Paper 132: Sustainability-related Educational Programmes for Sustainable Housing Design

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Abstract

As sustainability principles become prevailing in the construction sector, it becomes important to breed building performance experts and make the necessary changes happen in time. Training programmes for such professionals have been envisaged in this paper, focusing on current sustainability-related architectural educational programmes in particular. The higher-level architectural student's interests in sustainable design, awareness of related information and willingness for collaborative work have been extensively investigated. Their knowledge of sustainable housing design issues are examined based on the system for value judgement used in BRE's EcoHomes. The knowledge gaps between architectural students and the assessment criteria are identified. To achieve better results in the participatory decision making processes, there is a need to achieve a close consensus on sustainability principles between different stakeholder groups. Therefore, based on the framework of EcoHomes, a prototype of communicational platform is proposed to facilitate knowledge transfer. It is argued in this paper that architects should play a central role to introduce this discipline and get the message across. Moreover, since it is architect's responsibility to help other stakeholders make informed decisions, it is expected that their specialised decision making skills could be improved in the relevant educational procedures.

Keywords: education, sustainability, EcoHomes, communication, knowledge transfer

1. Introduction

As sustainability principles become prevailing in the construction sector, all building professionals should be trained as at least part-BEE (Building professionals who are Ecologically literate and Environmentally aware) [1] at a time when so many people need rapid and robust advice. To make the necessary changes happen in time, it is important to breed building performance experts, who could be trained Home Energy Report or Building Certificate evaluators, designers or managers for the built environment and so on [2]. Training programmes for such professionals should be encouraged correspondingly. In this paper, particular attention is paid to the current sustainability-related postgraduate architectural courses. It aims to investigate the educational programmes, through their effects on student's interests in sustainable design, awareness of related information and willingness for collaborative work. Possible measures can then be proposed to improve them.

2. Research Aims

It is argued that design can be described as a transfer between areas of knowledge bearing on a particular project, aiming for consensus of problem solving [3]. As a pilot study, this paper set up the domestic building as the particular project and it is expected that the problems encountered in the design processes should be sorted out by achieving a general consensus on sustainability principles.

Different stakeholders who are responsible for bringing their knowledge in the design process, including clients, users, designers and legislators and so on, may often have various knowledge background and diverse motive or power for the eventual decision-making. Therefore, there is a trend recently that more attention should be paid to the interactions between these key stakeholder groups. The knowledge gaps between them and the possible communicational methods have also been envisaged. Generally it is acknowledged that the more harmoniously they communicate with each other; the more deliberate design processes will be carried out [3]. Likewise, based on the same discipline, it is also believed that the closer consensus is achieved between them, the better results can be expected.

Among the principal stakeholders, architects have the responsibility to get the message across in the participatory decision making processes and educate other stakeholders into more genuinely collaborative roles [4]. However, it is questionable whether architects have been aware of all these underlying issues and would like to take the leadership to accommodate the diverse conflicts in practice. Therefore, this study intends to investigate whether the current sustainability-related education has equipped the higher-level students, the future architects, with sufficient knowledge to do so in terms of introducing the discipline of sustainable building design.

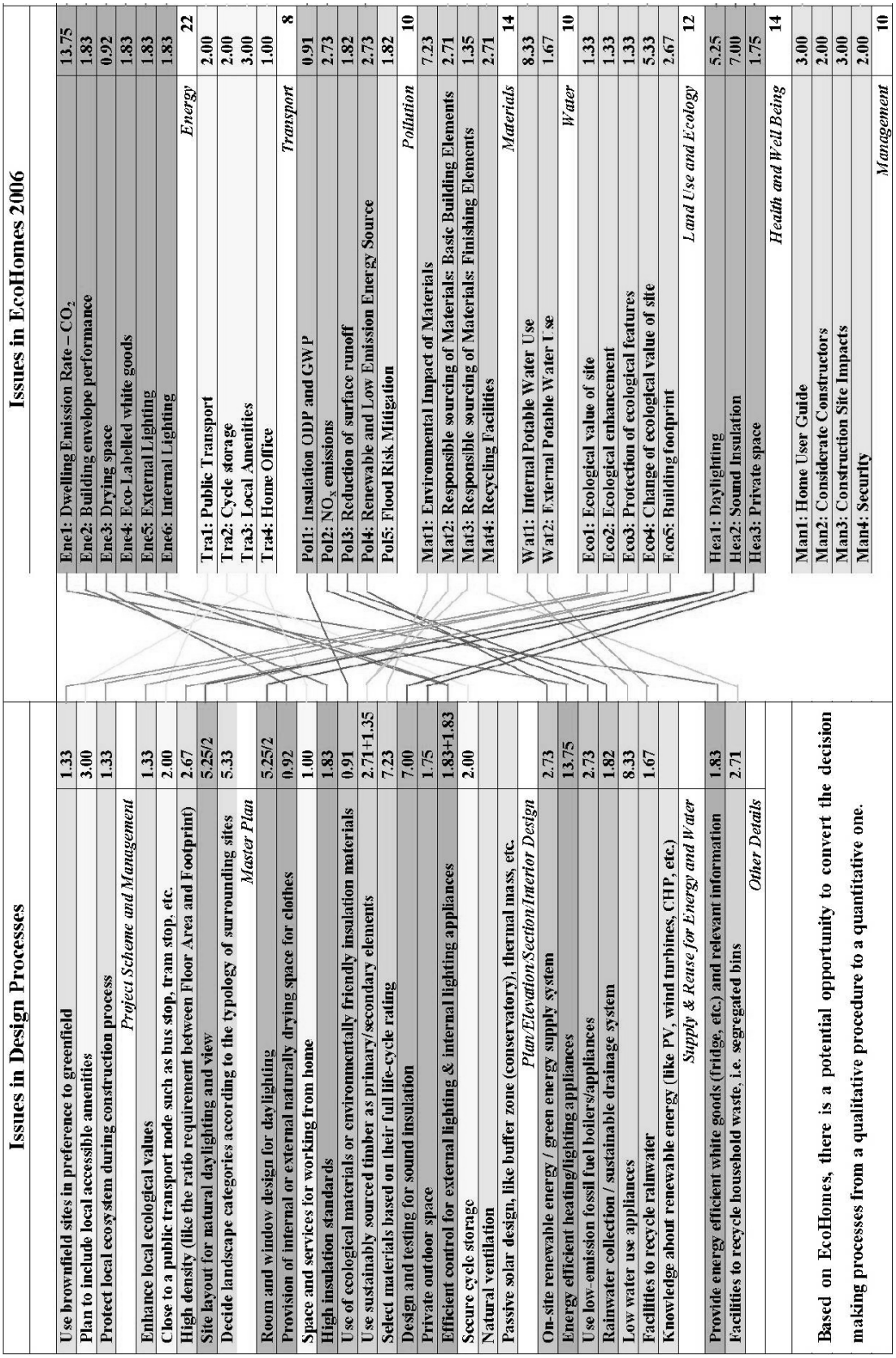

Fig 1. Questionnaire design based on housing environmental issues addressed in EcoHomes 2006

3. Methodology

As an innovative topic, research on sustainability often needs an intuitive method to reason under uncertainty, combine different data types, and learn from new observations as they become available. Hence in the recent trans-disciplinary studies and relevant modelling processes, the

method of Bayesian Belief Networks has been widely discussed and applied. For instance, it has been used in the CaRB project to construct a 'landscape' model to examine the knowledge synthesis across the social, economic and behavioural sciences and their influences on domestic energy consumption [5]. This network-based model can be used as a decision support system in the complicated circumstance of sustainable building design as it integrates data of varying quality and type and synthesises relevant factors in social, economic, ecological and technical fields systematically [5]. It can be found that education and its effects on environmental awareness and social desirability have been addressed as important factors which contribute to the bottom line of this model. Social research methods have then been applied to understand the relevant issues lying behind them.

To examine student's knowledge and willingness to address environmental issues in the housing design processes, a questionnaire was designed mainly based on the criteria in the BREEAM home version (Building Research Establishment Environmental Assessment Method), EcoHomes 2006 [6]. As shown in Figure 1, questions about design measures, coming from the environmental issues addressed in EcoHomes, have been reorganised in the questionnaire according to a typical design workflow.

EcoHomes is the prototype of the Code for Sustainable Homes [7]. They share many important characteristics in practice, such as the palette of environmental issues being addressed and the relative importance between them. In EcoHomes and the Code, the relative importance of different environmental issues is adjusted based on a set of consensus-based weighting factors that were derived from an extensive study by BRE. From an early consultation, it was found that the way in which EcoHomes and the Code addressed the housing environmental issues was positively supported by a variety of different cultural viewpoints [8]. Since 2008, the Code has been applied in the housing market as a mandatory rating requirement for all new homes; while EcoHomes, as a voluntary protocol, for the existing housing stocks. Therefore, it is argued that the system for value judgement adopted by the Code can be seen as the constraints brought forward by legislators, within which designers must work. So is the one in EcoHomes.

To achieve better results, it is expected that a close consensus should be achieved between student's knowledge and legislator's constraints. In other words, students are anticipated to have more knowledge of housing environmental issues which have been addressed as more important in EcoHomes. Therefore, by setting up the scheme of EcoHomes as standards, it becomes a central issue of this research to see whether the current sustainability-related education has equipped the students with sufficient knowledge for value judgement between the alternative options available and whether the students would like to make more informed decisions based on the principles lying behind the assessment methods.

Other questions in the questionnaire cover a wide spectrum of relevant issues, such as student's interests in sustainable design, awareness of related information and willingness for collaborative work and so on.

Higher-level architectural student undertaking the sustainability-related postgraduate courses have been selected as the target group as they are going to work as architects soon and should know more about the relevant issues.

4. Consultation Responses

There were 63 formal responses from the target group. Of these, 49 respondents were the fifth year architectural students and the rest (14) one year taught master students. Most of them already had related professional experience before, either in the UK or abroad. Almost all the respondents had an interest in the topic of sustainability or sustainable design, except one response missed from the fifth year architectural students. Hence it was expected that better results would be achieved from the analysis of the data from this particularly focused group.

As shown in Figure 2, although some students argued that sustainability principles and relevant design measures were important for all building types, there was a general consensus that they should be firstly taken into account in the design processes of housing projects (including both private and social housing), commercial offices and educational buildings. Since this finding is coincided with some early empirical studies [for instance, 9,10], it is believed that these students have been well informed about the importance of addressing energy saving and carbon reductions in domestic sector through the current education.

In terms of building design processes, students in the target group would often like to make decisions based on 'software simulations', 'assessment standards' and 'successful cases studies or examples'. In contrast, 'government building regulations' was considered as less helpful for decision making, and most of the students did not have 'similar experience before'.

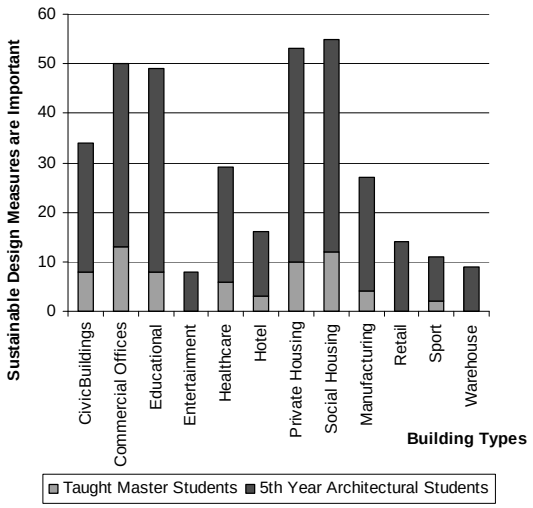

Fig 2. Importance of sustainable measures for different building types

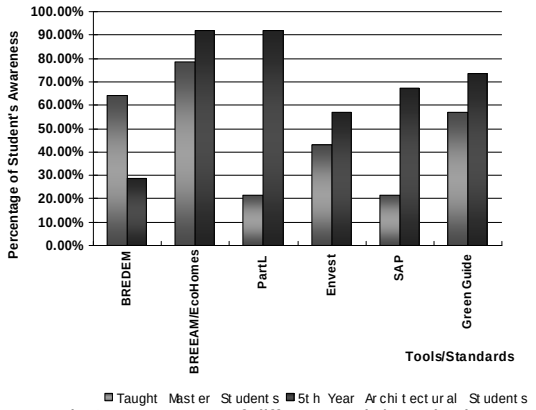

Fig 3. Awareness of different tools/standards

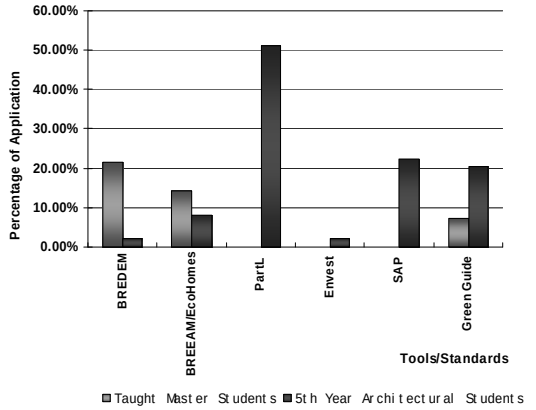

Fig 4. Application of different tools/standards

To achieve higher levels of sustainability, it is important to ensure that these future designers have been equipped with sufficient relevant knowledge in their educational programmes. However, the feedback was not optimistic. As shown in Figure 3, although many students in the target group have been aware of the design tools or standards prevailing in the construction sector, there are still some of them who have no idea about these valuable benchmarks. Moreover, some of the design tools need to be applied in conjunction (for instance, BREEAM EcoHomes has included the requirements from SAP, Building Regulations Part L and The Green Guide to Housing Specification as part of its content). Hence it makes no sense that the students rate their awareness of BREEAM EcoHomes much higher than SAP and The Green Guide to Housing Specification. This might be explained as that, through the current educational programmes, the architectural students have only been taught the general background of these design tools or standards while few of them truly know how to apply them to support the decision making.

This has soon been verified in Figure 4. Generally less than half of the target students had the previous experience of applying these design tools or standards in the housing design processes. This is much worse than expected as some of the building standards are mandatory in the construction sector, such as SAP, Building Regulations Part L and so on. Although people may argue that architects can get the technical support from other experts or specialists in the participatory decision-making processes, they need to have enough knowledge to collaborate with these specialists and intervene at the key decision-points in terms of information flow. In other words, architects need to be trained to understand more about these issues though they are not necessary to become EcoHomes assessors. This needs to be envisaged in the future professional training procedures.

Between these housing design tools or standards, more attention is paid to EcoHomes as it is the prototype of the compulsory Code. As argued earlier, EcoHomes provides a credit-based weighting system for the palette of environmental issues according to their relative importance. Hence it can be used as quantitative benchmark to evaluate the target student's knowledge of the relevant design measures (Figure 1). It was expected that, in order to achieve a better result (higher score rated by EcoHomes), more attention should be paid to the environmental issues with more credits in EcoHomes, such as 'landscape' (Eco4: max 5.33), 'materials with LCR' (Mat1: max 7.23), 'sound insulation' (Hea2: max 7.00), 'energy efficiency' (Ene1: max 13.75) and 'low water use' (Wat1: max 8.33). However, from the investigation, it was found that generally there was no significant difference between students' understanding of the variety of housing environmental issues, no matter how they had been rated by EcoHomes (Figure 5).

In fact, target students' average knowledge of sustainable housing design issues is much less than expected. Since most of these students already had relevant working experience, they were expected to know the importance of applying the assessment methods to support their decision making better. Likewise, they were also expected to have more knowledge of the related environmental issues than junior students, for instance, at least fully understood most of the environmental issues addressed in EcoHomes. However, most responses fell into the categories of 'have awareness', 'know the outline' or 'fully understand' while rarely 'applied in design' or 'know how to optimize it'. In other words, even if the students would like to address the palette of housing environmental issues in the order of relative importance as the one adopted by EcoHomes, their poor knowledge of related design measures will not allow them to do so.

A few issues have been well understood by these students, such as 'close to a public transport node', 'site layout for natural daylighting and view' and 'room design for natural daylighting' and so on. However, as argued by Gething and Bordass [11], items the architect judged to be much better in the self-assessment processes were usually related to things that had happened during the design and construction process but which might not be visible in the completed building. Thus, it is believed that the high self-evaluation of these design issues by the target students might benefit more from conventional architectural education rather than current sustainability-related training programmes.

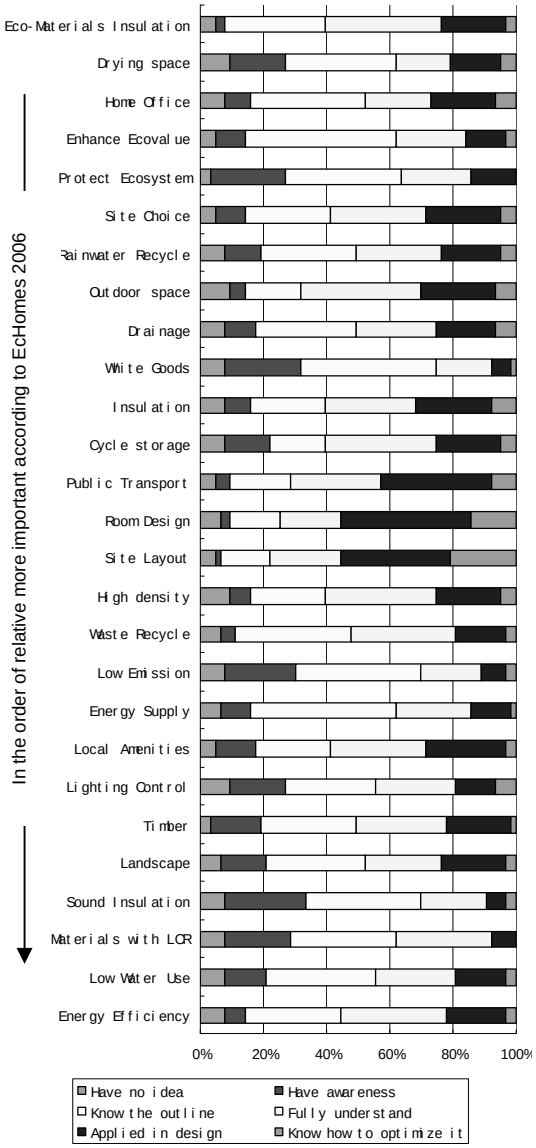

Fig 5. Student's knowledge of sustainability issues based on the scheme of EcoHomes 2006

To encourage these students to pay more attention to sustainability principles in their future housing design processes, the motivational factors, including both drivers and barriers, were also investigated. As shown in Figure 6, the top five drivers to encourage the target students to take sustainability principles into account were 'environmental benefits', 'reducing waste', 'doing the right thing', 'demonstrating best practice' and 'economic benefits'. While on the other hand, the top five barriers were 'lack of interest from developers or clients', 'affordability and cost', 'lack of information and relevant training', 'lack of awareness' and 'construction industry culture' (Figure 7). It was found that, although students in different groups (between one year taught master students and the fifth year architectural students) rated the motivational factors in different orders of relative importance, there was a general consensus on the principal motivational factors.

Furthermore, it was also found from this study that students in the target group would often like to look for information about standards, services, technologies and products related to construction and the built environment from 'professional journal or publication', 'project team members, colleagues or tutors', 'government publication', 'professional or trade body' and 'research organisations'. As a special general media, 'internet' was also welcomed by many students as an important information source. These findings are expected to be compared with the information sources of other stakeholder groups later. The communicational platform in the participatory decision making processes can then be built up based on their overlapping interface as it might be able to get the message across more effectively.

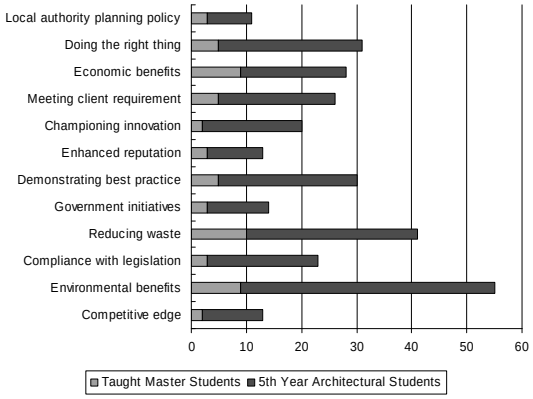

Fig 6. Top five drivers to take sustainability principles into account

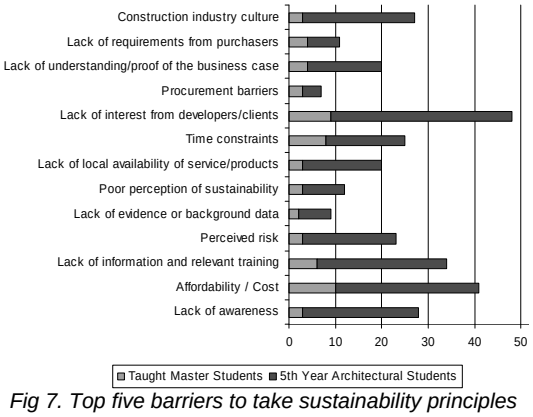

Fig 7. Top five barriers to take sustainability principles into account

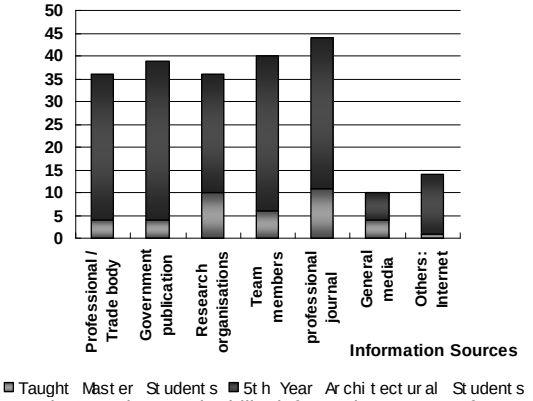

Fig 8. Main sustainability information sources for architectural students

5. Discussion and Conclusion

A wide spectrum of important issues, related to the current sustainability-related education and its effects on student's knowledge of sustainable design principles, have been investigated and discussed in this paper. Some principal findings have been summarised as following:

- Although the higher-level architectural students have realised the importance of addressing sustainability principles in design processes, few of them have been equipped with sufficient knowledge to do so under the current education. Actually, some students in the target group have not truly distinguished the housing environmental issues addressed in the assessment method from those encountered in the conventional design processes.
- Many higher-level students would like to take the current sustainability-related educational programmes as a technology-focused extension for their existing tutorials, and often take sustainability principles into account from a passive perspective. In the follow-up discussion session, many students admitted that they would not consider some sustainable design measures unless their clients required them to do so.
- A close consensus has not been achieved between student's knowledge and legislator's constraints. Furthermore, higher-level architectural students' limited understanding of the compulsory criteria (e.g. mandatory minimum requirements for some issues in the Code) may lead to serious problems. It is no longer about whether these future professionals would be able to address different housing environmental issues in a proper order of relative importance, but about whether they will be truly qualified and their products can be put into practice.
- The principal motivational factors, including both drivers and barriers, to engage students to take sustainability principles into account in the decision making processes have been identified. These issues are expected to be well addressed to improve the efficiency of future sustainability-related educational programmes.

There is a trend in the recent collaborative design processes that the role of architects needs to be re-identified. Architects are likely to abandon the traditional idea that individual designer is dominant in the design processes, but they may still believe that they have some specialised decision making skills to offer [3]. Therefore, the relevant educational programmes need to be revised accordingly: no only endow architects with sufficient specialist knowledge, but also improve their communicational skills to facilitate knowledge transfer and educate other stakeholders into more collaborative roles.

It is argued that environmental indicators for buildings have the potential to 'make the environmental impacts (and possibly benefits) of buildings visible to all relevant actors' and then to 'facilitate the consideration, management and communication of an array of environmental issues in the relevant decision-making phases' [12]. In this paper, therefore, the framework of EcoHomes is applied as a prototype of communicational platform to get the message across. However, this pilot study only makes the knowledge gaps between architects and legislators explicit. Further works are expected to study the knowledge gaps between other stakeholder groups, which should also be carried out on the basis of this communicational platform.

6. Acknowledgements

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