not assessed against the Code for Sustainable Homes it can not be certified to meet the enhanced environmental performance standards set out in the Code.

The energy performance of this home will be shown on the Energy Performance Certificate.

## NIL RATED

Developer

Date

**Rating system:**
**Nil rating**: A home that has not been designed and built to meet the standards set out in the Code for Sustainable Homes. It has therefore not been formally assessed against the Code and has a 'Nil rating'
**1-6 star rating:** A home that has been designed and built to the sustainability standards set out in the Code for Sustainable Homes. A 1 star home is entry level and a 6 star home being a highly sustainable, zero carbon home.

More information can be found at www.communities.gov.uk/thecode

# APPENDIX 4: PUBLICATIONS AND OTHER ACADEMIC CONTRIBUTIONS:

- Chen B., Pitts A. and I. Ward, 2008. Indicator for sustainable housing design: from EcoHomes to the Code for Sustainable Homes. In: *25th Passive and Low Energy Architecture Conference Proceeding (PLEA 2008)*. Dublin: 2008. [Online] Available at: < URL: http://architecture.ucd.ie/Paul/PLEA2008/content/papers_poster.html >

- Chen B., Pitts A. and I. Ward, 2008. Sustainability-related educational programmes for sustainable housing design. In: *25th Passive and Low Energy Architecture Conference Proceeding (PLEA 2008)*. Dublin: 2008. [Online] Available at: < URL: http://architecture.ucd.ie/Paul/PLEA2008/content/papers_poster.html >

- Chen B., 2007. Speaker in the CWiPP Workshop on Climate Change and Well-being in Sheffield on the 22nd November 2007. Online at: http://www.shef.ac.uk/cwipp/research/workshop.html

- Chen B., 2007. Participated in the translation of the book – Kang J. and S. Liu (eds.) (2007) *Architecture Education: Education System at the School of Architecture, University of Sheffield*. Beijing: China Architecture and Building Press (from English to Chinese)

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- Chen B. and A. Pitts, 2005. Rethinking Housing Design Processes for 'Sustainability'. In: *CISBAT Conference Proceeding: Renewable in a changing climate, Innovation in Building Envelopes and Environmental Systems*. Lausanne: 2005. 119-124

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- Chen B., 2004. *The Potential to Enact Zero Emissions Development in China*. School of Architecture: M. Arch Studies Dissertation, University of Sheffield, 2004.

- Chen B., 2004. Alpine Close: Sustainable Housing Case Study, UK. *World Architecture*, 170 (Aug.) 70-75 (in Chinese)

# Paper 131: Indicator for Sustainable Housing Design: from EcoHomes to the Code for Sustainable Homes

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**Abstract**

It is widely acknowledged that sustainability principles should be addressed in the housing market to tackle climate change. In the UK, many regulation- or policy-related housing assessment tools have been enacted to ensure the compulsory objective of carbon-neural new homes can be progressively achieved by 2016. Until now, however, there is no one of them can truly accommodate all the competing parameters in the design processes or apply to all circumstances of building construction alone. To select the most suitable ones and optimise the application according to their relevance, this paper aims to identify the specific characteristics of different assessment tools, particularly focusing on their innovative aspects relevant to designers today. Three prevailing sustainable housing assessment tools, Building Research Establishment's (BRE) EcoHomes, the Code for Sustainable Homes and Leadership in Energy and Environmental Design (LEED), have been closely compared. Based on the extensive studies, a general consensus is reached on the palette of environmental issues that should be addressed in the housing design processes. This set of sustainable housing design issues can be used as a prototype of the sustainability indicator to support the decision making processes, and as a communicational platform to get the message across between different stakeholder groups.

Keywords: housing assessment, EcoHomes, the Code for Sustainable Homes, LEED, sustainability, indicator

## 1. Introduction

It is widely acknowledge that tackling climate change should be envisaged as one of the overwhelming challenges and responsibilities for governments. Between various factors that contribute to global warming, more attention has recently been paid to the use of energy and its effect, through greenhouse gases emissions, on the world's climate. In the UK, three prevalent strategies have been enabled from an integrated perspective to incentivise investment in energy efficiency and low-carbon technologies and to change behaviour. They are regulations, emissions trading and taxation [1].

As stated by the Department for Communities and Local Government [2], between the possible activities, measures in greening built environment represent a huge opportunity for energy saving and carbon reductions. Therefore, it is expected that, after embedding measures to tackle climate change within the planning system, particular attention should be paid to increase building standards as a follow-up step.

This paper intends to focus on building standards in the domestic sector as energy efficiency and carbon reductions in this field play a central role in the tackling of climate change [3,4]. As pointed out by the Department for Communities and Local Government [5], there are around one-third of the total housing stocks in the UK will be built between now and 2050. In order to achieve the mandatory objective of carbon-neural new homes progressively by 2016 [3], many relevant regulations and policies have been enacted. In this shift, the Code for Sustainable Homes has been widely acknowledged as a benchmark based on which new housing standards are expected to be introduced step by step. In 2010, new homes must be built to the very high energy efficiency standards, with minimum requirement of three stars in the Code; then four stars in 2013 and six stars in 2016 by increasing the use of renewable energy sources at homes [3,6].

In the housing market, many assessment tools have been developed to introduce sustainability values and principles into mainstream practice and to foster the agenda of sustainable homes. Currently the potential interventions that might increase the effectiveness of these housing assessment tools are mainly concerned with completed products and their performance in use, e.g. Post-Occupancy Evaluation (POE) [7] and Design Quality Indicators (DQI) [8]. However, more attention is now also paid to the process that created them [9] and the knowledge transfer between different stakeholder groups in the decision-making processes [10].

To help different stakeholders better understand their responsibility and appropriately address the relevant issues, the existing housing assessment tools have been widely described and evaluated. Their implementations have also been analysed and compared in terms of certain features, such

as mandatory or voluntary, quantitative or qualitative, complex or simple and so on. Until now, however, there is no one of them can truly accommodate all the competing parameters in the market or apply to all circumstances of housing construction alone. To select the most suitable ones and optimise the application according to their relevance, therefore, this paper intends to identify the specific features of different assessment tools, particularly focusing on their innovative aspects relevant to designers today.

## 2. Existing Housing Assessment Tools

Today many housing environmental assessment tools coexist in the shared market, being influenced by and subsequently influencing each other. As shown in Table 1, a close comparison is made between four popular housing assessment tools, BRE's EcoHomes (by Building Research Establishment), National Home Energy Rating (NHER), the Building Research Establishment Domestic Energy Model (BREDEM), and the Standard Assessment Procedure (SAP). It is based on certain important features that might be relevant to designers today. Different sized bullets are used to highlight the specific aspects or purpose of the assessment tools.

Table 1: Close comparisons based on certain features

| Certain features \ Assessment Tools | | EcoHomes | NHER | BREDEM | SAP |
|---|---|---|---|---|---|
| Dimensions of sustainability | Environment | ● | • | • | • |
| | Economics | | | | |
| | Socio-Equity | | | | |
| Nature of assessment | Voluntary | • | • | • | |
| | Mandatory | | | | ● |
| Target buildings | Individual | • | • | • | • |
| | Communities | • | | | |
| Phases of building life cycle influenced | Pre-design | • | • | • | • |
| | Planning | • | • | • | • |
| | Design | • | • | • | • |
| | Construction | • | | | |
| | Operation | • | • | • | • |
| | Demolition | | | | |
| Scope of assessment | Energy/CO2 | • | ● | ● | ● |
| | Water | • | | | |
| | Materials | • | | | |
| | Waste | | | | |
| | Pollution | • | | | |
| | Management | • | | | |
| | Transport | • | | | |
| | Well-being | • | | | |
| | Land & ecology | • | | | |
| | Functionality | | | | |
| | Appliances | • | • | • | • |
| Web-based information | Free access | • | • | • | • |
| | Free download | • | | | • |
| Software available | Yes | | • | | • |
| | No | • | | • | |
| Regional approach | Yes | | ● | | |
| | No | • | | • | • |
| Related to user's lifestyle | Yes | | | ● | |
| | No | • | • | | • |

In practice, these four housing environmental assessment tools are interrelated. BREDEM is used as the basis for both the SAP and the NHER scales [11]. As a nationally recognised energy rating procedure, the SAP is incorporated into the NHER to allow for direct comparison between different dwelling types in different locations in terms of energy efficiency. BRE's EcoHomes consists of a series of assessment techniques and rating systems, such as the SAP, Life Cycle Assessment (LCA), and the Green Guide to Specification and so on.

Nevertheless, from Table 1, it can also be found that different housing environmental assessment tools would often like to address sustainability principles from different perspectives. Since uncertainties and substantial gaps still prevail in either design or assessment processes, there is no one assessment tool can truly accommodate all the competing parameters in the market or apply to all circumstances of housing construction alone until now. On the other hand, the emphasis on different aspects of sustainability may differ widely across the live projects in terms of practice. When evaluating building sustainability issues, therefore, different stakeholders would prefer to address the underlying problems from different dimensions, by different procedures, through different formats and to different extents, taking account of their intrinsically varying incentives.

Recently there is a trend that building assessment tools have evolved to assist building design professionals [12]. However, in the short term, the most significant aspect of building sustainability assessment tools is still focused on 'the integration of issues, different ways of knowing, different perspectives, values and objectives in decision making' [9]. Therefore, the choice of housing environmental assessments in the decision-making process becomes a dynamic balance between 'what is theoretically possible' and 'what is practically most desirable' [13]. In order to steer the decision making processes from a problem-oriented perspective, it is important to make discerning choices by clearly defining the distinct roles and characteristics of the variety of housing environmental assessment tools. Hence similar review procedures (e.g. Table 1) can help architects select the most suitable tools and optimise the application.

## 3. Sustainable Housing Issues

It is argued that an isolated review of the building environmental assessment tools would not be sufficient to move the construction industry of UK to a sustainable state [14]. To have a deeper insight into evaluating the performance of environmental management systems for housing development, more attention should be paid to 'the side-by-side comparison of their technical features' [15]. Further, since not all factors can be dealt with by such concerns of decision making, there is a trend in the current housing market that leads to 'a socially and environmentally more accountable handling' of the trade-offs between conflicting demands [16].

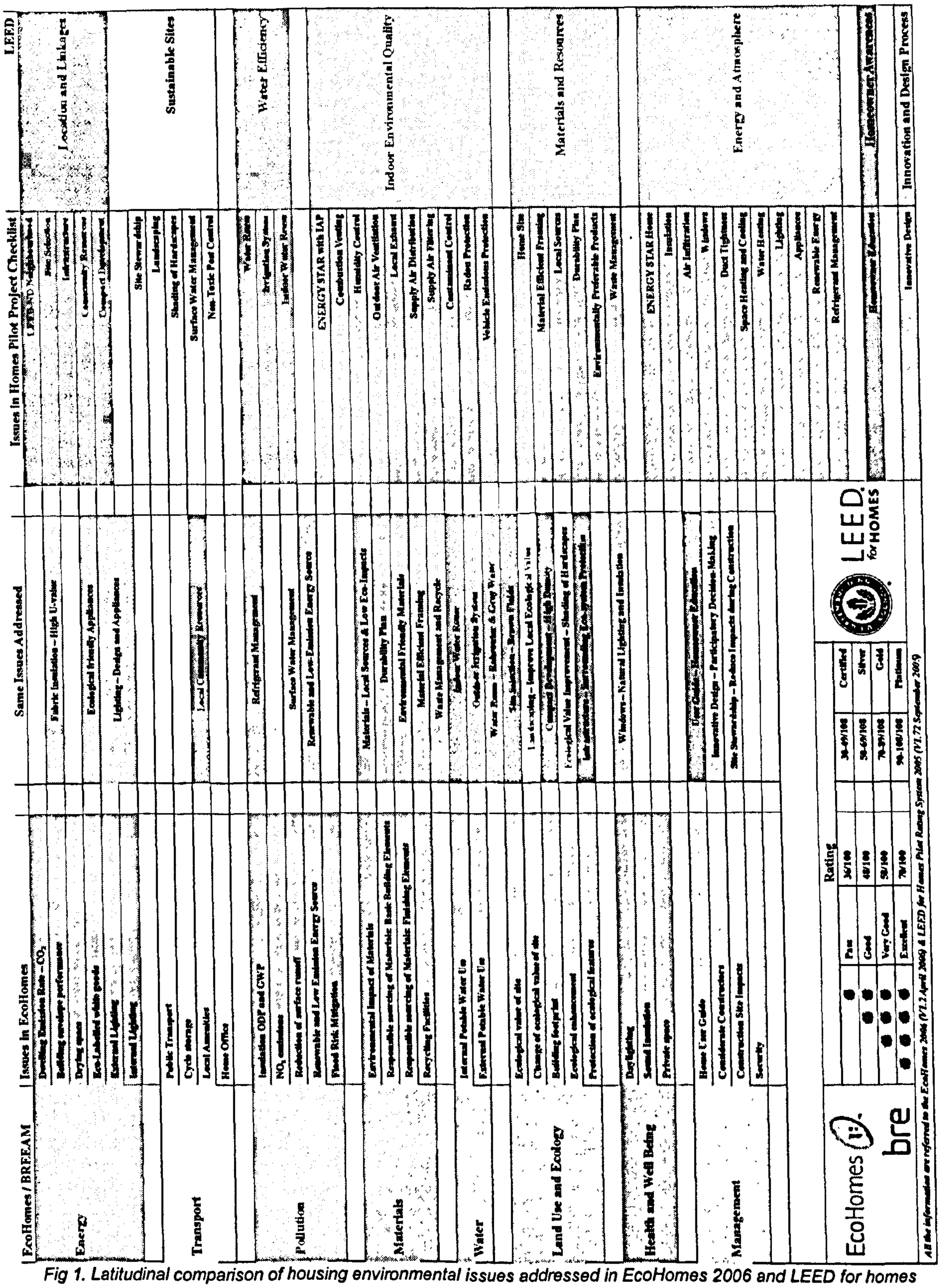


*Fig 1. Latitudinal comparison of housing environmental issues addressed in EcoHomes 2006 and LEED for homes*

To identify the palette of environmental issues that should be addressed in the housing design processes, LEED (Leadership in Energy and Environmental Design) for Homes in USA [17] and the EcoHomes by BREEAM (Building Research Establishment Environmental Assessment Method) in the UK [18] have been extensively examined and discussed in parallel in this paper. Each of them has been implemented in its national housing market and has been proved to be successful to some extent. As shown in Figure 1, although these two housing environmental assessment tools are tailored for different national conditions, a general consensus

has been reached. Some important issues have been addressed by both of them, such as fabric insulation, environmentally friendly appliances, light design and appliances and so on (issues in the middle column of Figure 1), although these issues have been classified into different categories in these two systems. To a great extent, these well-acknowledged housing environmental issues constitute a template of a 'minimal list of indicators' (standardization) which can be helpful for benchmarking purposes [19].
However, it is also important to note the principal difference between these two tools: LEED for Homes is more concerned with detailed design issues for single housing projects, such as issues in the category of 'Indoor Environmental Quality'. While in EcoHomes 2006, more attention has been paid to the communicational problems encountered in community development, such as issues in the category of 'Transport'.
To apply the housing environmental assessment tools to support the decision making processes, a further study is carried out based on the UK's circumstance, mainly focusing on EcoHomes and the Code for Sustainable Homes.

## 4. From EcoHomes to the Code for Sustainable Homes

As the housing version of BREEAM, EcoHomes aims to provide an authoritative rating for the property sector. Two relevant documents well known in the housing market are the Pre-Assessment Estimator and the Guidance [18]. Both of them are available online and can be free accessed. Compared with other sustainability regulations often remote from the design process, EcoHomes is a more straightforward, flexible and independently verified environmental assessment method [18] and has been revised more regularly. Furthermore, some important factors have also been embodied in the developmental targets of EcoHomes, such as integration through stakeholder participation, flexibility and one step ahead, transparency and accessibility and so on.
The Eco-point scale that underpinned EcoHomes was developed through a series of focus groups discussion. This procedure aims to 'establish a broad consensus on the weighting of different environmental impact categories' [20] and 'reconcile different expectations of an assessment tool' [16] among a variety of different cultural viewpoints. As a result, this checklist-based assessment tool involves assigning credits within each sub-area and establishes a weighting system between all areas that can be used for scoring.
Based on EcoHomes, the Code for Sustainable Homes (the Code) was released in 2006. After one year voluntary phase to gain experience in the methodology, it started to be applied as a mandatory rating requirement for all new homes from 2008. There are some differences between EcoHomes and the new Code. Compared with the retrospective manner of applying EcoHomes, the Code intends to assess the housing design processes from a more integrated perspective, from the early design stage review to the post construction review. Moreover, different levels in the Code are made up by achieving both 'the appropriate mandatory minimum standards' together with 'a proportion of the flexible standards' [21], which differs from the voluntary rating procurement of EcoHomes.
However, the Code also shares many important characteristics with its prototype EcoHomes. From a longitudinal comparison, it can be found that the scoring systems between these two assessment tools are similar. The Level 3 in the Code is approximately equal to the Very Good score in EcoHomes. Moreover, the palette of housing environmental issues addressed in these two assessment tools are almost same although they are classified into different categories and given with different credits. The main difference lays in that some issues, such as 'Construction Waste', 'Inclusion of composting facilities' and 'Lifetime Homes', have been firstly added to the new Code; while others, such as 'public transport' and 'local amenities' which used to be included in EcoHomes, have been removed. Certainly the credits for the same issue in different assessment systems also vary slightly.
Although the Code has been seen as a step forward by the Government, EcoHomes still plays an important role in housing market, especially for the sustainability assessment of existing housing stocks. Furthermore, since EcoHomes considers different housing environmental issues from a voluntary but balanced perspective, the credits available for each issue reflect its relative importance in the whole system. Hence in this paper, the framework of EcoHomes is used as the prototype of sustainability indicator to support the decision making processes.

## 5. Checklist-based Indicator for Sustainable Housing Design

It is argued that the methodologies often used to assess housing projects (for instance EcoHomes, the Code for Sustainable Homes and LEED for Homes) always attempt to quantify the often unquantifiable issues and require significant amounts of information to do so [22]. However, in the housing design processes, decisions are often made under some unlikely constraints, such as limited time, budget and so on. To apply assessment tools to assist design professionals, therefore, there is a need to develop a rapid but structured approach to compare the merits of different design measures across an agreed set of topics and obtain a picture of their relative importance. Principles related to efficiency and flexibility should also be addressed in terms of introducing this checklist-based indicator for sustainable housing design.
Architects should play an important role to introduce this indicator. It is expected that they could use this indicator as a communicational platform to get the message across and handle the trade-offs between different stakeholder groups. On the other hand, it is also expected that this indicator could help architects make

informed decisions and collaborate with other stakeholders efficiently at the key decision-points in the participatory design processes.
However, since EcoHomes is not designed for architect's specific demands, it is necessary to adjust its scheme towards typical design workflows and transfer its context to respond to those issues encountered in different decision-making stages. As a result, the scheme of EcoHomes is re-formulated to accompany the design phases as a hands-on guidance (Table 2). It is important to note that the environmental issues in EcoHomes need to be addressed at the very early phases of design decision-making (for instance 'brief' and 'sketch plans' according to Royal Institute of British Architects (RIBA's) Plan of Work [23]) to maximum benefits. In the indicator (Table 2), therefore, all the competing parameters in EcoHomes have been re-arranged according to a procedural sequence usually employed by architects' thinking.

Table 2: Sustainability indicator based on EcoHomes

| Checklist: sustainable housing design | EcoHomes 2006 | Credits available |
|---|---|---|
| ♦ **Project Scheme and Management** | | |
| Prefer to use brownfield site | Eco1 | 1.33 |
| Plan to include local accessible amenities | Tra3 | 3 00 |
| Protect local ecosystem in construction | Eco3 | 1.33 |
| Constructors for site management | Man2 | 2.00 |
| Site management to reduce the impacts | Man3 | 3.00 |
| Safe and security issues | Man4 | 2 00 |
| ♦ **Master Plan** | | |
| Enhance local ecological values | Eco2 | 1.33 |
| Close to a public transport node | Tra1 | 2.00 |
| High density (Floor Area / Footprint) | Eco5 | 2.67 |
| Site-layout for natural daylighting & view | Hea1/2 | 2.625 |
| Decide landscape categories | Eco4 | 5.33 |
| ♦ **Plan/Elevation/Section/Interior Design** | | |
| Room and window design for daylighting | Hea1/2 | 2.625 |
| Inter-/external naturally drying space | Ene3 | 0.92 |
| Space and services for working at home | Tra4 | 1.00 |
| High insulation standards | Ene2 | 1.83 |
| Use ecological insulation materials | Pol1 | 0.91 |
| Use sustainably sourced timber | Mat2+3 | 4 06 |
| Material choice based on life-cycle rating | Mat1 | 7.23 |
| Design and testing for sound insulation | Hea2 | 7.00 |
| Private outdoor space | Hea3 | 1.75 |
| Control systems for ex-/internal lighting | Ene5+6 | 3.66 |
| Secure cycle storage | Tra2 | 2.00 |
| Natural ventilation | | |
| Passive solar design | | |
| ♦ **Supply & Reuse for Energy and Water** | | |
| Onsite renewable/green energy supply | Pol4 | 2.73 |
| Energy efficient heating/lighting | Ene1 | 13.75 |
| Low-emission fossil fuel boiler/appliance | Pol2 | 2 73 |
| Rainwater collection/sustainable drainage | Pol3 | 1.82 |
| Low water use appliances | Wat1 | 8.33 |
| Facilities to recycle rainwater | Wat2 | 1.67 |
| ♦ **Other details** | | |
| Homes user guide | Man1 | 3.00 |
| Energy-efficient white goods, i.e. fridge | Ene4 | 1.83 |
| Facilities to recycle household waste | Mat4 | 2.71 |

The topics are grouped into five main categories: project scheme and management; master plan and landscape; plan, elevation, section, interior design; energy and water supply; other details. Compared with EcoHomes where all the issues are structured in a technical fashion, this new mapping procedure intends to reorganise these issues to be more related to the order of decision-making in an architectural project. It is important to note that the relationship between design measures and environmental issues are not always one to one. In contrast, integrated design thinking can address several environmental issues at the same time, while it is also possible that different design measures create similar environmental benefits.
Besides strategic direction to improve housing environmental performance as a qualitative checklist, this new indicator also provides a potential opportunity to allow architects to convert their decision making process from a qualitative procedure into a quantitative one. In EcoHomes, each design measure has been given a relevant credit in the *Pre-Assessment Estimator* and relevant detailed criteria in the *Guidance*. Hence architects may use these as a quantitative checklist (the column of 'credits available' in Table 2), decide to accept or reject a particular design measure according to its corresponding credit as well as how easy to meet the detailed requirements in real-life projects. Some issues in Table 2 have been highlighted as their corresponding issues in the Code have been required to achieve the mandatory minimum standards as entry levels. In terms of housing design, therefore, more attention should be paid to these issues.
However, whether this integrated decision making procedure will lead to a truly 'sustainable housing' is a more open question.

## 6. Conclusion

This paper intends to apply the existing housing environmental assessment tools to support the design process. Some principal research findings of this study have been summarised as following:

- Until now, there is no one housing environmental tool can truly accommodate all the competing parameters in the design processes alone. Thus, it is important to identify the specific characteristics of different assessment tools and make informed decisions through side-by-side comparisons.
- There is a general consensus on the palette of environmental issues that should be addressed in the housing design processes. These well-acknowledged issues can be used as a common language in the participatory decision-making processes or the worldwide debate about sustainable housing design.
- EcoHomes can be used as a checklist-based indicator for sustainable housing design. The combined determination, with both qualitative and quantitative perspectives, can help architects consider the palette of environmental issues in an order of relative importance systematically, and

encourage them to undertake analysis of alternative design measures consciously.

- Although this initial attempt might not be sufficient to bring forth green housing immediately, this study for EcoHomes will help architects increase their familiarity with a systematic thinking of environmental aspects by means of indicators.

Furthermore, it is argued that, besides adopting a progressive perspective, the ultimate success of the application of environmental assessment tools will depend on if, and to what extent, a consensus can be reached among the key stakeholders in the participatory decision making processes [16]. Therefore, besides addressing the specific characteristics of EcoHomes, such as integration, transparency and accessibility, this paper also highlights its potential responsibility for collaborative learning.

Since the system for value judgement used in EcoHomes can be seen as a common language that could help get the message across between different stakeholder groups, further work is expected to construct a communicational platform based on it to facilitate the knowledge transfer in the housing design processes.

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