Environmental Design & Sustainability: Strategies for Teaching and Learning in UK Schools of Architecture.

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3- Integrate knowledge.
4- Experience the work environment.
5- Bring Architecture closer to reality.
6- Induce collaborative work.
7- Promote communication and interaction.
8- Change attitudes toward teaching architects.
9- Teach teachers to teach.
10- Reduce teachers' administrative tasks.
11- Share teaching experiences.

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Such innovation would better prepare the next generation of architects for the environmental issues of the 21st century.

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Dedication

A la gente que más quiero: A los papás más lindos de este mundo, al Abo y a la mamama, a Ovidio y a Ricardo, a mi familia y amigos y a David.

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Research Structure

The research structure is summarised in the following way:

1- Primary research (pilot) was carried out to identify the way teachers approach their teaching tasks.

2- A focus group and discussion groups were organised to find a pattern of preference and efficiency from students' points of view.

3- A comparison of teaching methods was also part of the exploratory research. Two teaching methods were compared (workshop and lecture) using a semi-experimental setting.

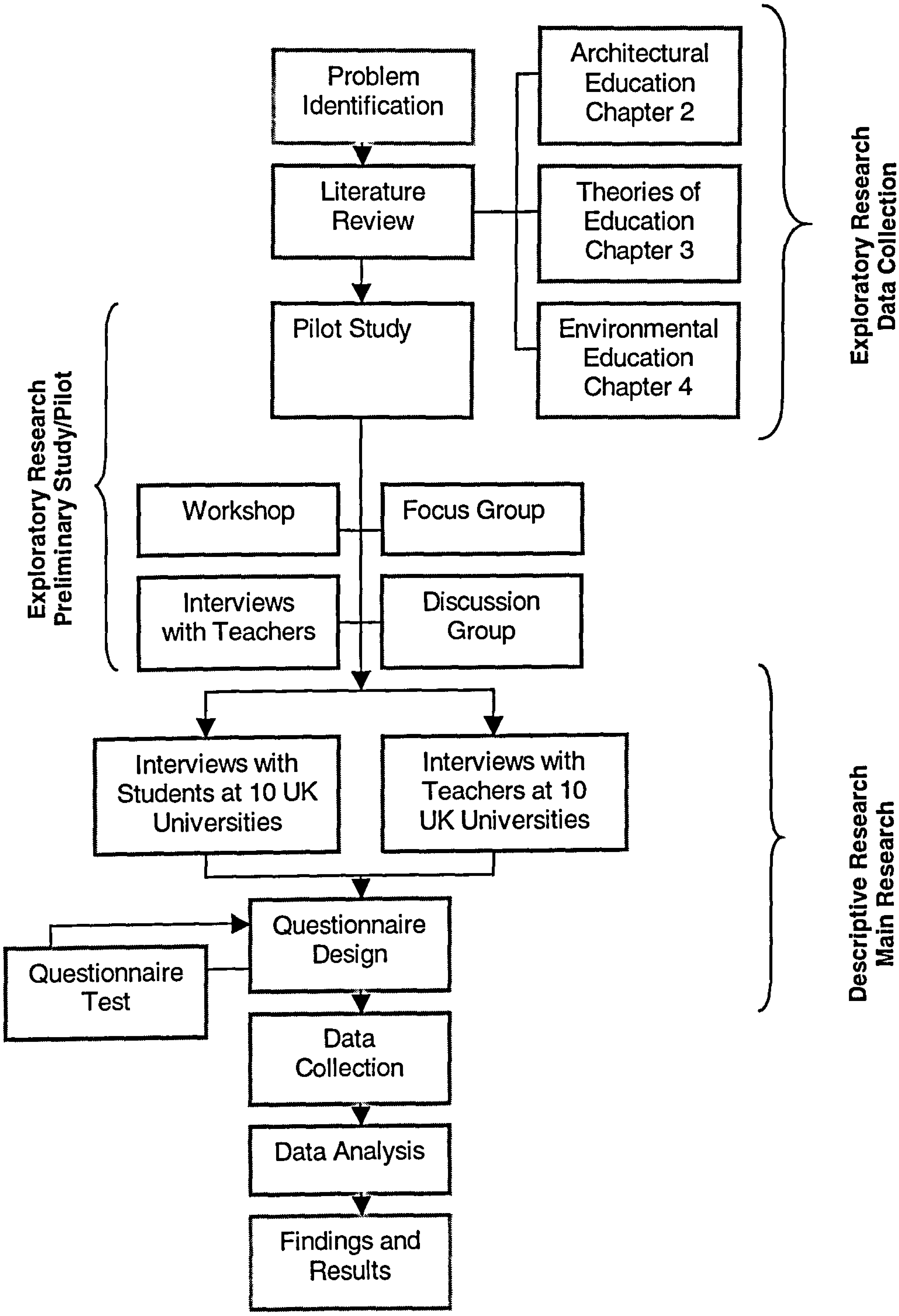
4- A feedback session followed the comparison of teaching methods to review what students thought about some subjects and the way they should be taught.

5- Qualitative research into students and teachers' learning and teaching preferences was conducted through interview of students and teachers of the same 10 universities participating in the study. Some of the aims were to find out teachers and students' understanding of and motivation for environmental education, through personal interviews.

6- A survey questionnaire based on the qualitative data was given to teachers following the interviews to corroborate the information in a more quantifiable way.

7- The data were compared and analysed and the results and conclusions were drawn.

Research Structure



Chapter 1. Introduction

Chapter 1

1 Introduction

There are many definitions of learning, however it is generally agreed that learning means a long-term change in people's knowledge, skills, understanding, beliefs, values and attitudes, acquired through experience. Learning is an aspect of human life that brings a higher degree of meaningfulness to the environment and human existence. Usually, education and learning are considered as synonyms. However, education is only a way of training, preparing and forming for social and working environments, and facilitates the acquisition of those skills, knowledge and understanding which can change the way people perceive life.

There are many theories of education explaining the way students learn and the way education has to be carried out to improve students' learning. However, most of them agree on the importance of meaningful knowledge and motivation to learn. When students are demotivated they repeat facts without learning (surface approach to learning), as opposed to understanding the facts' meaning and its consequences (deep approach to learning). When students are motivated to learn and understand, they search for logic and mnemotechnic elements that help them link isolated elements. Students, and people in general, tend to remember the meaning of something, or the main interest or tendency but not the exact text, cipher or knowledge. People digest the facts and interpret them; whatever they understand from it will be remembered, not in detail but in meaning, no matter how arbitrary the fact was. This is because learning is a personal experience and some things will be more relevant to some than to others. If a student is really interested in a fact, he/she will use the skills or knowledge learned from it and recall their application when needed (Chapter 2).

In architecture, there is no single theory that describes the way people learn. The education of architects has been defined as an individual process of learning skills, knowledge and the culture of building/constructing socially adequate human environments. Such socially adequate human environments are spaces that satisfy the expectations of the social structure at a specific time and place.

However, architecture was not always defined this way. Architectural Education has been shaped by history and has evolved substantially over a long period of time.

Some elements of the education of architects can be traced to times when education was based on following the elders and learning from them. Teaching architecture evolved from apprenticeship to mass education (Chapter 3), with Design and Drawing becoming the main elements of Architectural Education in later years.

It was only in the 20th century that Design was recognised as the element that differentiated architecture from other crafts and techniques in construction. Many good things have been developed through Design. It is considered an excellent teaching and learning tool developing students' self-sufficiency, self-confidence, problem-solving, and the ability to learn from experience. However, by differentiating this teaching technique from others, and giving it so much importance in the profession, other subjects have become devalued and internal conflicts have been promoted between areas of architecture: Art vs. Technology for example.

The Design studio has been at the centre of architectural teaching, complemented and supported by a series of technical and theoretical subjects which have been added throughout its historical development (Chapter 3). Nevertheless, there is a secondary role given to supporting subjects to the consequent detriment of the learning of these subjects.

There is a necessity to find out more about the way architecture students learn and, then, to try to narrow the gap between Architectural Design and other subjects in architecture, like Environmental Design and Sustainability, which have been left aside for many decades.

This need for integration is not a fad. The number of environmentally designed buildings is not very large. Architects and architecture teachers carry a lot of responsibility for this, for the lack of awareness in the classroom and the lack of confidence in construction. However, all humankind is responsible for the depletion of the atmosphere, environmental change and global pollution, which is causing climatic change and the depletion of the ozone layer.

The vast majority of the current increases in greenhouse gas concentrations (including CO_2) are created by human actions, and architects and engineers in particular deserve a large part of this responsibility. Smith and Pitts have pointed out that six billion tonnes of carbon dioxide emissions can be attributed to human activities and half of this to buildings and construction (Smith and Pitts 1997). A large part of the environmental problem we encounter today is due to cities and the built environment and therefore the criticism against architects and engineers for their participation in environmental damage is justified. However, it is the architects and engineers who also have the capacity to reduce the short, medium and long-term damage through greener design solutions (Chapter 4).

Some of the solutions teachers and students agree with refer to more practical learning and application in Schools of Architecture, so students can see the relevance of designing sustainable buildings, and also raise awareness for their future careers (Chapter 6). Others refer more to communication between staff and integration of teaching philosophies and strategies. All are summarised in Chapter 6 and 7 where solutions, likes and dislikes, opinions, criticisms and suggestions were compared and analysed in teachers' and students' own terms (Chapter8). Chapter 9 reports some strategies and suggestions to follow.

Several research techniques were used in this research; students and teachers participated in interviews and an online questionnaire. Also, students were involved in Focus groups and discussions observations, and annotations on students' and teachers' opinions and attitudes were recorded and classified as a theoretical base for study (Chapter 5).

1.1 Research Objectives

Having outlined the research area, the study now summarises the major research objectives:

1. To investigate and document current methods of delivering Environmental Design at 10 of the 37 Schools of Architecture in the United Kingdom.
2. To investigate the efficacy of different Environmental Design courses at these institutions, through the measurement of student and teacher satisfaction with various teaching methodologies, considering both:
    a) Teachers' assessment of their courses and students; and
    b) Students' assessment of their courses and teachers.
3. To identify the main learning requirements for attaining better learning performance in Environmental Design. Suggestions for improvements in Environmental Design practice are investigated through the use of personal interviews.

1.2 Defining the Research

Human beings have had a great impact in the global environment through the generation of polluting gases, waste, energy consumption and the reduction of biodiversity, among others. Architects have a big part in the construction of cities and its buildings, which generate pollutants, waste and consume energy. This is one of the main reasons why the idea of Sustainability (or prolonging the global resources) should become more of a mainstream component of Architectural Education. Some of the suggestions to achieve this integration are:

- "Tying studies to more 'real life' problems;
- Developing a range of teaching sources in studio instruction;
- Replacing the 'architect as hero' model with 'architect as team player';
- Acknowledging the formal curriculum as one phase in life-long learning;
- Promoting an interdisciplinary/collaborative approach among designers, sociologists, ecologists, etc; and
- Developing a solid theoretical and research base" (Boyer and Mitgang 1996).

The following section examines teaching, learning and teachers' attitudes. Some statements will be outlined after each section, in order to provide a testable list that can be used to organise the research design and help focus Architecture schools' observations.

1.2.1 Integration with Design

> "Architecture, unlike music, painting or literature, is of the earth. It belongs to the ground as a container for the activities of man and, as such, is part of his very existence. This intrinsic link is evident in the basic need for shelter" (Baker 1989).
>
> "...In general we may say that architecture is a human product which should order and improve our relations with the environment" (Norberg-Schultz 1985).

As the core of Architectural Education, Studio Design has great weight in students' acquisition of knowledge. The resolution of Design problems based in reality (to some extent) and the inquisitive, formative environment created by the presence of other students and tutors create an ideal background for a collaborative process of thought and production of ideas. In other words, the learning setting is perfect for a simulation of reality.

Students develop their design strategies from the studio. The idea is to achieve a conscious, higher learning, where students and future architects do environmentally friendly design without having to think about it as an extra element of the design. The awareness of environmental issues and the consequent design solutions and strategies will be as natural as the design process itself. As Neel points out, the main problem of design and technology is the fact that design is not to be taught; hence the suggestion of bringing technology to the studio would create problems in the acquisition of technical knowledge. Nevertheless, solving the design problem is central to all architectural courses, and so all staff and teaching methods sharing this task will be central to architectural education (Neel 1969).

In terms of technological issues, the presentation of physical principles should not take place in a separate course specifically oriented for architects. Rather, it should be integrated into the architectural programme at those points where understanding of these principles will provide the foundation for the comprehension of their architectural applications.

> "In our culture, technical subjects have always been the stepchild of Architectural Education and have been largely neglected. The formal, spatial and theoretical aspects of design have dominated Design education so far while the neglect of the technical component has slowly boiled up a crisis in Architectural Education with the NAAB (National Architectural Accrediting Board) and practitioners demanding quick changes and schools often slow to react" (Peters 1986).

Donald Schön suggests, in designing a building, that the architectural designer continually switches focus between the conditions of the problem, the general principles, and the suggested solutions. Others suggest that the restrictive nature of technology is extended through the architectural process, where technical, cultural, and organisational aspects interact together for a more integrated architectural solution (Smith 1987).

> "If we see architectural Design as a subset of environmental Design, architecture has a practical as well as an artistic purpose. Architectural Design has to do with the creation of physical objects or places which accommodate human or social activity and which are intended to change such an activity. Architectural products are solutions to problems coming from the environment, and the solutions also have a retroactive effect" (Yunus 2000).

Statement (1)

The integration of Environmental Design into the design project will make those issues part of the everyday design process that students will use in their future careers. The teaching and learning of these issues will be more efficient if they are part of the main design project and not just a reinforcement of it.

Integrating Environmental Design into the studio results in a more successful and efficient understanding of green architecture.

1.2.2 The Influence of Teacher

There is useful knowledge contained in most lectures. There are also skills to be learned in lectures that students can apply to other subjects, especially Design. However, what teachers transmit or try to transmit and what students receive from them are two different things.

The kind of learning that can be influenced by teachers is called extrinsic as it is influenced by external factors[1]. However, the processes of learning are not as simple as giving and receiving information. If the teaching is interesting and relevant, in theory, there should not be any problem with the learning. Nevertheless, teachers' attitudes and motivations towards environmental issues will be manifest and perceived by students. Students will therefore be influenced by these attitudes, motivations and approaches to Environmental Design in the way they learn the subject.

The way students approach learning is very important for the way they learn. Attitude is very much related to understanding of a subject and its use. When a student does not understand the content, its use or its relevance, he/she tends to approach learning in a superficial way. The opposite happens when the subject is understood.

If we compare teaching and learning in an Environmental Design course, we can find some links between teaching and learning. The success of environmental architecture is based on teachers' motivation for and consciousness of the subject. The position of a lecturer or tutor on green architecture, his/her motivation towards the subject and the level of commitment to the environment will all have a great

[1] This will be discussed in Chapter 2, section 2.1.1

influence on students' acquisition of knowledge and thus on the success of the objectives of the course.

Statement (2)

Teachers' attitudes and motivation towards the environment influence students' perception and attitudes towards Environmental Design and Sustainability.

1.2.3 Methods Preferred by Teachers and Students

Teachers' satisfaction levels with the way they teach seem to be different from the satisfaction of their students (Dejesús et al. 2000). It is probably common to hear complaints from students about a boring class while the teacher thinks the class was very enjoyable. This is because there are differences between the way teachers and students perceive learning, which could help explain students' demotivation for environmental subjects.

A new perspective in Architectural Education first has to focus on students' learning more than on their production of material. It is true that in architecture the amount of work done within a certain period of time is crucial in determining if students can cope with real-time situations. However, the main focus should be on learning, and the development of students' capacity to learn and understand, and find their own solutions and strategies to learning.

The methodology used to achieve these aims then has to be considered. The aim behind a process is one thing; the other is the strategy used to accomplish this aim. Teachers have to reinvent the way they teach, not because they all have a wrong approach, but because they have to adapt to new circumstances, students, material, and realities. Every new group represents a new challenge and the methodology successfully used one year may be disastrous for the next. Teachers have to adapt and change their strategies accordingly and be flexible and innovative in their approaches.

Learning and teaching are not the same. Teaching is the intention of the teacher to transmit some information, skills, values and attitudes towards a subject. Learning is how this intention is received, understood and applied. To learn, there must be a change in attitude and understanding of the subject. Therefore, there is a discrepancy between what teachers do and think of their class, the methods they use, and what students think and learn from the same class and method.

Statement (3)

The methods preferred by teachers to teach are not the methods preferred by students to learn.

One of the major problems in education is students acquiring knowledge and skills but having no understanding of what to do with them, how to apply them in design and their profession. It is a matter of being unable to relate the knowledge and skills to everyday life, and this is not only a consequence of teaching, but also a conditioning of the learning process. Sometimes students approach learning superficially, without having a proper stimulus from the teachers, or lack understanding of why that information is important. A deep understanding of the information will not happen without a meaningful approach to learning.

Statement (4)

Although Environmental Design has been part of the discourse of Schools of Architecture for many years, there are no strategies to motivate students' learning.

There is a general concern for the lack of integration between architecture, the environment and Sustainability. Nevertheless, a way of achieving this integrated approach to teaching and learning must be devised. Based on a Survey of the Literature, the author suggests that there are many factors, which affect students' learning of environmental issues. First, environmental issues are usually taught through lectures and not very often through Design (Chapter 6). Second, teachers and tutors' attitude and motivation towards Environmental Design vary and affect students' learning. Third, students prefer different teaching methods and learning styles to those preferred by teachers (Chapter 8). And finally, some teachers and architects are unprepared and/or lacking the confidence to teach or practise environmental issues in Design.

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Chapter 2. Education and Learning

Chapter 2

2 Understanding Education and Learning

Introduction

> "Learning is a process of active engagement with experience. It is what people do when they want to make sense of the world. It may involve an increase in skills, knowledge, understanding, values and the capacity to reflect. Effective learning leads to change, development and a desire to learn more" (Campaign for learning 2001).

Although there are many definitions of learning, almost all agree that learning means a long-term change in people's knowledge, skills, understanding, beliefs, values and attitudes, acquired through experience.

Although learning is a natural process, and everybody can and will learn something, it is common to relate learning to schooling and education, education related to a set of standards, activities and knowledge of a particular group. Of course, to learn something does not necessarily mean one needs someone else to teach it. There are some instinctive reflexes like breathing, crying and yawning that will need no teaching. Other activities like hunting and building are primarily learned through adaptation and trial and error, motivated by hunger and the search for shelter.

Nevertheless, teaching is important to maximise learning, as Vygotsky explained in his theory of social cognition (Vygotsky 1978). There are many theories of how people learn and, through history, teaching and schooling have been developed around these theories; for example, Pedagogy for children and Andragogy for adults.

Although there are many theories of architecture, which influence the way architecture is taught, no theory of Architectural Education has yet been developed. Despite this, much educational thinking has been adapted for use in the education of architects. At the end of this chapter, some of the elements of Architectural Education will be explained in terms of different theories of education.

2.1 Learning and Education

The Oxford English Dictionary defines education in the following terms:

> "The process of 'bringing up' (young persons). The systematic instruction, schooling or training given to the young in preparation for the work of life; by extension, similar instruction or training obtained in adult age." (Burchfield 1989)

Education is defined as a way of training, preparing and forming for social and working environments; also, developing character and the culture of the group. As Gulliver found out in his travels, education is also a way of improving human life, through experiencing practical and mechanical operations, in contrast to plain knowledge.

> "I had hitherto seen only one side of the Academy, the other being appropriated to the advancers of speculative learning...the universal artist told us he had been thirty years employing his thoughts for the improvement of human life... he said perhaps I might wonder to see him employed in a project for improving speculative knowledge by practical and mechanical operations" (Swift 1906).

Learning is an aspect of human life that brings a higher degree of meaningfulness to the environment and human existence. Entwistle says there is no learning without content, and thus no phenomenon of learning *per se* (Entwistle 1984). Nevertheless, this content has to be seen not as information itself but as relevant material for the learner's life. Dahlgren defines learning as a change in conception, although it has been demonstrated that it is not so much students' conceptions that are changed through learning but the way they use terminology to describe facts and information (Dahlgren 1984).

Acquiring knowledge and learning is not the same as education: is a person learning poker being educated? There is also a wide difference between education and being educated. Society recognises that education refers to the set of knowledge and abilities that will preserve and enhance the quality and standard of life of its citizens. In many of today's social circles, learning poker might not be considered as part of education, although it is something that requires effort, learning skills and intrinsic mental capacity. Education is generally judged by the cultural outcome, and a game is not generally considered as one of the achievements future generations need to preserve the social system.

> "Someone with the qualities that society prescribes is considered as an educated person. Someone who acquires abilities, skills and knowledge in an unorthodox way is not considered educated" (Kleinig 1982).

The way education is defined, it is limited to a particular group, excluding whoever wants to move apart from the norm, be creative in the way they learn or follow only the norms that suit him/her. The people choosing this path are "uneducated". However, although being "uneducated" is being outside the educational system and the social cult, this does not mean that those individuals are unable to learn or acquire knowledge, because learning is only partly about education.

Also, teaching has always been related to education, but this is not necessarily the case for learning. Learning is a natural process, an instinct; people do not need to discover how to learn, as learning is a survival strategy. However, knowing how to improve our learning process is a necessity, as it will be possible to improve the acquisition of knowledge and skills, and also the development of mental capacity and reasoning skills. The association between education and teaching is natural; however it is learning that should be important, as we learn to be citizens in universities.

Learning, therefore, is the model that should be associated with education and not teaching. Teaching is just part of the resources that help the development of students' thinking (Kleinig 1982). As Perry has argued (Marton, Fertence et al. 1984) the desired outcome of education is not teaching or learning but a change in students' thinking from a reproductive conception to a contextual, relativistic reasoning.

As Dahlgren points out, learning is a many-sided phenomenon: as many as there are things to learn, so there are ways to learn and as many different outcomes. This explains the way some theorists have developed ideas on the different ways of perceiving reality and learning. Gardner developed the theory of Multiple Intelligences using findings from research in neurophysiology. He suggested there are at least eight intelligences (and thus at least eight ways to learn), which are located in different parts of the brain.

The intelligences mentioned are:

Verbal-Linguistic--The ability to use words and language.

Logical-Mathematical--The capacity for inductive and deductive thinking and reasoning, using numbers and recognition of abstract patterns.

Visual-Spatial--The ability to visualise objects and spatial dimensions, and create internal images and pictures.

Body-Kinaesthetic--The wisdom of the body and the ability to control physical motion.

Musical-Rhythmic--The ability to recognise tonal patterns and sounds, as well as a sensitivity to rhythms and beats.

Interpersonal--The capacity for person-to-person communications and relationships.

Intrapersonal--The spiritual, inner states of being, self-reflection, and awareness.

Naturalistic—The ability to understand, relate to, categorize, classify, comprehend, and explain the things encountered in the world of nature.

Fig.1 Gardner's Multiple Intelligences (Funderstanding 2001).

Every person has different intelligences, some more developed than others. This does not mean that one cannot develop new ways to acquire knowledge and skills. The learning strengths will determine the easiest way for them to learn something.

> "The 'learning styles' theory implies that how much individuals learn has more to do with whether the educational experience is geared toward their particular style of learning than whether or not they are 'smart'" (Funderstanding 2001).

There are many theories of learning, however, and in the following sections a few approaches to learning will be explained.

2.1.1 Deep and Surface Approaches to Learning

> "There is a difference between learning and acquiring information. Learning implies an understanding and change in the way reality is perceived" (Svensson 1984).

Each person learns in different ways, and thus the outcome from similar activities of learning can be different. Asking students what they saw, or how they tackled an exercise can help to show how they reason and perceive certain information and therefore how they approach a learning activity.

It seems that the main difference between students' approaches to learning is that between intrinsic (interest) and extrinsic (threat, anxiety and teaching) motivation. The particular type of motivation determines whether students look at information deeply or superficially.

A deep approach to learning describes the understanding and critical analysis of information, a superficial or surface one describes the memorisation and repetition of facts and elements within that information. Students resort to different approaches to learning depending on their perception of a task; the form and content of the material; on its relation to other tasks; on the student's previous experience, on the student's perception of the teacher who marked it; and of how it will be assessed.

> "For any particular problem, a student who is thinking deeply and holistically will be looking for meaning and will be able to attend to the global level of descriptions, whereas the students who is thinking atomistically (superficially) will consider only the local components of the problem without seeking to integrate them meaningfully" (Laurillard 1984).

Experiments in teaching have shown that systematic help leads to a superficial approach (Dahlgren 1984). One of the main things that teachers have to take into consideration is the relevance for the students, how interested they are, and how unthreatening and relaxed the environment for learning is.

Marton describes a superficial approach as one that is atomistic, as it represents the separation between the content or information and how that content is analysed and used (Marton and Saljo 1984). He suggests students might do well in exams and assessment through a surface/atomistic approach, but they will not understand as well as through a deep/holistic approach. Students using deep approaches to learning will search for relations, try to make critical judgements, draw logical conclusions and come up with their own ideas.

> "In order to promote deep approaches of learning, we should above all keep in mind the students' own interests at the same time as we should try to eliminate the factors that lead to a surface approach (irrelevance, threat and anxiety)" (Marton and Saljo 1984).

The way a person approaches learning will determine how he/she will tackle it: either to understand it or just to remember it in case it is needed. Both approaches are useful at times, although only one will help understanding of a subject.

Teaching is considered an external motivation and therefore could be threatening and lead to surface approaches to learning.

2.1.2 Teacher-Directed Learning (Pedagogy)

What is needed for learning and developing skills in higher education is different from what is needed at primary or secondary level. Nevertheless, there are not many differences between the way a child and an adult learns, except maybe the fact that experience and self-confidence have a bigger role in adults' acquisition of knowledge.

The art and science of educating children is called pedagogy, which is often used as a synonym for teaching[1]. The difference between pedagogy and adult education (andragogy) is the way, in pedagogy, the focus is on the teacher and not on the learner. The teacher is responsible for making decisions about content, methods and the structure of the learning task.

Eduard C. Lindeman wrote in 'The Meaning of Adult Education':

> "Our academic system has grown in reverse order. Subjects and teachers constitute the starting point, [learners] are secondary. In conventional education the [learner] is required to adjust himself to an established curriculum. Too much of learning consists of vicarious substitution of someone else's experience and knowledge" (learnactivity.com 2001).

Although teaching is intended to help pupils build meaning, there is a dichotomy in the way teaching is usually carried out. Directive learning can lead to students' rote memorisation of information without any understanding or interest in the content and meaning of the information. In traditional teaching, such as teacher-directed learning, students can easily spot exam questions and memorise facts and theories considered important by teachers, but not necessarily understand what they mean (Entwistle 1984). As a consequence, in teacher-focused learning there is a group of learners who behave like 'empty vessels' to be filled with information, but who do not try to reason and understand the teachings.

[1] In the remainder of the thesis, unless otherwise stated, the term pedagogy and teaching will be used interchangeably.

2.1.3 Student-Centred Learning (Andragogy)

In order to help adults learn, Knowles developed the theory of andragogy. The theory is based on the assumption that adults are self-directed and expect to take responsibility for their decisions. Like pedagogy, andragogy has now taken on a broader meaning and is usually used to refer to student-centred learning.

Andragogy focuses on the process and not the content to be studied, so deeper learning is considered more important. First of all, andragogic learning students try to find out why something is important (its relevance). They have to be self-directed learners and approach learning experientially and as problem-solving, relating experiences to what they learn (meaning), and being motivated to learn, which often requires learners overcoming inhibitions, attitudes, and beliefs about learning. (learnactivity.com 2001, School of Psychology and Education 2001). Moreover, instructors are no longer lecturers or graders, but facilitators through strategies such as case studies, role-playing, simulations, and self-evaluation.

Student-centred learning gives a high value to the individual's motivation and the construction of meaning, placing the student at the centre of the learning relationship as far as knowledge and skill acquisition is concerned (Nicol and Pilling 2000).

2.1.3.1 Motivation and Meaning

Motivation has been described as the motive or goal of a person's behaviour; and as the desire to participate in the learning process (Lumsden 1994). There are different kinds of motivation. Entwistle describes two types of motivation — one which depends on external reinforcement for learning (from school marks, grades, or qualifications); the other on internal factors (interest and perceived relevance or striving for success and self-confidence). He describes a 'competent motivation' as the positive orientation towards learning created by the repeated experience of successful learning activities (Entwistle 1984).

Students' low performance in class cannot always be blamed on lack of motivation to learn or low intellectual capacity. Often, it can be attributed to poor teaching and meaningless content. Ideally learning is self-directed and occurs in a challenging but non-threatening learning environment, where students have freedom to analyse and experience. In this way students can make sense of experiences they have, make them useful for future experiences in life, and consequently be motivated to learn.

Nicol and Pilling believe that for meaningful learning to occur, students need to:

> "...Construct and reconstruct information input; by modifying, revising and extending it, relating ideas to each other and to what they already know, in an effort to make personal sense of it" (Nicol and Pilling 2000).

Things have individual significance and the importance of a fact is relative for each individual. Nevertheless, in order to have a broader understanding of information and knowledge, students should understand the benefits of collaboration and interaction with others through discussion and dialogue.

> "Meaning requires understanding **wholes** as well as parts. And parts must be understood in the context of wholes. Therefore, the learning process focuses on primary concepts, not isolated facts" (Funderstanding 2001).

It is not only dialogue and communication which help the development of meaning. Carl Rogers, in (Entwistle 1984), believes that significant learning occurs when teachers recognise that emotions are an essential part of learning, not only to develop personality but also the intellect. Being self-confident in the ability to learn, and feeling that the experience of learning will be personally rewarding and meaningful, will lead to a 'significant, existential' learning.

2.2 Architectural Education

Although criticism can be levelled at the individualistic character of Architectural Education, it is no doubt beneficial to develop critical abilities and problem-solving capacities in students.

> "Si me puedes definir la Arquitectura, defíneme el Amor. Si los defines, ni haces Arquitectura ni sabes Amar"[José Ignacio Sánchez Carneiro][2].

It seems architects do not consider architecture to be a definite concept. This could be one of the reasons for the variety of definitions and concepts of architecture. In fact, each School of Architecture around the world has its own; it could be defined as art or science, as technical or creative, or as action or theory. This lack of

[2] 'Can you define architecture? Define love! If you can define them both, you don't practise architecture nor know how to love' [Author's translation].

consensus results in a considerable diversity in what architectural students are taught.

The Oxford English Dictionary defines architecture as:

> "The art or science of building or constructing edifices of any kind for human use..." (Burchfield 1989);

Or, as defined by School of Architecture:

> "Architecture is the art of making the world habitable..." (University of Portsmouth 2000).

Defining architecture is a very subjective matter, with each architect or author having an individual concept and theory. However, it would probably not be fair to confine architecture to a simple concept, a single area. Architecture is a discipline career that is formed by a variety of other subjects that in themselves form separate study areas. Architecture is in a way the summary of many areas, the point where they meet.

> "A group of stones with a character, a metaphor, is it green or is it a part of technology? Probably all of them, according to the time on which the discourse is taking place. Architecture seems to vary depending on who sees it, and when" (Shepheard 1994).

Architecture has evolved and all the subjects that once had recognisable boundaries have grown and are expanding. Cultural influences and social trends have also defined architecture, and redefine it each time they change. Thus, architecture has been changing with time and space since the beginning of man-made construction, and the way people appreciate and study it has, although more slowly, changed accordingly.

2.2.1 Aims and Objectives

Taking into consideration the concepts of education and architecture mentioned previously, Architectural Education, then, aims to prepare students for a working world, and the culture of society that supports the idea of the architect. Architectural Education can be defined as the process of instructing, training, preparing young people, in a systematic way, to acquire the habits, knowledge, skills, culture and character for building human living environments.

As we have said, architecture is defined subjectively and therefore studied in the same way. Architectural Education is an individual journey, which each person has to experience in order to decide which path his or her profession should take. It provides many opportunities to develop a critical and reflective way of thinking, which can lead to a variety of interpretations and practices. Thus, the process students have to experience to become 'educated' in architecture changes for each person. Schools of Architecture set educational structure, but each student sets his or her own agenda inside Architectural Education. The education of architects is an individual process of learning skills, knowledge and culture of building/constructing socially adequate human environments[3].

Nowadays, societies are not only concerned about architecture in the sense of individual health, comfort and accessibility, but also in the broader sense of human and global health. As society has become increasingly aware of a global interrelated environment, so Architectural Education is moving towards greener, environmentally conscious ideas. This is creating new definitions of the role of architecture and Architectural Education in society.

> "...We must define the role of Architectural Education as a method of making connections between the creative urges of a student and the developable ability to see the world as a fabric of interwoven social, political, and environmental concerns" (Malecha 1993).

It is clear that any definition of Architectural Education will be interpreted differently by society, which directly influences the educational process and will also depend on the historical moment the definition is interpreted. Likewise, how Architecture Education is defined will depend on the cultural connections of the societal group and the learners' individual interests and abilities, as well as on the aims and objectives set by each specific educational institution and regulating body.

Architectural Education has already been defined. However, we also need to understand how it is being taught, the internal aims of the faculty, and the inner culture of an architectural student, to understand why and how Architectural Education has developed into what we know today.

[3] By socially adequate human environments, it is meant following the expectations of the social structure at a specific time and place.

> "[Architectural Education aims...] to form conscious citizens who can contribute to the development of cities and society; independent thinkers who will be able to confront any kind of situation in an urban and global context; and future architects who should form part of a body of professionals that can make a difference in the way people live their lives" (Dejesús et al. 2000).

This could define Architectural Education's aims globally, accepting that Architectural Education is in the hands of different institutions with particularities in thought and pedagogical strategies.

The aims and objectives of each School of Architecture vary according to each university: some are very detailed, some very basic and others not obvious. Among the aims published on Schools of Architectures' web sites[4], some of the principal goals are similar to the ones stated on the RIBA syllabus: communication, environmental concern, understanding of the profession, etc...(RIBA 1996).

In most schools' online prospectuses, there is a clear division between the academic aims and objectives and the institutional objectives, between the educational side and the business side of education. Each school that defines its aims and objectives intends to attract students to enter into a symbiotic relationship, where the university provides education if the student pays for it. Therefore there is intense competition for places (from those who can afford higher education) and a great deal of marketing as universities try to publicise their schools and departments.

This is one of the reasons why the majority of universities concentrate on promoting the awards and resources they have, how well recognised they are nationally and internationally, and the status students will have after studying with them. Sometimes, this is at the expense of the educational objectives and aims of the school, or at least results in a failure to make them clear. The line between education and business is very thin and sometimes it seems that the reputation and achievements of the institution are more important than what, at present, it is offering academically.

[4] The information about the aims and objectives of different schools is based mainly on online prospectuses, as this is often the easiest way of finding information about the different universities in the UK and from around the world.

Some of these aims and objectives are exemplified by the following quotes from university prospectuses:

> "[the Architecture course] aims to combine an international reputation for research with a vigorous and critical debate about the future of architecture" (University of Sheffield 2000).

> "...Our graduates have a reputation for being all-round professionals who are creative, competent and responsive to people's needs" (University of Brighton 2000).

In academic terms, Schools of Architecture present a range of objectives, mixed with a definition of the aims and an outline of the structure of the respective subjects within architecture. Some Schools define architecture as something in the Arts, others as something on the technical side of the university spectrum. In general, Schools try to develop skills, confidence and understanding of the profession, as the aims of the following schools show:

> "...Acquisition of imaginative insight into the needs of building users ...the refinement and articulation of feelings connected with the experience of buildings" (University of Cardiff 2000).

> "The Stage forms a foundation for the development of your skills, confidence and critical understanding" (University of Plymouth 2000).

> "Developing the individual student to become a member of the architectural profession, equipped with the necessary skills to enhance the environment in which we live" (University of Portsmouth 2000).

> "Have acquired a knowledge of how information necessary for the design of a building is organised, and an understanding of how to acquire, retrieve and use it..." (Mckintosh School of Arts 2000).

Acquiring the right vocabulary and an understanding of the responsibility of architecture within society is a common aim in Schools' prospectuses. Consequently, students with an Architecture degree will in theory be adequately prepared to enter the working environment, and be proficient in construction techniques and building sciences, as well as in creative arts and design.

> "Students entering the field will have to deal with a fast-changing world in which the threat to human survival demands a response in which wit, understanding and the spontaneous use of resources will be a priority, in

addition to the traditionally recognised understanding of aesthetics and technology" (University College of London 2000).

"...An education in architecture, with its strong design emphasis, should create graduates who are responsible, competent and caring, whilst being self-motivated and creative" (University of Plymouth 2000).

There are also institutions that are trying to introduce the environment[5] as a new concern of architecture (University of Cardiff 2000). These institutions are trying to make the environmental element one of the key components of Architectural Education and not an extracurricular activity outside the core course.

Architectural Education "will prepare you for a career in architecture in a world where environmental issues and sustainable design are becoming more crucial. The course has been designed in collaboration with potential employers, professional bodies and environmental agencies to address the challenges of the 21st century" (Sheffield Hallam University 2000).

Architectural Education is directed, in a way, by what the RIBA[6] and other institutes dictate, but each School has its own interpretation of what is being suggested by these bodies. Despite the discrepancies in terms of defining aims and objectives, architectural institutions seem united in aiming to provide responsible and intelligent professionals, able to solve complicated design problems and use new technologies and resources available in a particular environmental situation. Architectural Education's main themes, then, appear to be moving in a positive direction: environmental consciousness, professional responsibility to the built environment and its occupants, and a collaborative multidisciplinary career focus.

2.2.2 Architectural Courses

One of the Institutes that validates Architectural Education in the UK is the Royal Institute of British Architects (RIBA):

"The Royal Institute of British Architects is a worldwide organisation, with more than 32,000 members in over 100 countries. It is a registered charity, whose objects are: the advancement of architecture and the promotion of the acquirement of the knowledge of the arts and sciences connected therewith. RIBA is an international knowledge-based network, which is

[5] By environment it is meant Environmental Design as defined in Chapter 4

[6] Royal Institute of British Architects defined in section 2.2.2 of this Chapter

> committed to the improvement and enjoyment of the physical environment through the development and sharing of values, ideas, learning, and practices" (RIBA, 2001)[7].

Together with the Architects Registration Board (ARB[8]), RIBA validates Architecture courses in the UK through the Joint Validation Panel (JVP). The Validation Panel has the objectives of enhancing the quality of architectural education, encouraging experimentation and innovation, and updating and improving the way the courses and teaching strategies are delivered.

The Architecture course has three essential parts: Part 1 with three years of full-time education; Part 2 with two years of full-time education; and Part 3 after a minimum two years of professional practice. A maximum of one of these years of practice can be undertaken after Part 1 and prior to Part 2.

Part 1 of the course covers the areas of Design, Context, Environmental Design, Construction and Technologies, Communication Skills, Professional Studies and Management and practical training. In Part 2, students will strengthen their knowledge of these areas and of the interrelation between them.

The current criteria for validation and the syllabus for this study were published in the year 2000, but a new publication to be published in 2002 will include some amendments. Some of the amendments to the previous syllabus were related to issues of Sustainability and Environmental Design, also Construction and Architectural Technologies:

Old text	Changed text
This subjects group involves two interdependent areas of study, environmental design and architectural technology. The first area examines the function of buildings to provide healthy and comfortable conditions for people, as a microenvironment, as a filter between internal and external conditions and its impact and use of utility infrastructures,	An understanding of the extent of human impact upon the environment and the mechanics for the interaction of buildings and the environment are essential to both. The impact of building design and specification decisions upon atmospheric carbon levels, other forms of air and water pollution, natural resources and biodiversity are key topics... Central

[7] See also 'From Apprenticeship to the Education of the Masses' in Chapter 3.

[8] The Registration Board is the body responsible for keeping a Register of Architects and for determining the standards of education and professional competence required for registration in the United Kingdom... An applicant for registration by the Board is entitled to be registered and thereby use the title "Architect" (RIBA-ARB, 1997).

both supply and waste. The physical principles of heat, light and sound and air movement and quality, together with biological needs of human beings provide the knowledge and framework for decision-making.	concerns are the rational use of energy, water and other resources at all stages in the life of every building and the relationship between buildings and utility infrastructure. The physical principles of heat, light and sound and air movement and quality, together with biological needs and perceptions of human beings provide the knowledge and framework for decision-making.

These changes to the Architecture syllabus include the definition of Sustainability described in Chapter 4 (section 4.2). These ideas of Sustainability are very useful for broadening the understanding of Environmental Design in Schools of Architecture and will be discussed further in Chapter 4.

As the RIBA and ARB only outline the skills and knowledge students should obtain for validation, the curricula set out by Schools of Architecture, although covering the bases set out by the JVP, vary greatly in content and style of delivery.

2.3 Learning in Architecture

There are many theories of learning that can be applied to the methods used in architecture. Most of them use similar terms to those used in the architectural teaching and learning process, like experiential learning, peer interaction, problem-solving, relevance and emotions. Nevertheless, there is no architectural theory of education as such.

A theoretical base has been developed in order to explain the role of discourse as the foundation of the learning process in architecture (Özersay, 2002). However, this theory has not yet been applied or proved at any School of Architecture.

> "Every truth is relative to its time and place, every discourse is truth and valid." (Cherryholmes 1988)

Teaching and learning in architecture will be discussed in the following chapter. In this section, some of the theories of education will be used to give some theoretical bases to the way architecture is taught. The list of theories is extensive and the ones mentioned in this section are not exhaustive.

2.3.1 Theories of Learning in Architecture

Almost all theories of education are based on the same concepts of motivation, relevance, experience, context and meaning, among others. Nevertheless the differences between theories appear in the way they explain the relationship between these concepts and the way they affect or generate learning.

One of the theories that comes close in explaining Architectural Education is Constructivism, which is defined as the construction of personal meaning through experience:

> "Constructivism is a philosophy of learning founded on the premise that, by reflecting on our experiences, we construct our own understanding of the world we live in. Each of us generates our own "rules" and "mental models," which we use to make sense of our experiences. Learning, therefore, is simply the process of adjusting our mental models to accommodate new experiences" (Funderstanding 2001).

An architectural project could be explained in terms of elements used to construct meaning. For a housing project in the countryside, students will have a better and more meaningful learning experience if:

- They have previous knowledge of a similar housing project;

- They have reference to something known or familiar, they have lived in the countryside, and they live in a house or have been in a similar house;

- They think this exercise is relevant to their studies;

- They are open to and relaxed about the idea of the project;

- They have understood what is wanted from the exercise; and

- Their emotions, motivation, self-confidence, and interest are focused on the exercise.

Nevertheless, each person has a different approach to learning or, in Gardner's words: multiple intelligence learning is individualistic (Gardner 1983). So, in addition to all the factors above, there are individual intelligences that could help solve a problem. Each person has developed abstract concepts through their own set of experiences, which are only partially shared with others. The information people receive is interpreted in terms of prior knowledge and concepts, which might contain shared or unique shades of meaning.

> "The purpose of learning is for an individual to construct his or her own meaning, not just memorize the "right" answers and regurgitate someone else's meaning" (Funderstanding 2001).

This does not mean that, in order to learn, individuals have to be isolated from others. Constructivism and many other theories support collaboration, discussion and dialogue, not only to help analyse and interpret information but also to optimise students' learning in a social context[9], and help see all aspects of a problem.

This kind of approach is also very similar to Neuroscience, which basically studies the human nervous system and the biological basis of consciousness, perception, memory, and learning. Hence, the followers of this theory (Constructivists) believe in teaching not to create meaning but to develop the brain's intellect (Funderstanding 2001).

This explains why some Schools of Architecture use Constructivist ideas, for in a design project, students have to understand the whole project in terms of its needs, impact and costs, in order to work on its parts and develop a coherent answer. Schools of Architecture use problem-solving and hands-on experience to give a deeper meaning to the individual learning process, and improve learning in a complex design project.

Architecture is mainly concerned with problem-solving, whether design problems, structural problems or social problems. Many of the theories of learning are based on the way problems are approached and the learning outcome. Associationism, for example, sees creative problem-solving as a stream of associations, where each association produces successive new attachments and thus new insights about problems (Rowe 1987). Here the problem works as a stimulus that prompts the learner's mind to confront the task and solve it in a structured framework of meaning. Bartlett also explained problem-solving in terms of an organised arrangement of ideas, so as to develop imagination (creative insight) into a problem's solution.

Like Bartlett, the Cognitionists believe, among other things, in using perception and thinking as the way to solve problems and thus the way to learn, as opposed to others like Behaviourists who believe in trial and error. Among Cognitionist theories,

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[9] This is what Vygostky called the zone of proximal development in his theory of social cognition.

there is the Gestalt psychology, which describes human cognition in terms of the quality of perception and thinking, and information processing theory, which categorises the mechanism of people's perception and thinking. The Gestalt focus is on the whole meaning of a problem and how it is structured, whereas information processing is concerned with how to proceed through a problem once one has ascertained the source of the problem.

Another way to explain the way problems are solved is through Behaviourism.

> "Learning is the result of associations forming between stimuli and responses. The hallmark of connectionism (like all behavioural theory) was that learning could be adequately explained without referring to any unobservable internal states" (Kearsley 2001).

Behaviourism talks about external conditioning responses as the main learning process. It is easy to remember Pavlov's dogs' salivation after seeing food or hearing a bell. This is called basic conditioning. However, Behaviourists like Skinner also refer to an 'operant conditioning' where the response is greater when some reinforcement or reward is given after the stimulus response occurs. Some examples of Behaviourist approaches in higher education are the reward of grades, or changing a submission date to an earlier date after a heavy argument in class.

There is much trial and error in architecture and learning through reward, especially in design, where the tutor's position of power controls the development and assessment of students' projects. This also supports the theory of Observational Learning in which students have a model to copy. The success of this model can depend on a teacher's attitude, although it is more likely students will follow a successful student's attitude. Observational Learning occurs in a social and environmental context. Therefore it is not difficult to understand why some cultural elements present in Schools of Architecture have been carried from one generation of scholars to the other.

In a way, Vygotsky's theory of Social Cognition supports this contextual learning:

> "Culture is the prime determinant of individual development" (learnactivity.com 2001).

Culture teaches us both what to think and how to think about it. What is beautiful? Why is that building good and that one not? Architectural students will answer these questions firmly using the aesthetic concepts acquired through contact with peers, tutors and the published information in magazines; secondly, with arguments supported by an understanding of the technical characteristics of the building or its impact. So Architectural Education provides the contextual setting for architectural students, influencing them in the way they think about something and how they establish the links in their thinking process.

Learning in architecture is a dialectical process as described by Social Cognition, where peers and tutors share experiences in solving problems, helping each other to increase their capacity to learn. Moreover, as the Institute for Research on Learning in California (IRL) work stated:

> "Learning is fundamentally a social phenomenon. Knowledge is integrated in the life of communities that share values, beliefs, languages, and ways of doing things. The processes of learning and membership in a community of practice are inseparable. Knowledge is inseparable from practice. Empowerment--or the ability to contribute to a community--creates the potential for learning" (Stewart and (reporter) 1996).

This 'Community in Practice' theory fails in the way it relies on all the members of the community sharing a 'communist' approach to development and learning, whereas in reality competition interferes in the learning process. This theory might work in some environments, but despite the fact that Architecture students study in groups, the level of competition is too high to support this theory.

As in all professions, in architecture, sharing experiences with peers is an important element of learning. Nevertheless, it is clear that without motivation students will not learn, no matter how big the external stimulus might be, and it is known that architectural students are sometimes motivated by recognition and stardom rather than working with peers.

As explained by William Glasser in his Control theory (Funderstanding 2001), behaviour is inspired by what a person **wants** most at any given time: survival, love, power, freedom, or any other basic human need. As students will not learn or do things that they consider irrelevant to their lives, it is not easy to interest someone in a subject which has no personal relevance.

Another theory that gives a strong significance to the community we live in is Critical Pedagogy. It refers to groups' interest in communal learning, however this theory also recognises the power relationships and the social reality. Critical

Pedagogy supports the basis of education, as a means of changing the way we perceive and live life. The primary characteristic of this school of thought is that social theory, no matter where it is applied, should play a significant role in changing the world, not just recording information (Scheurich 1999). Apple, Freire, Giroux and McLaren's ideas have promoted a deeper involvement of education in politics and power relationships in Schools, as well as encouraged interdisciplinary knowledge and ethics in teaching and learning.

> "Critical Pedagogy...signals how questions of audience, voice, power, and evaluation actively work to construct particular relations between teachers and students, institutions and society, and classrooms and communities...Pedagogy in the critical sense illuminates the relationship among knowledge, authority, and power" (Giroux 1994).

2.4 Conclusion

Key to learning architecture is the presence of experience, problem-solving, and the application of context and motivation. Architectural discourse and collaboration, with peers and tutors, are important in setting the contextual bases for architectural culture, and thus meaning, in education. There are many theories of education and, although none has been applied specifically to architecture itself, many could be used to support the way architecture is taught.

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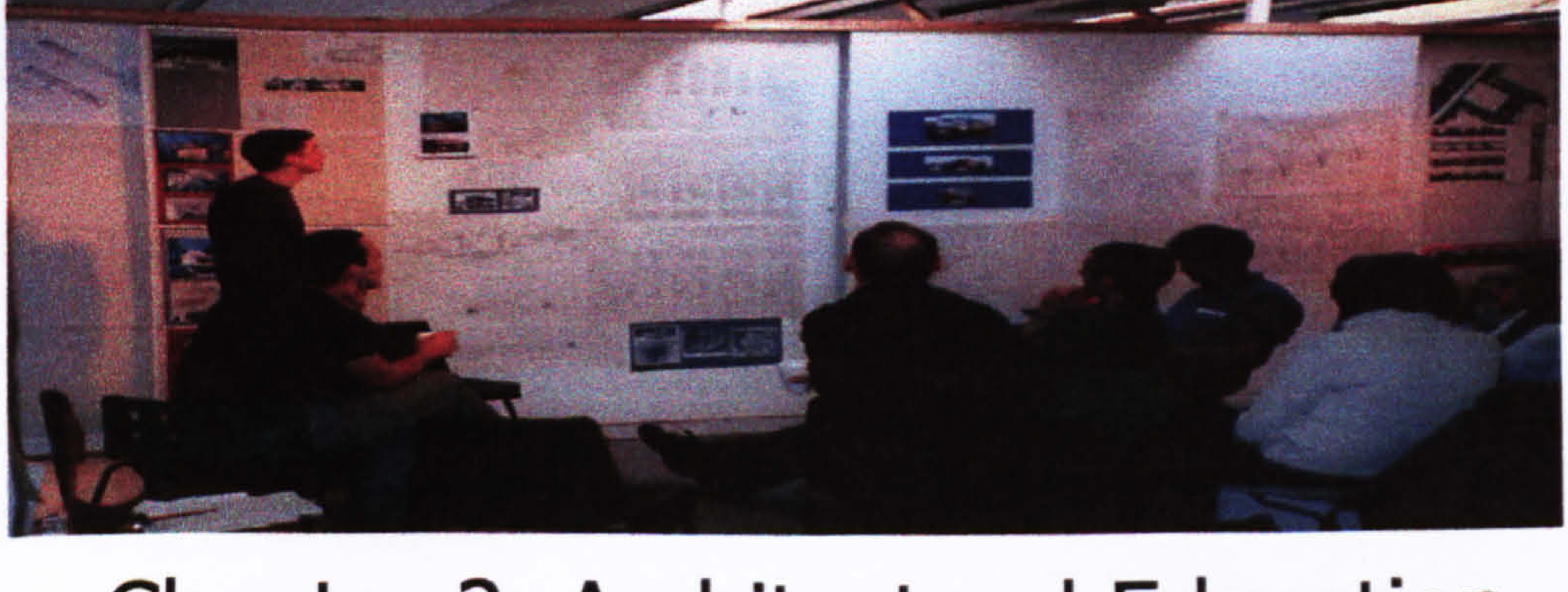

Chapter 3. Architectural Education

Chapter 3

3 The Evolution of Architectural Education

Introduction

> "...Architecture has been a non-institutional career that is still trying to adapt to the jump from the apprentice age to institutional learning. Architecture is being structured in a way that the transmission of knowledge is organised around the idea of what the architect should know, and how the architect should be. A hierarchical ladder where students have to start with a series of de-cultivation steps towards the new culture of the architect" (Crysler 1995).

Architectural Education has been shaped by history and has evolved substantially over time. However, the principles that shaped the teaching of architecture are still relevant today. In this chapter the evolution of Architectural Education in general and the factors that have shaped the education we have today in the UK will be summarised. A special emphasis will be given to the elements affecting the teaching of environmental architecture in the UK.

Design and drawing have always been the main elements of Architectural Education (Society of Architectural Historians of Great Britain 1993). However, it was only in the 20th century that these elements were recognised as those that differentiated architecture from other crafts and techniques in construction. The supremacy of design and drawing have led to the growth of many creative elements in education like self-sufficiency, self-confidence, problem-solving, and the ability to learn from experience, among others. However, it has also led to the devaluation of other subjects and promoted internal fights between subjects: Art vs. Technology for example.

The education of the architect has also been traditionally elitist (Crysler 1995, Society of Architectural Historians of Great Britain 1993) and it was only after the World Wars that, for economic reasons, architects had to open up to mass customers.

While many elements in Architectural Education can be traced to its origins, some emerged instead as part of the development of architecture as a subject taught in university: communication, dealing with clients and users, working in a multidisciplinary environment, contact with real life and communities, etc... Some have expanded the horizons of the career, others pointed out the deficiencies and weaknesses.

Many lessons, then, can be learnt from the evolution of Architectural Education, not only for the architectural environment, but also for the benefit of higher education in general.

3.1 From Apprenticeship to Education of the Masses

Architectural Education has always been influenced by society's needs and the necessities of shelter and protection from climate and dangers. The first constructions were developed through trial and error for protection against nature. Architecture was learnt through 'doing architecture', with the environment being the primal generator of the construction (Lawson 1988, Shepheard 1994). This architecture was part of the cultural patrimony of the group and learned from childhood, transmitted from generation to generation; learned, done, experienced and built by the community according to its needs.

Indigenous vernacular construction changed from being a communal response to the environment to becoming practised, in Egyptian and Greek times, by a more sophisticated social stratum of builders and constructors. All the learning was based on practising construction and each building taught a lesson that could be put into practice in the next construction. The concept of 'an architect' or 'architecture' was not defined as it is today.

At the beginning of the profession, the person educated and trained in arts and sciences could have developed and practised architecture, or the arts, or medicine, or law, or all of them. Therefore, before the emergence of architecture as a career, the architect, the builder, the surveyor, the engineer, the artist, and the scientist did not belong completely to different areas. In fact, it was only in the first century, as written records testify, that architectural training became distinct from other activities. And even then, architects continued to develop their understanding of many of the other areas of knowledge available at the time.

Vitruvius[1] wrote about the education of the architect:

> "Let the student be educated, skilful with the pencil, instructed in geometry, know much history, have followed the philosophers with attention, understand music, have some knowledge of medicine (hygiene), know the opinion of the jurists (law) and be acquainted with astronomy and the theory of the heavens. He then deals in turn with sites, building materials, temples, the orders, planning and grouping of public buildings, private houses and decoration, and water supply; astronomy, mechanical appliances for raising water and military purposes" (Vitruvius, 1914).

As Cunningham has explained, Vitruvius believed that: "Technical training must be broad, both theoretical and practical in character... He emphasised the educational need to order material and introduce it in small, easily assimilated amounts, and the importance of mastering one point before proceeding to the next and organising all the learning around systematically arranged bodies of content. He recommended frequent classroom discussion and setting the students to teach others to make his knowledge more 'active' (Cunningham 1979).

The architect was expected to plan, design, calculate the dimensions, and construct the building, as well as experiment with materials. Architectural knowledge and content were not separated from construction, or engineering, or knowledge of nature or the arts.

Vitruvius' concept of Architectural Education promoted dialogue, discussion and peer teaching in order to encourage a more active knowledge. This contrasted with followers of Plato[2]. For them, the purpose of education was to promote individual development, the awakening of an inner knowledge intrinsic to each individual. Both Vitruvius and Plato's ideas had a close link with nature.

With the collapse of the Roman Empire, however, most of the learning from the philosophical schools was lost. From the time of the Romans through to Medieval times and until the Renaissance, apprenticeship was the only system of teaching

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[1] Roman engineer and architect, who lived during the first century, probably around 27 BC. Named Marcus Vitruvius Pollio, he was famous for his 'De architectura libris dicem' (Ten books on architecture), which is the only known systematic work of architecture in antiquity (Encyclopaedia Britannica 2001b).

2 Ancient Greek philosopher, the second of the great trio of ancient Greeks—Socrates, Plato, and Aristotle—who between them laid the philosophical foundations of Western culture (Encyclopaedia Britannica 2001a).

architecture. Architecture was part of the artisanal and craft tradition, with knowledge passed from the master to the apprentice for generations.

During the Renaissance, architects revived the classical Greco-Roman orders, both in their constructions and as the basis for education. It was in 1470 when the first institution of 'formal learning' in architecture and the arts was established, with the foundation of the Academia Platonica by Alberti[3] , which was sponsored by Lorenzo de Medici. This Italian Academia offered an alternative to working with a master, teaching architects, painters and sculptors the normal drawing and craft techniques of the times but also the theories behind the arts. The Academia Platonica set the trend for the foundation of other academies in Europe like the Académie Royale in France. It also popularised for the first time the notion that the aesthetics of design were much more important in architecture than nature and the response to the environment.

While the Europeans were attempting to 'institutionalise' architecture through the academies, in Britain the education of the architect continued through contact with artists and in architectural offices through the formalised system of apprenticeship called 'pupillage'. At the time, "the system of pupillage in Britain barred the way for British architectural schools" (Bingham 1993). However, any educated member of society could become an architect through diplomacy studies, building sciences, artistry, science, or even self-learning.

In the 18th century, doubts about the benefits of the British system started to arise, firstly because of complaints about the working conditions of the pupils; secondly as it was not able to produce the number of architects needed. An increase in the number of pupils and the demands of new technologies meant that the style of education had to evolve to meet public needs. The model was the French style of education, which at the time was considered the best.

[3] Leon Batista Alberti was a prolific writer on matters to do with human relations and in 1435 he turned his hand to a study of perspective and proportion: Della Pintura.

3.1.1 The French Influence

In France the education of the architect was divided into two main schools: the École de Beaux Arts and Blondel's school. The first was part of the École Nationale Supérieure des Beaux Arts, founded in 1793 by Jean-Baptiste Colbert. The school offered instruction in drawing, painting, sculpture, architecture, and engraving (Encyclopaedia Britannica 1987). It was basically a discussion group of eminent architects who, apart from advising the King (Louis XIV) on architectural matters, also claimed to "bring forth a more exact knowledge and a more correct theory" of architecture (Broadbent 1995). It advocated a classical education rooted in Roman and Hellenic civilisation.

The second school conformed to the "new French style". Funded by the architect, Blondel[4], the Paris-based school gave classes twice a week. During the mornings, students spent their time in discussion with the professors; while in the afternoons there were lectures on military architecture, fortification, mathematics, geometry, mechanics, perspective, stone-cutting, water supply and drainage. Also, during April and May there were twice weekly visits to notable buildings in and around Paris (Bingham 1993).

In 1793, after the French Revolution and to compete with the Académie Royale d'Architecture, J-N-L Durand founded the École Polytechnique. It offered the first full-time Architecture course, which had a more geometric approach to design.

> "The classical model of the École des Beaux-Arts was replaced by an industrial, and a more practical, concept of teaching... without renouncing the advantages of learning by role model, precision in work techniques and other traditional teaching strategies, ...[the modern teaching and learning model] comprised: next to practice-oriented lectures, exercises and projects in the drawing classes, practical courses in the laboratory and studio, excursions, construction site visits, vacations and field work as well as training, etc. In addition, academic guidance in the form of permanent teaching examinations, internal class competitions and graduation diplomas" (Pfammatter 2000).

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[4] Jacques-François Blondel, (1705-1774) was an architect best known for his teaching and writing, which contributed greatly to architectural theory and the taste of his time.

Continental European teaching was based on the French educational system and therefore reflected the separation between the classical Académie and the more industrialised Polytechnique. In 1819 the academies merged into the École Royale des Beaux Arts in an attempt to compete with the innovative system of the Polytechnique and the Art School. All this competition between schools promoted a high standard and recognition for both architects and engineers in Europe.

The approach of the Polytechnique was also important in marking the return of 'technical subjects' to the architectural curriculum, although it sowed the seeds of later misunderstandings between science and the arts.

3.1.2 The British Education

In spite of the Industrial Revolution, Britain continued with the pupillage system and the European model was not established in the United Kingdom until later. The first Schools of Architecture were formed with an École des Beaux Arts educational approach. William Chambers adapted the model of the Royal Academy (created in 1769) to resemble the French model of education: two separate kinds of teaching; theory in the classroom and design in the ateliers. Students would continue working in architects' offices, but could slip away to the schools to attend the evening lectures and to use the library, and therefore acquired a more formal education in architecture.

> "The aims of the schools were to give the students a highly developed sense of design and bring this achievement to public notice" (Bingham 1993).

Working students would, in theory, acquire all the required knowledge in construction and drawing during their working hours, so the teachings of the Royal Academy schools were concentrated on history, theory and design. During their first few years in an architectural office, students had to do drawings and perfect their techniques until they were considered competent enough to work on a project. Some architects encouraged their apprentices to visit building sites to observe and learn from the different stages of construction. Therefore, most of the technical knowledge was acquired through observation of the construction process and the analysis of the finished building, in order to identify faults and avoid them (Richardson 1993).

Entry to the schools was considered important not so much for the knowledge acquired in history and drawing, but for the right social contacts students gained. Nevertheless, both academics and students were critical of the system, arguing that the schools were only considered as a supplement to apprenticeship, in contrast to the European full-time education.

> "Students felt these were all detached methods of learning, discouraging a spirit of debate and criticism, and that schools did not encourage dialogue" (Bingham 1993).

By 1836 the architecture section of the Royal Academy schools was very much questioned, both by the public and academics. As a consequence, the London Architectural Society and the Architectural Students Society were created to try to solve the needs of the educational system. However the former members of these societies became promoters of change and supported the formation of other architectural institutions.

According to Jenkins, the institutionalised education of architecture began with the establishment of the King's College in London in 1840, with a curriculum of construction, civil engineering and architecture. (Jenkins 1961). Nevertheless, the institutionalised system was not yet well established, and the British education continued to be criticised. In the 1850s the Commissioner of the Society of Arts decided that the British lacked industrial quality, due to the separation between industry and science. Despite the British considering continental industrial instruction as a means of increasing the efficacy of practical training, it was not thought the only educational solution. Consequently, architecture continued through an apprenticeship system. Pfammatter regards this as a negative trait of British education:

> "The English model lacked an institutional correlation between theory and praxis...[and after the Industrial Revolution] Britain was forced to catch up quickly...[with the European standard]" (Pfammatter 2000).

The Royal Institute of British Architects (RIBA), formerly the Institute of British Architects created in 1834, also in the 1840s the Architectural Association (AA) was created as an independent forum for architects to have free discussions and listen to critiques by visiting lecturers. Both groups, one of formal education supervised by

RIBA, the other independent learning co-ordinated through the AA, continue today in similar fashion.

From the 1880s architectural culture divided into three parts with different values and very little intercommunication: The RIBA, whose efforts failed to formalise education; the AA, which supported independent lectures and dialogue; and the apprenticeship system that had been established long before.

> "Britain had the most chaotic and under-funded system of architectural training in the world in the 19th century. Compared to other countries, 'modern' education was neglected and undervalued in Britain" (Powers 1993).

By the end of the 19th century the teaching of architecture was handicapped, not only by the division of the system, but also because the RIBA had put exams before teaching. However, according to C.H. Reilly, in (Powers 1993), in 1906 academics and professionals considered the RIBA an advisory board rather than an executive one.

The idea of Architectural Education as a taught profession was not widely accepted, especially as there was no consensus in terms of what students were learning and what made an architect different from others. At the beginning of the 1900s, teaching consisted of institutions funded and managed in a variety of ways, where the ideas taught were determined by the director of the school. Some stressed classicism and drawing; others construction and sciences, but there was no established route to becoming an architect.

Back in 1893, the establishment of the London Central School of Arts and Crafts' (LCC) Technical Education Board had permitted an alternate and more structured system of training. Nevertheless, the profession looked down at art schools and technical colleges for their non-vocational character (Powers 1993).

At this time, additional pressure was placed on the RIBA to make a distinction between architecture and other areas of the construction industry, such as surveying and building, as many of the professions and crafts overlapped. Moreover, a uniform exam, such as the RIBA's, was not considered sufficient to define professional boundaries.

These boundaries started to emerge when the Schools of Architecture found that their attractiveness to potential students depended on making design and drawing the core of the curriculum (Powers 1993). Consequently, architecture was defined as design in contrast to construction and crafts.

During this period the RIBA Board of Architectural Education was established (1904) to control and validate courses, beginning the move towards curricular uniformity. At that time the RIBA Board proposed a course structure consisting of two years' full-time training, followed by two years' evening classes in conjunction with pupillage. In this way, RIBA aimed to satisfy all parties: on the one hand, the supporters of institutional teaching, on the other hand, the supporters of pupillage in architectural offices. From this period onwards, the majority of institutions decided to follow the Board's pattern, and by the 1920s the system was unified throughout the British Empire. This helped the international exchange of scholars and also the entrance of women into architecture.

One important step in the definition of architecture as an individual profession was the foundation, in 1894, of the first full-time architectural course, at Liverpool University. The final separation of architecture from other professions, however, was not finally obtained until 1922, with the creation of a RIBA Visiting Board, and the Architect's Registration Act in 1931, which excluded other professionals from becoming architects.

In RIBA's 1939 report, published in 1945, the Institute stated that the education of architects could only be provided in a "systematic, balanced and comprehensive" education, which the pupillage system was unable to offer (Jenkins 1961). Although the change from apprenticeship to institutionalisation was accomplished by the 1930s, in practice, apprenticeship had not been completely abolished. Even in the 1950s almost 50% of British architecture scholars learnt their trade through pupillage. Indeed it was only with the withdrawal of the RIBA external examination that more emphasis was placed on a university education.

The move towards institutionalisation had two main consequences for Architectural Education: first, the definition of architecture as a design-based profession; second, the "gap" that arose between design and other areas which support the education of the architect, such as construction, history, technology, and structures.

The new impetus for the development of Architectural Education in the UK came from Germany.

3.1.3 The Bauhaus Influence

While in the UK the institutes were trying to establish a unique system of Architectural Education, in 1919 Walter Gropius formed the Bauhaus school in Germany. Whereas the British system tried to exclude all the crafts from architecture the Bauhaus tried to include arts and crafts and make them the basis of architectural training. Teaching was conducted first through the learning of the crafts and then the development of architectural skills through abstraction. However, "students complained that exercises in abstraction by no means equipped them to make design. The slip of craft and design started to appear." (Broadbent 1995)

In 1928 Hannes Meyer replaced Gropius. He changed the syllabus and, for the first time in a design school, included psychology, sociology and economics. Moreover, the subjects of heating, ventilation, statics, building design, materials, daylighting and technical drawing were also included in the curriculum of designers. All the same, this innovation did not change the division of teaching, begun by the École des Beaux Arts between practical and theoretical. The last director of the Bauhaus was Mies Van der Rohe, 1930-1933, who cancelled the previous curriculum, including the live projects, and focused on a more urban scale: town planning, orientation, housing and apartment, and urban infrastructure.

This kind of urban thinking was gaining currency, not only in Germany but also in many parts of the world and, due to the political and economic situation during and after the War, became much more influential than the international modern style (Lubbock and Crinson 1993).

In The UK, especially, the Architectural Association (AA) scholars rejected the primal ideas of the Bauhaus. Nevertheless, with all the changes of curriculum, some of its elements influenced British architects, especially in the post-war era, when there was both more interest in and need for public and mass construction. Consequently, by the end of the 1950s modernism was the dominant philosophy of architectural institutions worldwide.

The movement from the Beaux Arts system towards Modernism that had begun in 1936 with the dropping of the classical orders by the AA became evident at the Oxford Conference in 1958. It was a change from a monumental classicism (Powers 1993) and an emphasis on major public and commercial buildings and well-off clients to a commitment to public service and town planning for a broader social spectrum (Lubbock and Crinson 1993). Together with the influence of the 'Architectural Review' publication, this change promoted the modernist discourse and affected the RIBA policies of the time, especially the length of the courses, which increased to five years of institutional schooling, with the addition of two years' practice in an office.

However, Modernism didn't have it all its own way:

> "Although Beaux-Arts content as style was stripped from the new system, the French institutional framework triumphed. The university institution is a kind of academy where the design project dominated the curriculum. Modernism in Britain did not destroy the academy, it perfected it" (Lubbock and Crinson 1993).

With plenty of support from architects, Modernism was well established as the educational strategy in British architecture by the 1960s. Nevertheless, the continuous societal changes on which Modernism was based caused controversy, as they would not allow for a curriculum to be easily defined. Moreover, modernist ideals did not sit easily with tradition and vernacular construction.

In the search for betterment of the theoretical basis of education, some experiments have come after Modernism: Postmodernism, Deconstructionism, Brutalism (as represented by Group/Team X, Non-Plan, Archigram). However, these are considered basically modernist ideals (Lubbock and Crinson 1993). Leach considers that postmodernist architecture consists only in adding history to modernist buildings, and simply reinforces the "aestheticisation of the world, a move from a world of reality into a world of images" (Leach 1995).

3.1.4 The Contemporary Influences

It was during this time of architectural "identity crises" that environmental education started to appear, perhaps not so strongly in architecture but in other areas like engineering, geography and biology.

By the late 1970s and early 1980s, the parlous economic situation around the world meant that a remedial strategy and governmental action had to be implemented for education in the UK. As a consequence, the length of the Architectural Education course had to be reduced to cut costs. This was considered an easy solution, rather than a real attempt to discuss the causes and look for remedies to improve Architectural Education (Davey 1989). Some problems encountered during the 1980s were not analysed at the time and continue to affect architecture today; for example, the threat from closely related professional areas offering the design skills thought unique of architects, poaching clients and projects and threatening architects' leadership in the building team.

While some of the problems that came after the institutionalisation of the profession such as curriculum integration and lack of student practice started to be addressed during the last decade of the 20th century, other issues are just starting to be, or have not yet been, addressed, such as those concerning Environmental Design and Sustainability in Architectural Education. Two centuries of modernisation may have helped to develop the way the architect is taught today in most Schools of Architecture, but the ideas that first influenced architecture and educational thought (those of Plato, Socrates and others) remain central.

> "Nothing much has changed since the times of Jesus Christ; our syllabuses these days are much like those that Vitruvius describes" (Broadbent 1995).

The factors that shape today's architecture and architects can be traced to the origins of architecture as a profession and to the transition from apprenticeship to institutionalisation.

3.2 Characteristics of Architectural Education

Amidst all the changes in architecture during the last centuries, the only identifier that seems to be certain is that architecture is basically Design.

The design studio in the UK is based on the ideas inherited from the École des Beaux-Arts, although in some countries it resembles more the Bauhaus style (Abel 1995). The design studio continues to be at the centre of architectural teaching, which is complemented and supported by a series of technical and theoretical subjects, which have been added throughout its historical development.

Architectural design education has been modelled around the architect idea. The aim, apart from learning the profession, has been to acquire much of the cultural background and implicit knowledge from the educator, in order to become part of, and be accepted in, the architectural circle. Architectural students learn more than a career – they are being prepared for a completely different way of life (Stevens 1995). In this architectural life students are encouraged to develop creativity and be able to produce great amounts of high visual impact material. Team working and collaboration are part of the architectural course; yet individuality and uniqueness are also highly rewarded.

Nevertheless design and the designer's culture are not the only elements characterising the architectural profession. In contrast to many careers, almost all the courses in architecture are problem based. The studio environment on which it stands is perfect for the development of students' reasoning and collaborative work. Moreover, teaching and learning processes are endemic, and heavily based in local culture, character and environment. Consequently, design characterises not only Architectural Education, but also the skills of professional architects.

Comparing educational styles in different careers, architecture is one of the most assertive methods of education. However, Architectural Education has many problems: the cult of 'the genius designer' has denied space to the development of other branches of the profession like history, theory, technology, construction, and ecology. Moreover, the position of the architect in the past, as chief and master of construction, has brought communication problems with users and clients, and causes a separation from reality (CUDE 1999).

Architectural Education is by no means perfect; but it incorporates aims, ideas, structure, and teaching processes which could encourage a more open approach to education in other university careers. In the following section, some of the main elements that characterise Architectural Education will be summarised.

3.2.1 Architectural Design

The main characteristic of the architect is that he/she is a designer. Architects communicate, solve problems and create through graphical representation and design. Design refers not only to the act of drawing architectural forms, but to the process architects have to go through to reach a creative practical solution.

> "Through pupillage architecture students learn the most. Studio work, then, must remain the essential core of Architectural Education: it needs radical reinforcement. In the studio, students learn not just to design, but also with it, how to integrate all the many disciplines of architecture. Inevitably this is a process that takes time to master" (Buchanan 1989).

Some authors suggest that design is not to be taught, but can be learnt through imitation (Schön 1990, Grover 1993, Correa 1997). In order to learn this process of design, especially at the first stages of education, the presence of the 'master architect' (now called tutor) in the studio continues to be necessary (Richardson 1993).

This feature of studio design, with its emphasis on copying and mimicking the tutors rather than personal development, has been fiercely criticised. Willenbrock associates the expectation of becoming an architectural student "with ideas of being part of an innovative, flexible multidimensional profession". However, she discovered a very different reality faced by some students during their first years in an architectural environment.

> "Although the aim seems to be develop our own thinking which will allow us to learn a new cognitive process... I felt that my learning was being forced into a particular style contrary to my thought process, and that my success was measured in terms of how well my thinking paralleled that of my teacher." (Willenbrock 1991)

Jarret also discusses the unreal setting of studio design projects and expresses doubts about the benefits of such unrealistic teaching:

> "The studio works as a laboratory where design methodology is contained artificially and frequently prescribed with guaranteed success" (Jarret 2000).

On the other hand, the studio idea is also about designers developing a multidimensional thinking capacity and the consequent ability to adapt and solve complicated problems, which will be essential for their development and progress in the architectural profession. Schön considers the studio system as the promoter of special qualities of Architectural Education. He sees Architectural Education as the very model of education for all the professions, including medicine, law and even business. For, like architects, these professionals also have to deal with:

> "Complexity, uncertainty, uniqueness and value-conflict... They all have to learn, understand and incorporate material from the applied sciences which themselves are constantly developing... Architecture is the very prototype...the other professions have been selectively inattentive to artistry... whereas architects, whatever the technical complexity of their work, tend to make decisions on aesthetic grounds" (Schön 1985).

The design studio system, beneficial or not, has always been present in Architectural Education. Students follow their architect teacher, copying his/her design skills, mannerisms, likes and dislikes. Indeed, this seems to be the way to learn architectural design as evidenced by the number of hours dedicated to design.

The curricular weight of design and the studio element in each department of architecture is different. Some schools dedicate as much as 70% of the curricular time to studio design (The Bartlett); others 50% (Portsmouth, Plymouth)[5]. In any case, all Schools of Architecture place a big emphasis on design and studio work. There are also a few schools starting to integrate design with other subjects until now considered theoretical; ecological design, international courses, etc.(Huddersfield, Sheffield Hallam, among others).

Although studio design does not reflect completely real-life situations, it can be a close representation of the working environment, which is beneficial to the way architects learn about the profession. The practice and simulation of the working environment represented in the studio class is very important, considering that through learning by doing, solving problems and developing multicultural working strategies, students best record useful knowledge for future collaboration.

As Aguirre Cárdenas points out, the recording through memory of the things discussed during the studio review is important in recalling what was really said in a future situation (Aguirre Cárdenas, 1992). This is important, considering that during studio time, all the elements used, promoted and emphasised in the class form part of students' learned information. In other words, the information, skills and attitudes towards design problems learnt in the studio will shape the future architect's knowledge and vision of the profession.

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[5] All references to universities' curricular emphasis are based on universities' online prospectuses from the academic year 1999-2000.

Design is the main characteristic of the education of the architect. It is a medium not only of communication, but of solving problems, generating ideas, doing projects and organising learning. This predominance of design in architecture, however, has encouraged the idea that architects are design stars.

3.2.2 The Architect

> "A series of government and professional studies indicate, amongst other criticism, that architects are perceived as arrogant, uninterested in the values and requirements of their clients and users and poor at teamworking" (Fisher 2000).

Over the past few centuries, architects have concentrated exclusively on the individual and not on the society. During this time, architects were members of a selected social and economic environment; they were creators of spaces, monuments, castles and art. Their clients were the kings, nobles and clergy who were the owners of capital and power.

As previously mentioned, after the World Wars, architects were forced to change their attitude. Nevertheless, the idea of the famous designer remained in architects' minds, and it is reflected in the way architecture is being taught in architectural schools (Torrington 2000).

This idea is reinforced, first of all by the existence of filters inside the university, which appear to favour students from a specific social status. Architecture is an expensive career that requires full-time commitment: students are expected, for example, to travel and visit historical monuments. Architecture's discourse is also intended to favour a group of students that have grown up in a similar environment: architects are used to saying and doing what they think is right; money is not an issue, simply the exploration of ideas and expressions of art.

> "Instead of [architecture] being understood as interventions into the environment that bear social, economic, and political programs, architecture oscillates uneasily between self-expression and some forms of effete cultural commentary" (Ghirardo 1991).

Secondly, the idea of the architect star persists through the continuation of a pseudo-pupillage-style studio course, where tutors promote individuality and architect-centred ideas. Nicol expresses concern about Architectural Education being focussed more on the central figure of the architect than on his part in a team of collaborators:

> "...The design studio in Schools of Architecture still remains primarily geared towards developing individual star architects as unique and gifted designers, rather than preparing team players" (Nicol and Pilling 2000)

As previously mentioned, architecture is taught through design, where students follow their teachers' attitudes, as formerly they would have followed their master. Teaching is based on the idea that students should learn from their tutor/master and try to become 'the master' themselves. Instead of teaching collaborative architecture, architectural schools seem to be teaching competition for a stardom culture.

> "In Architectural Education it is the natural designers who are best rewarded from the outset by the traditional system. They may see no need to nurture their communication skills. In turn, their dazzling tectonic performance in the early years of a course can induce such a lack of confidence among their fellow students that the latter may retreat into other areas where they know they can perform well" (Torrington 2000).

It seems a contradiction to inculcate architects' culture in the studio, considering that a great number of architecture students will not pursue an architectural career. The skills and abilities acquired in Architectural Education have a wide application, therefore the split between discourse and the attitude that is encouraged in the design studio is not logical. Some students are only searching for a flexible and adaptable education, one which will prepare them for a multidisciplinary environment, develop their communication skills and give them experience of group collaboration. Others are attracted by the fact that architectural students do not have to sit exams.

> "The larger purpose of architects is not necessarily to become a practitioner and just build... but to become part of the community that enriches society.... To that noble end, architects must unite with all professions, and all citizens, in common cause" (Ruedi 1998).

The problem is that architecture has changed in theory but not in reality, and that the beliefs and structures that formed the older generations of architects are still very much in evidence in the approach of educators and professionals today.

3.2.3 Teaching Tradition

Some arguments have arisen about studio teaching in architecture. Teachers in architecture aim to guide and orient students to be independent members of society who will transmit their cultural knowledge. Nevertheless, it seems that teachers cannot leave their own ego aside and allow students to grow and learn at their own speed and by their own means.

The architectural hierarchy has much to do with the tutors' relationship with students, who are considered at the bottom of the 'chain of command' (Crysler 1995). Only the teachers of architecture seem to be given value in design education, with students expected to believe teachers' opinions about architectural discourse to be correct (Willenbrock 1991). In this way students are not encouraged to solve problems, but to adapt to teaching circumstances, and copy and praise their superiors (Wilkin 1998).

> "There is a danger that in a school of architecture, students learn how to be successful architecture students rather than successful architects" (Sara 2000).

This idea of mimicking the architect is one of the legacies of the early years of Architectural Education. The old system is revived each time a group of teachers, in a review, try to impose ideas and not discuss solutions. Despite the design studio being centred mainly on the tutor's knowledge, there are some pluses of the review process (Willenbrock 1991, Wilkin 1998, Dejesús 1999): problem–solving, multidisciplinary work and the development of self-confidence, communication skills and a non-linear thinking process.

> "Through design studio projects, students acquire knowledge, develop skills and explore appropriated professional, social and cultural attitudes. The design studio acts as a micro-environment for the development of professional competence" (Nicol and Pilling 2000).

Analysing the dynamic inherent in studio teaching, it is clear that the tutor cannot be the only value in the studio. The tutor brings his/her experience and discourse to the class and so do the students.

> "Teachers and tutors are important in education in encouraging students' dialogue and participation and increment motivation in the subjects, which will lead to learning" (Schön 1985).

Tutors, however, are not the only people capable of 'revealing the secrets of design'. Students have found peer interaction, discussion and external reviews as important as tutors' opinion. This is shown in students' views on the value of discussion with peers to clarify or reshape ideas and/or generate new ones:

> "Some people pick up (things) from (others) and then again think about the subject and discuss with (more) people; you get more ideas through discussion interacting with your classmates" (First Year Students, 2000).

Dialogue and discussion, then, seems to be the key to the success of teaching in the design studio. Schön supports this idea, as he considers that an ideal learning environment must contain dialogue (Schön 1985). Willenbrock agrees that, without dialogue in architecture, there can be no learning, so to develop students' thinking, and uninhibited exchange, there must be dialogue and communication. This will be the moment when "the exhilaration of learning and the liberation of knowledge (will) take root" (Willenbrock 1991). Nevertheless, to make the learning and teaching of design work, Schools of Architecture have to encourage dialogue between peers, tutors and students of other courses.

> "To equal the power balance of Architectural Education a dialogue between students and teachers should be promoted. Decisions on the method and the content to be learnt should be shared and discussed, and students and teacher should be part of an equal system of relations where there is no dominant group." (Schön 1985).

Dialogue appears not to be an issue for students, who have no problem in asking their peers to criticise their work, believing it will have a positive input on their projects.

> "Design students are surrounded by peers for many hours a week, often relying on them for assistance." (Stevens 1995).

However, when students have to rely on others' expertise in group work, instead of explaining ideas and communicating, students defend their work and individuality – a culture of the individual apparently learnt from architect teachers.

Despite the 'collaborative' studio environment, architectural students mainly work and learn alone. Design tutors may say that students of architecture are self-sufficient (Architecture teachers 2001), but an education aimed at creating independent and self-sufficient students is threatening to produce a mass of individuals who cannot trust and depend on others' decisions.

3.2.4 Communication

There are three main elements of communication in architecture: cultural communication, learning through communication, and communicating to others.

Architects generally construct buildings which will last a long period of time, leaving a message for future generations to understand part of the culture and social values of the time. Architecture, then, could be said to have a transcendent quality, representing a long-lasting patrimony and a permanent element of the built environment.

> "The area of concern is architecture. By expanding our awareness of the various issues that influence design, it is hoped that the quality and effectiveness, and thereby the influence, of architectural design will be extended" (Smith 1987).

Once an architectural piece is built, the effect on the environment where it is erected cannot be denied. Architects are always planning the effects of their buildings in society: architecture happens sometimes to be lived, sometimes to transmit an idea, sometimes to change attitudes or to improve the quality of life and work; sometimes to last a few months; at other times to be more permanent. Architecture as a semi-permanent reality has an important role in the lives of cities. It can transform environments and the lives of inhabitants in a positive or negative way. Architecture can be many things but not static, superfluous or insignificant.

> "During the erection of buildings, no architect thinks of transmitting the culture and knowledge of the time. However, Architecture is permanent or at least long lasting, becoming a window that manifests the creative power, thoughts and culture of the society that created it. Architecture becomes meaningful with time, as from simple space of living it transcends as witness of its cultural environment" (Aguirre Cárdenas 1980).

Architecture becomes a communicator, a testimony of the times it witnessed and of its creators, their culture and their society. Architectural Education has a deeper meaning in the life of cities: those pieces of knowledge, the influence that education can have on a student life, will be reflected and will remain for long periods of time affecting the environment and the lives of future generations.

This is one of the reasons why the development of communication skills in Architectural Education is so important. The idea of leaving a message that can be understood, and can be lived in the future. Architects' education should add some consciousness when projecting design solutions and be effective in transmitting this ideal of transcendence, sustainability, and long-lasting messages of past concerns for future well-being.

Of course, some of the best-funded ideals of sociological wealth represented in architecture have proved to be unsuitable for what they were designed: social housing projects in the 1960s and 1970s, and their failure to provide a good living environment for all their inhabitants, are an obvious example.

Nevertheless, the communicating role of architecture is obvious, and students should learn to become good communicators. Architectural Education appears to value communication skills (RIBA 2000). Nonetheless, in the last few decades divergent ideas, actions and needs have arisen with regards to the communication value of Architectural Education.

As mentioned before, Architectural Education and the studio design environment can be very helpful in developing the communication skills of students. Almost all the skills to communicate thoughts orally and through drawings, sketches, videos, animations, and models should be acquired in an architect's formative years. Design projects constitute the practice and development of abstract ideas that have to be understood by other students, tutors and most of the time by invited juries and staff from other schools.

However, there is a contradiction in the way architects communicate and the way they are supposed to communicate. In studio environments students spend most of the time interacting with each other, exchanging ideas and helping each other. Nevertheless, in a collaborative exercise, or in group work, all these communication skills disappear.

> "The design studio is 'potentially' good for communication skills and team working"[...but] team working is encouraged only at the first stages of design. Hence assessment processes in schools do not specifically encourage students to share and develop their ideas with each other" (Nicol and Pilling 2000).

The high level of competition in Schools of Architecture, which is perhaps sometimes unintentionally encouraged by staff, turns students from apprentices of communication into isolated entities of knowledge and ideas. Architectural students are good in 'selling' a project's idea. With only two lines on a piece of paper, they can make the listener enter into their minds and understand the elements and variables that will be part of their design solution. Nevertheless, when classmates have to judge their work or participate together, only in exceptional cases are positive results achieved. Students generally prefer not to work with others, especially with students from other disciplines, however it is known that collaboration is a useful learning practice.

> "Architects must be able to listen effectively, recognising and utilising the different ways in which it is possible to listen and the importance of checking they have understood what is said, instead of simply assuming they do. They must know how to develop dialogue around representations of design proposals, acknowledging that non-architects may have difficulty reading these. They must have the collaborative skills needed to negotiate options. They need effective flexible verbal presentation skills, matching what they say and the language they use to the needs and interests of different audiences" (Fisher 2000).

This is a contradiction at the heart of Architectural Education. The main result is that architecture students and architects have difficulties not only with team work, but also in communicating ideas and collaborating with other professionals in construction and areas of influence. Moreover, clients and users have no idea of how to establish a link, either to understand or to be understood by the architect, not only because architects struggle to communicate with non-architects due to the use of jargon and specialised words, but also because architects have little experience of and contact with multidisciplinary environments and real life projects.

3.2.5 Contact with 'Real Life'

> "...There was a most ingenious Architect who had contrived a new Method for building houses, by beginning at the roof, and working downwards to the foundation; which he justified to me by the like practice of those two prudent insects, the Bee and the Spider" (Swift 1906).

This passage illustrates architects' search for novelty in technology, even if it is out of step with technological practicality. Exploring beauty, searching for innovation and adapting to new situations are great merits of architects. Nevertheless, architects are used to working alone, which means that they are often ignorant of what others have investigated and poor at connecting with what is happening in the world outside academia.

> "She threw up her hands and declared that students (architecture students) never know enough about the 'real world'" (Willenbrock 1991).

> "Architectural Education needs to place greater emphasis on direct experience of inhabiting the urban world" (Jarret 2000).

If architecture students are encouraged to free their imaginations and dismiss any trace of reality in favour of creativity, it is difficult to expect that, as professionals, they will have their feet firmly planted on the ground. One of the problems is the method of problem-setting in studio design: most of the projects in architectural schools are fictitious, sometimes without any basis in reality.

As a consequence, there seems to be a digression between the demands of professional practice and architects' training in universities and colleges. If Architectural Education aims to form conscious citizens who can contribute to the development of cities and society, why has architectural teaching in recent years been largely based on stressing the visual impact of expression? Architectural Education has not given enough credit to the collaboration and communication skills that are necessary to both the practice of the profession and in the linking of architectural practice to society.

> "Design education, as undertaken in the Schools of Architecture, appears to be preparing students for models of practice that are no longer in full accord with the current professional context" (Nicol and Pilling 2000).

There have also been conferences on this subject (CUDE 1999), focusing primarily on the issue of communication and the integration of clients and users within the professional and academic environments.

Some authors, however, think that the digression between practice and education and the consequent crisis in architecture is due to its loss of social relevance and purpose:

> "The architectural profession is in crisis. Architectural Education is in crisis. Education and practice are divided from one another. Architecture is losing its social purpose. Architects are becoming irrelevant. Architects are unsure

> of their roles. Architects must reform themselves if architecture is to retain social meaning" (Ruedi 1998).

Architectural Education has lost touch with the profession because it is not interested in following the trends of real-life situations; it is not "on fashion". It is more convenient to maintain and praise the system that has created today's professionals, than analyse it and identify its faults.

> "Most of us do not use categories like these when we think about practice because our professional subjectivities are already shaped: we have internalised appropriate rules and ideologies, have accommodated ourselves to dominant power relationships, and are more concerned with performing expected actions than with analysing them. But in order to exert control over practice and not simply react to it, we must be explicit not only about what we do but also about what it is that structures what we do" (Cherryholmes 1988).

Architecture has never been exempted from cultural and social changes and influences. Today, there are new clients, new building requirements, new environmental laws, new materials, new climatological conditions and new technologies, among others. All these variables influence architectural practice, which changes and adapts according to daily demand.

Practice and education are not communicating, thus changes in the profession are not being noticed by academics, and vice versa. Consequently, such changes are being ignored. The educational system also adapts to changes, however at a slower pace through the addition or subtraction of subjects and/or changes in research interests.

Nonetheless, changes in curricula reflect only slight changes in the profession, and it is neither a profitable nor practical solution. Changes in structure are too slow to solve immediate problems, to mention nothing of the costs of reorganisation in a state of perennial educational flux.

Some British teachers think there are several things that Architectural Education can do to bridge the gap that separates it from reality. One is to learn from other teaching experiences (Architecture teachers 2001). Another is to exploit existing resources in the schools and to learn to communicate with other professions and the public, thereby linking people's and industry's needs to architecture and the architect.

In many professions, students have direct contact with industry and clients, whereas architecture has lost this contact in the process of developing as a university career (Pfammatter 2000). In product design and engineering, for example, first cousins of the architectural profession, the clients, the users, the industrial development and the costs are primordial in the design, projection and construction of any product, even if the project is just for exercise purposes.

Looking at other professions and learning from their experiences, then, could significantly improve education in architecture, as could making design projects more realistic and increasing contact with clients and users.

3.2.6 Learning by Doing

> "Mind develops as a result of hands-on experience" (Anaxagoras in Willenbrock 1991).

Experiencing, doing, practising, hands-on work – these are all strategies that allow students to develop meaningful knowledge and learning. Solving realistic problems is beneficial to learning. So too, solving a problem through practice, and experimenting to find a suitable answer while in contact with users, clients and the people affected, can open perspectives and motivate students to learn architecture and other skills. The studio and reality should be connected in a way that mind and hand work together and not as separate experiences (Willenbrock 1991), because, as Pyatok argues, having a separation between designers and users, between construction and design, causes the erosion of technical knowledge and a dualistic construction of reality(Willenbrock 1991).

This technical knowledge has always been part of architecture. In most of today's Schools of Architecture, there are some experimental design exercises, where students complete the design process by building their proposal. Usually, the projects students are involved in are of small scale, but they prove to be useful in exposing them to the use of materials, technical problems, communication with clients, and collaboration with peers and/or colleagues (Architecture teachers 2001). Listening to a lecture can be very enlightening, however, applying that information to the situation where it is most likely to occur in reality or where it is more relevant to the course being studied, will produce deeper and longer lasting learning

(Chapter 2). To build memory, it is more relevant to do something than to hear about it. (Architecture Students 2001, Aguirre Cárdenas 1980).

Moreover, architecture students have been used to learning through practice: working for the master architect and learning through the experience of design and construction *in situ*; experimenting with building materials in laboratories; making structural or design models; or even building the proposal or a part of it for testing. Experimenting can be counterproductive, as when there is too much emphasis on construction and structure, as happened in the Polytechniques founded in France in the 1800s. However, at that time there was a big social and ideological commitment to such experimental exercises.

> "The modern teachers and students were modern not only because they were educated in modern schools, therefore they were modern in their thoughts and actions; but because they took on novel building tasks or worked and experimented with iron, glass and concrete. They were modern because they considered their discipline to be part of a whole, as a means to create structures of culture and social utility" (Pfammatter 2000).

Although experimentation has always been present in architecture, the idea of including experimental exercises was reborn inside Schools of Architecture and engineering after the Industrial Revolution and the boom of technical schools (Polytechnics)[6]. Today, these schools are still working side by side with industry and have been instrumental in helping the development of technology over the past few decades.

Developing intellectual as well as technical education in architecture is very important. The initiative of going out into the real world and working with real clients on small projects is embraced by many, if not all, Schools of Architecture. Nevertheless the examples of live projects are few, constrained by time, costs, and evaluation requirements.

Moreover, there are not enough small projects to suit all levels and schools. Some experimental projects also have the problem of students being unable to understand

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[6] The technical schools or polytechnics competed with the teaching style of Les Écoles des Beaux-Arts in France.

and cope with the pressure of a real situation and/or having no motivation for adding extra effort to their university work (Sara 2000).

Experimenting is very beneficial, but it is not the only way to understand the behaviour of structures and materials. Schools of Architecture also use case studies and access to laboratories, model workshops and computer simulators, which allow a close representation of reality. Students also have access to many literary resources and the possibility of exploring projects, in addition to practitioners' and clients' opinions and attitudes.

The experience of working in a real situation is very useful in developing skills and aptitude for future professional practice. Moreover, it can help develop the communication skills and collaboration practice needed in an architectural career. However, as it is not available to all, some other possibilities need to be explored.

3.2.7 Problem-Solving

> "Architects need expertise in accessing, identifying, evaluating and prioritising information. This implies a high degree of autonomy and flexibility in learning throughout life" (Nicol and Pilling 2000).

In an architectural studio, a problem is set and students are supposed to solve it, through design. There are different opinions and theories explaining how problem-solving occurs, not only in architectural design but in all areas of knowledge. Some have stressed more the empirical procedure; others the thinking. Comparing theories like Gestalt and Information Processing (Chapter 2), it is clear how approaches to problem-solving can be looked at from different points of view and yet have similarities in methodology.

> "Gestalt psychology describes human cognition in terms of quality of the perception and thinking, while Information Processing theory categorises the mechanism of our perception and thinking" (Laurillard 1984).

Following the Gestalt approach to problem-solving, students have to identify the problem and perceive its structure in order to see the relationship of its parts. Through an Information Processing approach, by contrast, students will have to test a series of possible solutions to the problem. These theories are complementary in the way they approach problem-solving, as without a problem structure it would not be possible to have an insight into how to solve it. In Architectural Education, however, what matters is how meaningful learning through solving problems can be.

In the early 1970s, many schools started looking at problem solving, in art and design professions, in order to increase students' discerning capacity and competence in their line of work. In medicine and other health professions where students cannot experiment with patients from early in their training, problem-solving has become the main teaching strategy. Students form groups and strategies to solve a very complicated case, and in the process they learn to search for information, develop intuition, ethics, evaluate data and symptoms, and deal with new variables (Barrows 1988). A similar process can be described in architectural projects, if the big influence of tutoring is set aside.

The disadvantage of using problem-solving as a teaching strategy in architecture is that it is an unreal representation of a real-life problem. Real-world problems do not come well formed; on the contrary, they tend to present themselves as messy and indeterminate, with many influences and variant factors.

> "By defining rigor only in terms of technical rationality, we exclude as non-rigorous much of what competent practitioners actually do, including the skilful performance of the problem-setting and judgement on which technical problem-solving depends. Indeed, we exclude the most important components of competent practice" (Schön 1985).

Nevertheless, as already mentioned, problem-setting for architecture students is one of the best ways in academic life to simulate reality. To solve a problem, different students perceive it in different ways and this initial perception will determine how they act. Students' approaches will depend on the form and content of the problem, on its relation to other tasks, on the student's previous experience, on the student's perception of the teacher who set it and of how it will be assessed (Laurillard 1984). The learning approach, deep or surface, will shape an urge to think and solve or to copy and please teachers. Students rationalise their approaches to learning. First they make an analysis of what is required from them in the course/exercise/situation and then they choose which approach they will use (Chapter 2).

In architecture, problem-solving and sometimes problem-setting are widely used in studio and design classes. Students are able to learn from their solving process and from their classmates' processes and thinking. Students are also influenced by other teachers/tutors, whose expectations and assessment lead the process.

The risk of negligence in teaching and hidden agendas and standards, however, could diminish the problem-setting/solving strategy. Teachers play a big part in forming students' perception of what is required and thus influencing students' discernment and learning. Problem-solving is a good teaching strategy to develop thinking and meaning, but it must be properly set and carried out.

> "Architecture is not a matter of solving problems, it is a question, of finding what the problems actually are. Students need to educate themselves to a new competence when they don't really know what it is they need to learn, they must therefore take a plunge into doing before they know what to do" (Schön 1985).

As previously mentioned, other careers such as medical sciences have taken advantage of problem-setting/solving and its benefits. Despite some problems that might appear in the way problem-solving is approached and facilitated, the learning experience is highly positive.

Due to the lack of economic resources and real projects, setting design problems and solving them in architectural courses is the best solution for learning about the working environment and the relationship between materials and techniques.

Architecture finds solving problems, real or not, a natural process in design learning, while technical knowledge in design has always seemed like an intruder. In the next section, some of the ideas central to the discussion between art and technology in architecture will be summarised.

3.2.8 Art vs. Technology

Art and science elements have always being included in the training of the architect. During the first years of professional education, the knowledge base was small enough to be put together into a single discipline, and be part of the training of architects and other professionals. Arithmetic, geometry, optics, physics, astronomy, law, letters, history, philosophy, music and drawing were all on the list of subjects that Vitruvius recommended as basic for the education of the architect.

Today it is possible to find similar subjects to those recommended by Vitruvius in his preface to the Ten Books of Architecture, as curricula have not changed much over the years. Subjects like arithmetic, geometry, construction and materials (optics, physics, acoustics) and history are still present in Schools of Architecture, while astronomy, law, letters, philosophy and music have disappeared or been subsumed within other disciplines. Most of the schools now give space to other subjects like communication (drawing, Computer Aided Design CAD), technologies, environmental design, cultural context and management.

The presence of technology and arts has therefore been constant and throughout the history of architecture, although some suggest that the balance between the arts and the technological has been relegated in architecture in favour of a greater focus on social problems.

> "It seems that in different moments of our history the balance has inclined towards one or another of these 'categories' (Technology and Arts) like the movement of fashion and social trends. However, during the last century and the beginning of this, architecture has inclined towards society... from technical to a more human science..." (Aguirre Cárdenas 1980).

Nevertheless, the dichotomy between art and technology seems to persist and be directly proportional to the growth in the body of knowledge. Architecture seems to be caught in the middle point between arts and sciences, being neither one nor the other:

> "This world seem to re-enforce our uneasy sense that architecture is somehow orphaned on both sides, not theoretically specific enough to be called a scientific subject, not free enough from physical, social and economic constraints to be called an art" (Maxwell 1980).

Herein lies one of the main problems of modern Architectural Education. Historically, architecture was taught as an art, in the atelier, following the master architects at work, and being enriched with all the subjects that a person of the time should know. Now all this knowledge is so dense and vast that it is impossible to cope with all the subjects and elements that once formed part of the basic education of architects. Architecture had to compromise itself to choose between some of the elements in order to survive as a profession, disturbing the balance between both poles.

According to Llewelyn-Davies, the problem of having more technical subjects in architecture resides in 'the science, construction and technologies etc.' being easy to teach, as has been demonstrated by the successful and efficient education provided by the various schools of engineering. Moreover, design teaching, which is the nearest architecture gets to art, is rather subjective and imprecise. There have been attempts to teach design theory and processes in a scientific manner, but with no successful results. As Maxwell points out:

> "...We must recognise that training is design is not a form of teaching, but something quite different. Teaching involves fact and knowledge, which are imparted to the students by a teacher. There are no facts about design, and we should not try to give lectures about it or write books about it" (Maxwell 1980).

Others place the emphasis on the way architects understand technology: as a set of "sizes and shapes" determined on technical grounds that will allow the building concept to be constructed; or technical problem–solving, where both aesthetics and technology live happily together without there being a major emphasis on either side. It is their technical and conceptual perspectives that separate architects from artists and engineers (Willey 1989).

The debate about the difference between technology and technique still rages, where one talks more about the advancement of human activities and the other of the ways this is accomplished. Technology and technique have been related for many decades with science (physics, mathematics, biology being well structured and controlled subjects), whereas art reminds us of painting, dancing, sculpture, acting and unconstrained elements.

Art and technique seem to be opposite poles of the same magnet, as contrasting elements they repel each other. They differ in the way they are taught, learnt and in their tradition and understanding of reality. However, as parts of the same entity, art and technique can live together in a harmonious ecosystem, in fact, they cannot exist without the other.

> "If architecture is considered as an art, then the consequent frustration of having to deal with materials, calculations, physics and dynamics to fulfil the buildings requirements. If considered as a scientific subject, then the difficulty of form creativity and aesthetics of buildings, tendencies and art movements. Architecture has to be considered as a hybrid, a middle point

> where all the factors mentioned and more, are perfectly mixed in a homogeneous balance" (Schön 1985).

Finding the middle point has been a difficult task:

> "This unique situation is ideal for the development of a discipline which, in seeking to improve the relationship between people and their environment, encompasses the social and physical sciences as well as the arts" (Mckintosh School of Arts 2000).

It seems it is not clear what is understood by technology and science in architecture. Technology is defined in many ways, from being a discourse of the arts and crafts passing through all its processes and applications in cultural social and economic environments, to the sense of technique and industrial development.

> The development over time of systematic techniques for making and doing things; the term technology, a combination of the Greek technē, "art, craft," with logos, "word, speech," meant in Greece a discourse on the arts, both fine and applied. (Encyclopaedia Britannica 2000) "Étude des techniques, des outils, des machines" (Rey 1998); "The science of the industrial arts" (Collins 1990).

According to Vesely, the artistic impulse and curiosity are the originators of technological advance, therefore one could say that the search for architectural aesthetic is the motivator and not the enemy of technique (Vesely 1995). Considering that technology should define all the processes of advancement of humanity, then to pit technology against art seems a contradiction, as art is one of the technological generators.

More fruitful would be to focus instead on the importance of the integration of architecture and technology. The question "What is technological about architecture?" should then be changed to "What is architectural about technology?" (Lance LaVine in Smith 1987, p 5), suggesting that architectural design becomes an interpretation rather than a translation of the principles of environmental forces, providing design opportunities instead of specific solutions (Smith 1987).

Design has maintained its supremacy above all other subjects and constitutes the element that binds architecture into the arts. Architecture is considered an art due to all the creativity involved in building design, the aesthetics and the uniqueness of responses that each student/architect can give to the same problem, and the unlimited interpretations and reactions from users. However, architecture is also scientific, as large numbers of calculations, techniques, technologies, norms and procedures have to be followed in order to construct and support a building. Consequently, architecture could be explained as the art of design put into reality through construction technique.

3.3 Summary

Architecture is a special career with an innovative system of education. However, it has always been historically criticised for the way its teaching has been carried out; as an individualistic, anachronistic and unreal educational system. A proof of this is the number of comments about its failure: "There is a gap between academia and practice" (Buchanan 1989); "For whom are we teaching?" (Ruedi 1998); "We should change Architectural Education" (Dejesús 1999). There seems to be a problem, not only in teaching and living the career, but also in understanding and defining what is needed, what is aimed for, and what is achieved in Architectural Education. There are still many controversies about Architectural Education and yet there are so many elements of architecture that are useful to other disciplines.

Many theoretical careers can learn from the practice and flexibility of ideas of Architectural Education. The problem-solving strategies, the practical side of problem-setting, the qualities of the architectural scholar (self-confidence, critical thinking, spatial visualisation, etc.) and the teaching strategies that are used. The continuing challenge of Architectural Education is to move from the inflexible structure that has been in place for so many years of history and to avoid the repetition of errors between generations of teachers and architects.

In the same way that there are things architects can learn from other professions, so too the legacy of architecture to other careers is a real one.

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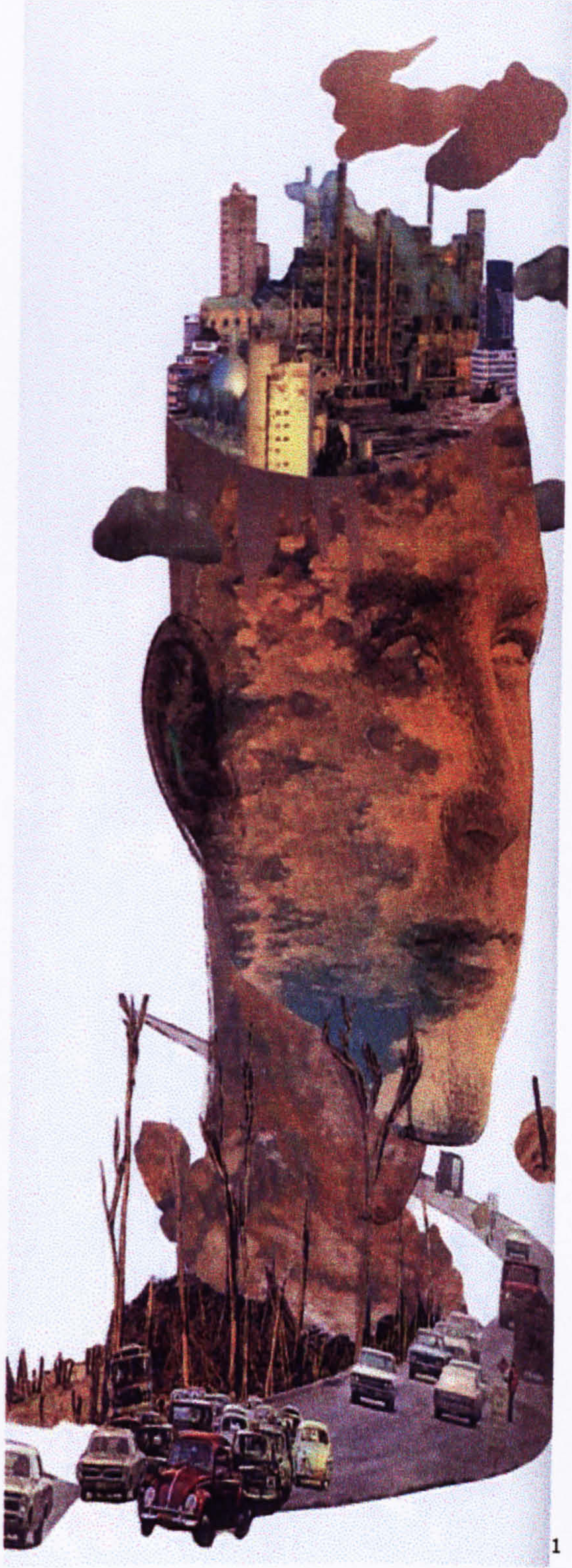

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Chapter 4. Environmental Education

Chapter 4

4 Environmental Education

Introduction

"Be efficient!" "Save energy!" "100% Organic!" These are some of the current slogans used to advertise all sorts of products. But, why this sudden concern for the environment, climate and health in general?

In reality, theories of global warming, global cooling, the new Ice Age, etc. have been circulating in both the public domain and the architectural profession for decades. There has also been a gradual increase in public concern about environmental change and the "potential for human activities to alter the Earth's climate to an extent unprecedented in human history" (Meteorological Office 1995).

Nevertheless, there have been few noticeable effects on daily life. In fact, it is only in the 1990s that a succession of natural disasters has triggered public awareness. From being a passive group, the public has started to be a participant in the debate about the environment, prompting a search for causes, consequences and blame.

Clearly, human activities have had and continue to have adverse effects on the atmosphere, environmental change and global pollution. Most greenhouse gases and a large amount of the world's CO_2 are created by human actions. Clients, developers, planners, architects and engineers have a significant responsibility:

> "Six billion tonnes of carbon (are) currently emitted worldwide due to human activity, and about 4.5 billion tonnes is attributable to the industrialised countries. Approximately half of this are due to buildings in one form or another" (Smith and Pitts 1997).

A major part of the environmental problem encountered today is due to cities and the built environment (The Commission of the European Communities 1994). Public criticism of architects and engineers for their participation in environmental damage is therefore justified. However, as Smith and Pitts point out, architects and engineers also have the ability to improve the situation:

> "Architects and engineers have it in their power to reduce building-related carbon emissions by at least 60%, which translates to 1.35 billion tonnes of carbon. At the same time, the built environment is the sector most

> amenable to environmental modification in the short to medium term" (Smith and Pitts 1997).

The issue of CO_2 emissions arises from the very beginning of an architectural project. Architects have to plan not only to reduce the running costs that the building will incur, but also the energy expenditure or Operational Carbon Dioxide emission made through heating, cooling, ventilation, lighting, water supply and maintenance. There is also the Embodied Carbon Dioxide pollution created during the construction process itself, for example, through the transport of materials, land movement and building techniques, all of which will influence the amount of polluting gases [CO_2 included] released into the atmosphere and the level of construction wastage the site will produce (Sustainability Working Group Report 2001).

> "In 1999 the UK's energy consumption produced around 556 million tonnes of CO2; around 50% of this was energy used in buildings. Around 70 million tonnes of construction and demolition waste are produced every year (approximately 17% of total waste). 360 million tonnes of construction materials (around six tonnes per person) are used in the UK every year" (Sustainability Working Group Report 2001).

If there is little doubt that architects and all the professionals involved in the construction of living environments are responsible, through their buildings, for generating a large proportion of the world's polluting gases, so too they have the power to reduce the production of those polluting gases. As the many cases of 'green architecture' around the world prove, there are now environmentally friendly designs and techniques. These allow architects to deal with and solve many of the production and running problems in a way that minimises energy expenditure and the pollution of the environment.

However, how many 'environmentally friendly designed' offices are there? Or how many people live in environmentally friendly housing? Although there are cases of 'eco-design' around the world, it seems they are few.

There are many socioeconomic reasons for this lack of real-life examples of sustainable buildings: the extra investment cost of new technologies, new specialised labour, and new requirements; a discontinuity between building tradition and people's own ideas of how buildings should be. Nevertheless, rising public concern, together with the publication of additional scientific data, has pushed the international community into agreeing that new constructions and refurbishments should represent an improvement in energy efficiency and reduce polluting risks (United Nations 2001, United Nations 1992) and that education of the public is important.

The British government has added its own voice in support of this consensus:

> "The construction industry has a huge contribution to make to improving the quality of life; both directly by providing safe, secure buildings for people to live and work in, and by ensuring that the industry itself works in a sustainable way, husbanding resources, reducing pollution and waste and valuing its workforce" (DETR 2000).

Why, then, the lack of sustainable construction in practice? Perhaps the reason for this lack of 'green architecture' is rooted not only in the professional environment, but also in the educational process.

4.1 Environmental Education

Much of the original interest in the environment came from the study of nature and farming, which can trace its origins to the beginnings of civilisation. As a discipline, the Environmental Sciences evolved as a branch of the Health Sciences as part of the attempt to sanitise areas of deplorable living conditions after the Industrial Revolution.

By contrast, environmental education as a field of study is relatively new. Environmental education finds its roots in philosophers' thoughts from two centuries ago (Goethe, Rousseau, Humboldt, Haeckel, Froebel, Dewey and Montessori among other 18th and 19th century thinkers). Paul and Percival Goodman first used the term "environmental education" in 1947 in the book Communitas, referring to the knowledge of plants and animals and the biological systems surrounding them. However, internationally it is claimed that Thomas Pritchard first used the term in Paris (in 1948) at the meeting of The International Union for the Conservation of Nature and Natural Resources (Palmer 1998). Whichever is the case, it was only around the 1960s that environment and education were linked for the first time as a cognate idea.

Environmental education as a discipline had a difficult start due to disagreement on the boundaries of the subject. It was only after the creation of the International Environmental Education Programme (IEEP) in 1973 that the environmental discourse started to take shape, placing 'nature conservation *per se* at the centre of environmental education' (Gaudiano 2000). This was a matter of dispute in the environmental education field as some thinkers thought it too narrow because it excluded inhabitants and social issues.

With the expansion in knowledge, the idea of environmental education as mere preservation of nature evolved into a more holistic concept, encompassing everything from sociocultural, political and economic values to the conservation of the planet.

Today, notions of environmental education are present in many, if not all, subjects and educational strata. The growth of environmental education and thought is reflected in the fact that there is practically nothing at present that cannot be defined in environmental terms (Figure 4.1).

In Figure 4.1 the evolution of environmental education can be seen, starting as a natural science but evolving into a more holistic approach.

Today, environmental ideas are well established in society. Many governments and international groups have tried to implement and promote environmental education worldwide, not only as a result of the growing social concern but also with the intention of preserving the natural and social environment (United Nations 1992). The British government, for example, supports and encourages the inclusion of environmental issues in all areas of education, at all levels. However, it is only recently that schools and professional associations have included environmental education in their curricula.

1960s	**Nature Study**	
		Learning about plants and animals, and the physical systems that support them
	Fieldwork	
		Led by 'experts' with a particular academic focus — biology, geography, etc.
1970s	**Outdoor/Adventure education**	
		Increasing use of the natural environment for first-hand experiences
	Field studies centres	
		Growth of field and environmental/outdoor education centres for developing awareness through practical activity and investigation
	Conservation education	
		Teaching about conservation issues
	Urban studies	
		Study of the built environment, street work.
1980s	**Global education**	
		A wider vision of the environmental issues
	Development education	
		Environmental education has a political dimension
	Values education	
		The clarifying of values through personal experience
	Action research	
		Community problem-solving. Pupil-led problem — solving, involving fieldwork
1990s	**Empowerment**	
		Communication, capacity-building, problem-solving and action, aimed at the resolution of socio-environmental problems
	Education for a sustainable future	
		Participatory action. Relevant approaches to changing behaviours and resolving ecological problems
2000s	**Community of partners?**	
		Pupils, students, teachers, NGOs, politicians — working together to identify and resolve socio-ecological problems?

Figure 4.1 Key trends in environmental education (Palmer 1998)

4.2 The Environment in Architecture

Over the last 20 years, representatives of 55 countries have agreed to reduce the production and emission of carbon dioxide and polluting gases in the atmosphere. Nevertheless, despite the tangible effects on our climate, some of the major producers of greenhouse gases, such as the United States, have withdrawn their support to the Kyoto agreement because it represents a major financial investment and the change of local policies.

As mentioned by Berrien Moore III in the U.N. Intergovernmental Panel on Climate Change:

> "The problem of global change is real, and it is more serious than is currently perceived politically" (Max 2001).

The world's public support the idea of environmental education and environmental action at all levels, governments encourage it and universities and educational institutes include it in their curricula. So, why is it not sufficiently prominent in construction, or at least of sufficient importance to have a significant impact? The idea of environmental Design has been around in the architectural profession for more than four decades. Nevertheless, just a small percentage of the world's buildings (commercial and domestic) are environmentally designed.

In the UK, 7.2 % of the housing in 1996 was considered unfit to live in. Furthermore, 29% of housing in the private sector and 40% in the social sector was considered non-decent housing[2] (DETR, 2000a). According to another survey, 1.5 million houses in England are considered unfit for human occupancy (Sustainable development 2001), not only because of the poor condition of the buildings, but also because of the energy inefficiencies.

British architects' concern for the environment has been passive for many decades. The teaching of the environment has been present in the curriculum in many ways since the 1970s, but not really applied in all design strategies. It is only today that the governing institutes, which validate Architectural Education in the UK, have included it on their agendas.

The Royal Institute of British Architects has included a Sustainability definition in its architectural syllabus and pushed for the inclusion of environmental elements in design projects (RIBA 2000). Its environmental manifesto is useful as a guide for the development of Sustainable Architecture in UK Schools of Architecture:

> "Sustainable development is defined as development which raises the quality of life and serves the goal of achieving global equity in the distribution of the Earth's resources whilst conserving its natural capital and achieving significant and sustained reductions in all forms of pollution, especially emissions of greenhouse gases" (RIBA 2000).

Schools of Architecture that wish for their courses to be validated and assessed by the RIBA follow RIBA's guidelines and many schools have included new

[2] A decent home is one that is above the current statutory minimum standards for housing, is in a reasonable state of repair, provides a reasonable degree of thermal comfort and has modern facilities and services (DETR, 2000a).

environmental subjects and extra elements in the curriculum: courses on energy efficiency, environmental assessment, alternative energies, recycling, etc.

If architects are not using environmentally friendly designs very often, does this reflect a lack of concern for such designs in architectural curricula? Schools of Architecture have certainly changed their curricula to include some Sustainability and environmental issues. Moreover, many conferences on Architectural Education and architectural practice have been organised to improve approaches to environmental architecture and encourage the sharing of techniques. Education, therefore, does seem to be concerned with the global problem and the realities of architectural practice. The problem appears to be rather in the way architects' education is carried out.

First of all there is confusion in terminology. Most lecturers can reach consensus on what Sustainability 'represents'; however a big group will disagree on what 'Environmental Design' is and on the boundaries that divide it from Environmental Science.

Part of the problem comes from how Environmental Science was established as a subject. It did not begin as architecture; it started as a concern for the hygiene and the health of inhabitants in poorer areas, and it developed through the improvement of living conditions, the reduction of negative impact on the environment and the development of the living and working performance of buildings. Therefore, it was introduced into the architectural curriculum as 'Building Sciences', dealing with building services issues such as acoustics, lighting, heating and cooling, ventilation, water, comfort and energy consumption.

The term 'Environmental Science' (which evolved from Building Sciences) should not be confused with 'Environmental Design'.

The Encyclopaedia Britannica gives the following definition:

> Environmental science: [From Old French 'en': in + 'viron': circuit. surroundings. Latin 'scire': to know.] (Encyclopaedia Britannica 1987).

Environmental Science concerns itself with the knowledge of surroundings, exploring the area where people live. In architecture the term 'Environmental Design' describes the process of designing, with knowledge of the surrounding areas where the project will be built, and the consequent impact this building may have on the surroundings and its inhabitants.

> "'Environmental architecture', 'green architecture', 'bioclimatic Design', 'energy efficient Design': these and others are terms coming under the heading of what we might call Environmental Design. Environmental Design is architecture that is not only concerned with the aesthetic, structure and systems of a design project. It is also concerned with the impact that a project will have on the health both of the global environment and of building occupants over the short, medium and long term; before, during and after the construction of the building"[3].

Put more simply, Environmental Education is a design approach which includes a major consideration for the environment.

The other problem in Architectural Education is the lack of integration. Because Environmental Design and Sustainability are considered part of Environmental Science, as theoretical subjects, they are kept apart from the Design core. They are taught as facts and theories, case studies and climatic data. Nevertheless, they are not well promoted in design work and in the main assessment process.

In Architectural Education, the main learning and assessment tool is design. The separation between subject matters and the design studio is causing a break not only with the environmental side of design, but also with other scientifically based subjects.

In general, the teaching of science subjects in Schools of Architecture[4] fails because teachers and the faculty in general seem not to have considered the 'big picture' of how students learn. Students in Schools of Architecture learn from the beginning of the course to consider design work as the main subject and the main skill needed, or at least the one most stressed and assessed by teachers (Lima 1998). Therefore, students learn through the design process to deal with problems as in a Design studio.

[3] From the conference paper (Dejesús et al. 2000) based on the pilot study of this research, see section 5.3.1 for methods used.

[4] By 'science subject', it is meant a more scientifically based subject in contrast to design. Examples of science subjects are Building Services, Construction, Materials, Topography, Acoustics and Sustainability.

Education, however, is not only doing, it is also "reflecting on action" (Schön 1982). Through the design process, students think on the project, find solutions and test them. During the process, they reflect on their actions to counterbalance the new impacts of the solutions and start the process again.

The learning of science subjects, however, is kept outside the design process. They should be integrated into the structure of Architecture Education as part of the whole system and not as extra subjects taught in a scientific manner. Students will then start seeing the design process as simply one way of solving multi-faceted problems (Lima 1998). Learning how mechanical systems work or being conscious of the effects of CO_2 on environmental balance will make no difference to the way students learn and do design unless these subjects are integrated into the structure of Architectural Education. In architecture, science concepts must be integrated into the mainstream of ideas and not held at the periphery (Lawson 1975).

However, the integration problem goes beyond teaching and curricular structure. Academics are not talking to each other across disciplines: this includes lecturers and tutors within the same department, from other departments and subject areas, and also within the professional environment.

The problems in terminology and integration have created a gap in understanding between educator and educated; professionals and educationalists are committed to the environmental problem but students seem not to understand this concern. The curriculum is such that the students learn about environmental considerations without receiving the education and skills necessary to put environmental design into practice. Moreover, they are not learning how to work with other disciplines and see barriers being erected between areas of the same working spectrum (engineering, planning, landscaping, surveying, etc.).

In summary, environmental education in architecture needs to revise its teaching and learning in order to improve the application of design and sustainability in the real world. However, this can only be done with the help and support of 'design' tutors.

4.3 Teaching Methods in Environmental Education in Architecture

> "Architecture has received many interesting situations with the arrival of environmental sciences into university curricula. Architecture as part of the city generator, and the society that lives on it, should be changing and dynamic. That is the reason why teaching future professional architects cannot be based anymore on conventional ways of delivery" (Radovic 1998).

Architectural Education has become increasingly technical in content, as well as more focused on societal problems as a whole. This complexity is one of the reasons why we need to explore learning and teaching in architecture.

According to research on Environmental Design teaching, some of the theories of education are being discussed in Schools of Architecture. More Schools of Architecture are also trying to integrate Environmental Design into their curricula and are clear that to promote awareness of Sustainability, efficient and effective teaching is essential.

Lectures, as will be explained in the following sections, are intended to provide information. Nevertheless, architecture students frequently pay little attention to the courses that support Design (considering them secondary). Therefore, a great part of the necessary information is not reaching students. This causes the demoralisation of the staff members and the devaluation of the lectures (Neel 1969).

Lecturing is the most widely used method of teaching. Tutors agree that a combination of teaching approaches, at different times of the academic year, will be favourable to learning, as variety is what maintains the necessary motivation for efficient and effective learning (Figure 4.2). However, students are dissatisfied that teaching is carried out mainly through lectures. This dissatisfaction could be due to time constraints, lack of students' motivation, schools' constraints on teaching methods, high expectations from tutors, and/or tutors teaching in an area foreign to their expertise.

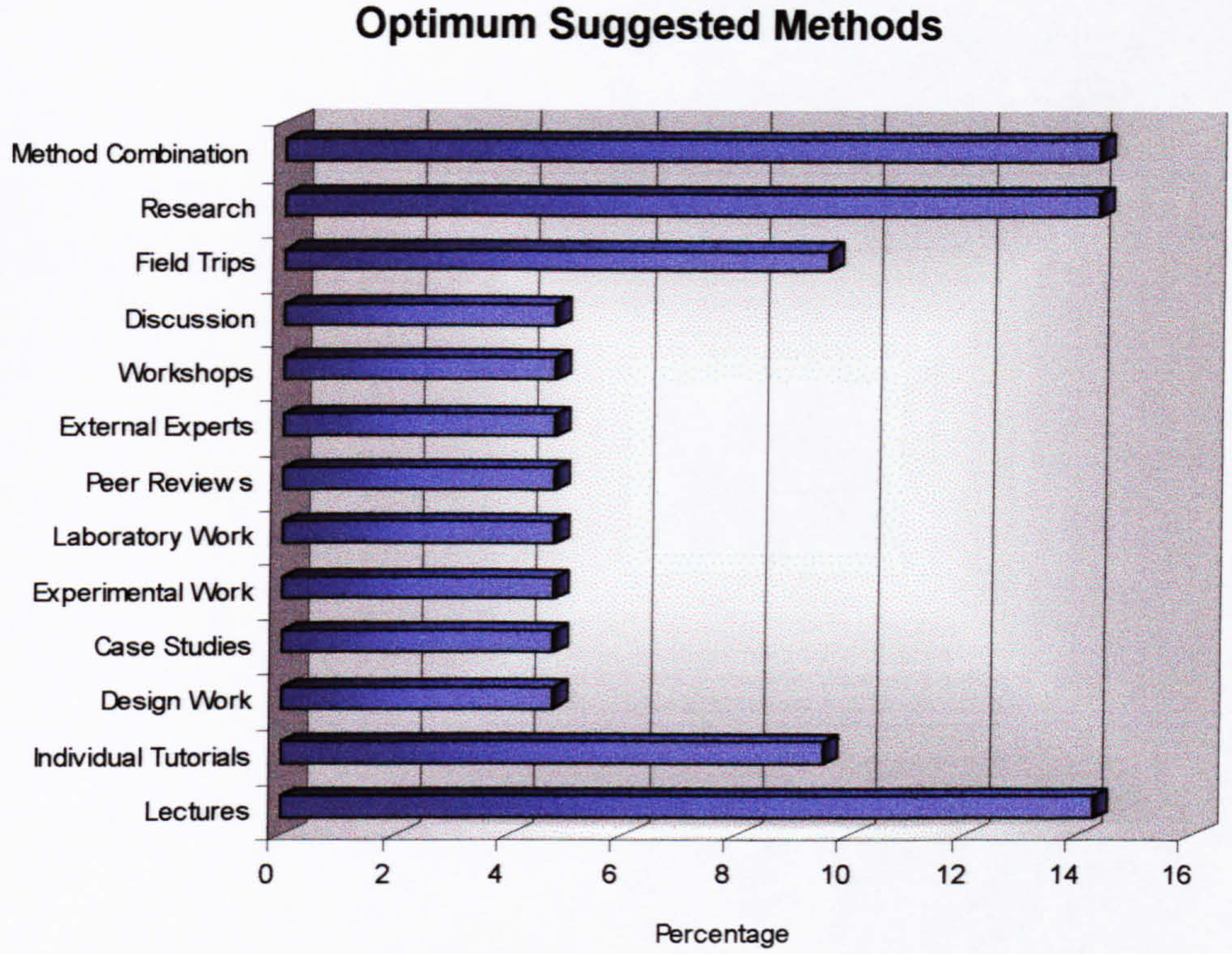

Figure 4.2 Optimum methods suggested by tutors of Environmental Design[5]

Environmental Design and Sustainability are also taught through experiments, case studies and site visits. Most of this is to support lectures, although sometimes there are integrated projects that can be partially successful in helping students relate techniques to the design projects and gain a deeper understanding of the subject. Neel argues that integrating design projects and technical subjects can work if both students and teachers are motivated, and if the technical design information is relevant to the Design (Neel 1969). Smith also believes that the learning experiences and the relevance of the information will improve the learning of Environmental Education, in contrast to presentation techniques and the simple exchange of information (Smith 1987). These ideas are supported by research in educational psychology and theories of education discussed in Chapter 2, which are helpful in understanding the changes needed to improve the teaching of Environmental Design in architecture.

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[5] Results obtained from the Pilot Study of this research, published in the year 2000 as a conference paper (Dejesús et al. 2000), also refer to section 5.3.1 in the following chapter were the methodology used will be explain.

4.3.1 Large Group Teaching

4.3.1.1 Lecture

Lecturing is a very useful way of teaching big groups of students, as all the students receive the same information at the same time. Nevertheless, transmitting information is not the only purpose of lecturing. Sometimes lectures are intended to motivate students to search for more information on the topic or to give them some concepts and principles to work with (Newble and Cannon 1991).

> [In a lecture] "the intention of a teacher/ tutor is to transmit some cultural information, knowledge, values, skills and/or attitudes to the students in an oral discourse. It is usually supporting a more practical subject. In architecture, lecturing has become one of the most popular supports to Design, especially in subjects like technology, construction and history. However, sometimes it seems that they [the lectures] have no effect on the Design" (Gelernter 1988).

As mentioned previously, lecturing is sometimes considered secondary to Design, because students passively try to absorb information on technical issues and there is not much interaction between students and teachers, or lecture and design project.

Lectures are good in transmitting knowledge only when the teacher assumes a facilitator's role and not that of a provider of knowledge. Researchers have concluded that the student-teacher relationship is very important and that the attitude of the teacher determines the success of the lecture method. Students want to be stimulated and enlivened by interesting, enthusiastic lectures that have some relevance to their problems and are put into context. How interesting a 'communication' is seems very important to audience attention. Some think lecturing is an effective method of transmitting information, but not very good at promoting critical thinking and changing students' attitudes. Especially when, as Hodgson argues, attitudes are more important than methods and techniques (Hodgson 1984).

Moreover, teachers who only lecture, or mainly lecture, seem to feel less satisfied than the ones using combined methods of teaching, and they perceive their students as dissatisfied and de-motivated with their teaching methods (See Footnote 4 in the previous page).

Nevertheless, lectures remain the basic educational tool for Schools of Architecture, besides Studio Design, which frequently includes visual materials and case studies. Lecturing might be more frequently used because it allows the tutor flexibility in selecting the material to be demonstrated, and therefore he/she is more in control of the course content. Another reason for lectures' popularity could be the length of the course, which has to communicate a considerable amount of information, in many cases in a limited period of time.

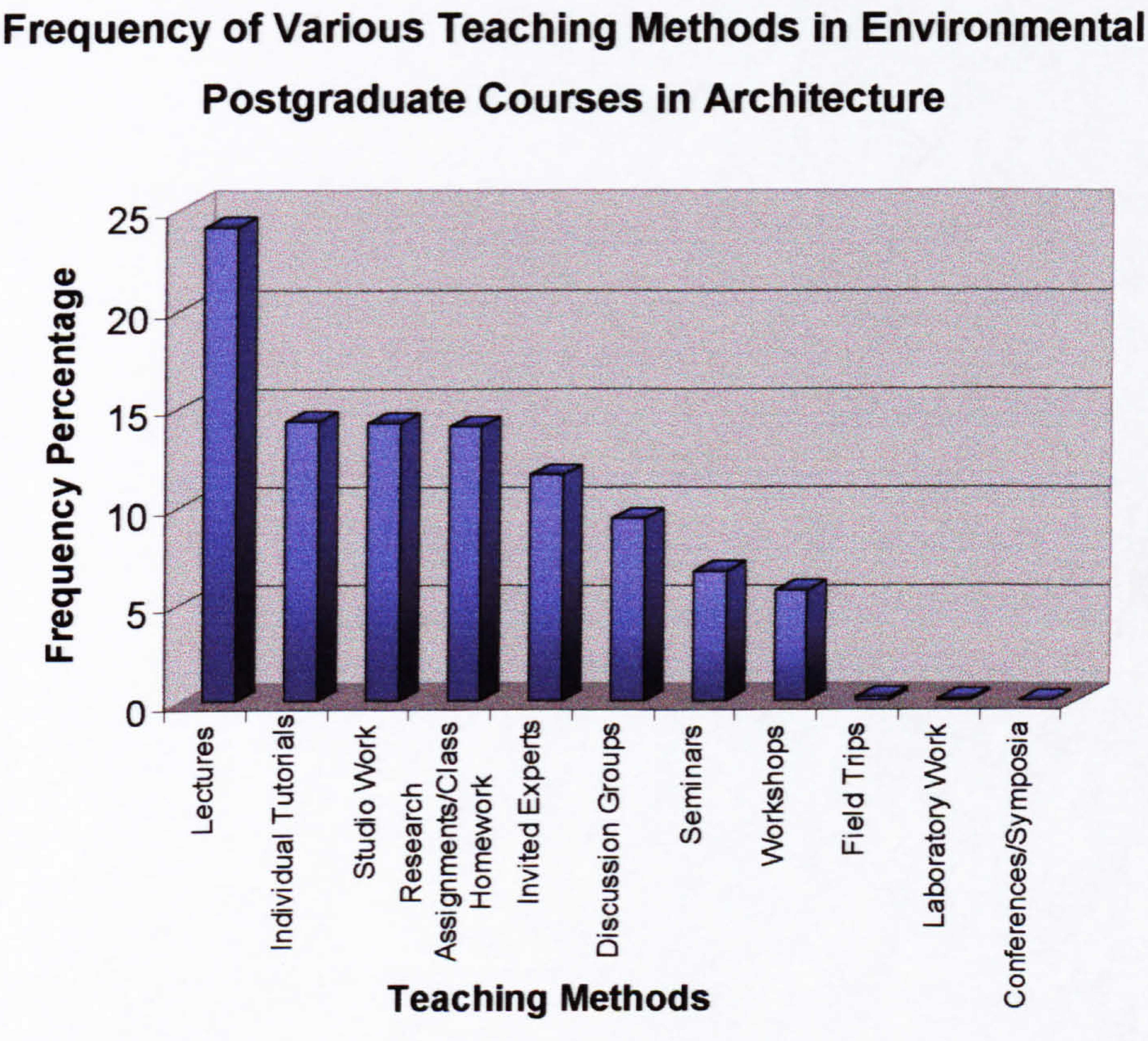

Figure 4.3 Proportion of time spent on different teaching methods in Environmental courses in Architecture [6]

Lecturing on Environmental courses occurs almost every week, sometimes as the only teaching method (10% of the respondents), at other times providing a theoretical foundation for a more combined teaching strategy (20%). In 90% of cases, a combination of methods is used throughout the year, although lecturing is always predominant. Also, lectures by invited experts seem to be an important

[6] Results obtained from Pilot study published in the year 2000 as a conference paper.

method of exchanging architectural knowledge. In the Study (Figure 4.3), outside experts were invited almost 12% of the time during an academic year, refreshing students' ideas and introducing new concepts and arguments. Discussion groups, seminars and workshops are held with similar frequency, underlying the fact that discourse is an important element of Architectural Education.

4.3.1.2 Research projects

Another way to teach large groups of students is through projects. A whole class will receive the same assignment with a set of objectives and a non-specific subject to research.

> [The project] "asks the students to undertake an enquiry process in which the students collect some material and then organise and present the data...typically through an extended piece of work" (Henry 1995).

Projects can be individual or for small groups. Students have a certain freedom and control over the project they are doing and therefore their motivation to learn increases. In Environmental courses, projects usually involve some problem-solving by students, for example, finding ways for a particular building to reduce the level of CO_2 emissions or creating an environmentally friendly design for a particular design problem.

Henry describes two different types of projects depending on how much responsibility students have in the various stages of the problem:

Structured project	**Unstructured project**
Topic defined and materials provided	*Student decides on topic and collects own material*
Case study Project exercise Structured project Semi-structured project	Extended essay Project component Project-based course Project credit Project method

Figure 4.4 Project continuum by degree of structure (Henry 1995).

Projects are a commonly used teaching method in Architectural Education and Design. Few projects are real projects where students have a real situation to deal with. However, as was explained in the previous chapter, this unstructured method is very productive as a learning experience. Nevertheless, in Architectural Education the most frequent project used for teaching purposes is a Design project.

4.3.2 Small Group Teaching

Group learning means:

> "...A number of people who are in face to face contact, so that each other of them can interact with all the others" (Abercrombie 1974).

In order to work, the size of the group has to be small, enabling all the members to interact with the others (between five to eight is ideal for most small group teaching (Newble and Cannon 1991)). Also, the teacher, although present in the group, is not the centre of attention: he/she becomes part of the group of equals where his/her main role is to encourage interaction among the members of the group.

In a survey of students' opinions in the UK carried out in the 1960s, group teaching was preferred by students to other teaching strategies in higher education. The Commission on Teaching in Higher Education concluded that students preferred less time in lectures and more time in learning through other teaching methods, of which small group teaching was favoured in most institutions of higher education (Abercrombie 1974).

Group teaching is important, because it gives students the opportunity to discuss with their classmates and develop higher intellectual skills of criticising, analysing, problem-solving and decision-making (Newble and Cannon 1991). Moreover, it is useful to be exposed to different points of view and to experience how to work and learn as a collaborative team.

In the teaching of Environmental Architecture, there are several small group-teaching strategies that are being used. Tutorials, seminars, informal meetings and workshops are some of them. In tutorials the main focus is the development of students' views around a subject, whereas seminars are centred on the subject itself, using presentations, prepared questions and arguments to stimulate students' learning on a particular topic. Discussion is also a feature of informal meetings. Nevertheless, such meetings are not structured and the subject can, and probably will, change during the meetings. The difference between these methods and workshops is that workshops are carried out without much interaction from the teacher. Students are left with a task, something to do or to build, and from that experience they can discuss with the group and draw conclusions, the teacher keeping the time and probably chairing the discussion.

Of course, small group teaching also has a social importance. Students get to know their peers and have the opportunity to discuss other problems in the group such as difficulties encountered in the course or in studying, in attending the class and so on, difficulties which also affect the performance of students' learning (Newble and Cannon 1991).

In Architectural Education, Studio Design is one of the main learning strategies. Although the groups are bigger in numbers (around 20 students), the design work is mostly done individually.

4.3.2.1 Studio Design Projects

Learning through Design is an individual process. As in any project work, some projects will be researched in groups, but the final submission will be different for each student. Design projects are widely used in architecture. However, it is only until recently that Environment and Sustainability have started to be taught through Design projects, after architects and academics gave some value to environmental issues in architecture.

> "...Preserving the environment will quickly become the larger purpose of architects in the next ten or twenty years. We have a responsibility to use less and get more. We need to be economical and rethink some of the extravagant ways of our modern predecessors" (Boyer and Mitgang 1996).

> "Many authors have expressed their beliefs in the inclusion of Environmental Education and Sustainability in Architectural Education" (Tauke 2001).

However, there is some debate about the way Architectural Design is taught. As Smith points out:

> "...The technological design process model tends to be based on technical rationality which suggests that Design is 'problem-solving made rigorous by the application of scientific theory and technique'. Architectural Design, however, seems more appropriately based on 'complexity, uncertainty, instability, uniqueness, and value conflict'" (Smith 1987).

Nevertheless, the benefit of Design learning outweighs the problems encountered. After students learn or acquire some of the skills needed to design, they benefit from the research, discussion, interaction and production of an integral solution.

One of the most educationally rich experiences of Design is the review process. Although it has been criticised many times, it is full of learning opportunities:

> "The analysis of the data suggests that the great majority of staff believe that a considerable amount of learning does take place in reviews, and the students' comments support this assumption" (Wilkin 2000).

For students, the review process improves their own skills and abilities, not only in presenting information but also in understanding the reasons given during the review.

4.3.2.2 Individual tutorials

The main difference between group tutorials and individual tutorials is the number of people involved. Individual tutorials are one-to-one teaching. They are very frequent in Architectural Education, focusing on each student's project, and representing the main teaching tool in Studio Design. Through tutorials, the tutor can help the development of students' learning by identifying problems and individual needs.

4.3.2.3 Field trips and laboratory work

Practical classes are intended to show students the fundamentals of the course and/or give them some experience of what they will use in the working environment.

Field trips, for example, are very useful in helping students see and experience buildings and sites. Students can understand better how buildings work and how they interact with surrounding buildings and with the site. Traditionally, architects travelled after or during their studies to experience what had been done in other countries and acquire part of the visual language used by other architects. Today part of that experience can be acquired through magazines, journals and TV. Nevertheless, actually seeing and walking through the construction or the site promotes a deeper learning experience. Although very popular among students, field trips are not used frequently; probably because this method is expensive and depends on the budget of the school and the students.

Laboratory classes are the classic practical learning method. Students are told what they will experience and therefore to practise the technique or learn how to use specific equipment. In laboratory demonstrations or practices, students will acquire practical techniques (like measurement of room temperature and humidity or the construction of a small structure) and also the techniques relevant to the course (the use of topographic equipment or of the artificial sky, among other equipment). Also, as Newble and Cannon say, through practical teaching students can learn the process of scientific enquiry: the critical analysis of literature; the identification and resolution of set problems; the analysis and interpretation of experimental data; and written and verbal communication (Newble and Cannon 1991).

Through enquiry and analysis, students of Environmental courses are able to simulate a building in order to predict how it will behave and interact with the surrounding environment and its occupants. Today, it is less common that students use laboratory equipment to simulate the living environment, as computer simulation is very effective for this purpose. However, computer simulation programmes take time to master and so does the input of data. Furthermore, old technology (Heliodon, artificial sky, air tunnel) is more accessible to students who want a quick idea of the building's behaviour and its impact on the surroundings.

4.4 Summary

Much has been said and written about environmental problems and solutions in an effort to make the public aware of the problem human beings have produced over the last few decades. Educationalists, environmentalists, sociologists and members of many professions have expressed their concern about the environment, the impact of human interference, settlements and technology on the health of the earth and its occupants (Palmer 1998).

Given that people spend more than half of their time inside buildings, we can conclude that everybody has to learn about how to reduce the detrimental effects of our daily life activities on global health. The reduction of emissions in the atmosphere has to be achieved by communal agreement and collaboration. Part of this intention has been already implemented in Schools of Architecture and through publicity campaigns.

Although it is the responsibility of the global population to save and diminish the damage to the environment, it is the responsibility of the construction industry and other key sectors to improve the built environment. This can be achieved by reducing energy expenditures and promoting, within buildings and settlements, energy savings and attitudes that will facilitate environmentally conscious activities on the part of users.

As an integral part of the building industry, architects have been searching for better and more environmentally conscious ways of building, using less polluting materials and less energy expenditure – in sum, a more effective and efficient building industry. This is particularly important considering that during the 1992 World Summit in Brazil, it was revealed that buildings and the construction industry cause 50% of the CO_2 emissions in the atmosphere[7].

Schools of Architecture have adopted some subjects and professional interests, like Environmental Design, waste disposal, and energy efficiency, among others, in order to increase awareness and action from Architecture students and future architects.

Teaching techniques used in the Schools range from large group teaching, mainly through lectures, to small group teaching, mainly through Design projects and tutorials. Although useful, lectures are usually considered secondary and as a support to the Design project. Learning through Design has many learning advantages and, although it sometimes promotes individuality and communication problems, can be used to promote Environmental learning and as an example to other careers.

Teachers of Architecture consider that a variety of courses and teaching techniques is better for the development of students' learning and also increases their own satisfaction as teachers of Architecture.

Having discussed the state of Environmental Design and Sustainability in Architecture, in the following chapter the methodology used during the research process (qualitative and quantitative, exploratory and descriptive) will be explained. The reason for the selection of different methods will be discussed as well as the possible biases and limitations of the research methods selected.

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[7] In 1992, the leaders of the world's nations met at the Earth Summit in Rio to set out an ambitious agenda to address the environmental, economic, and social challenges facing the international community.

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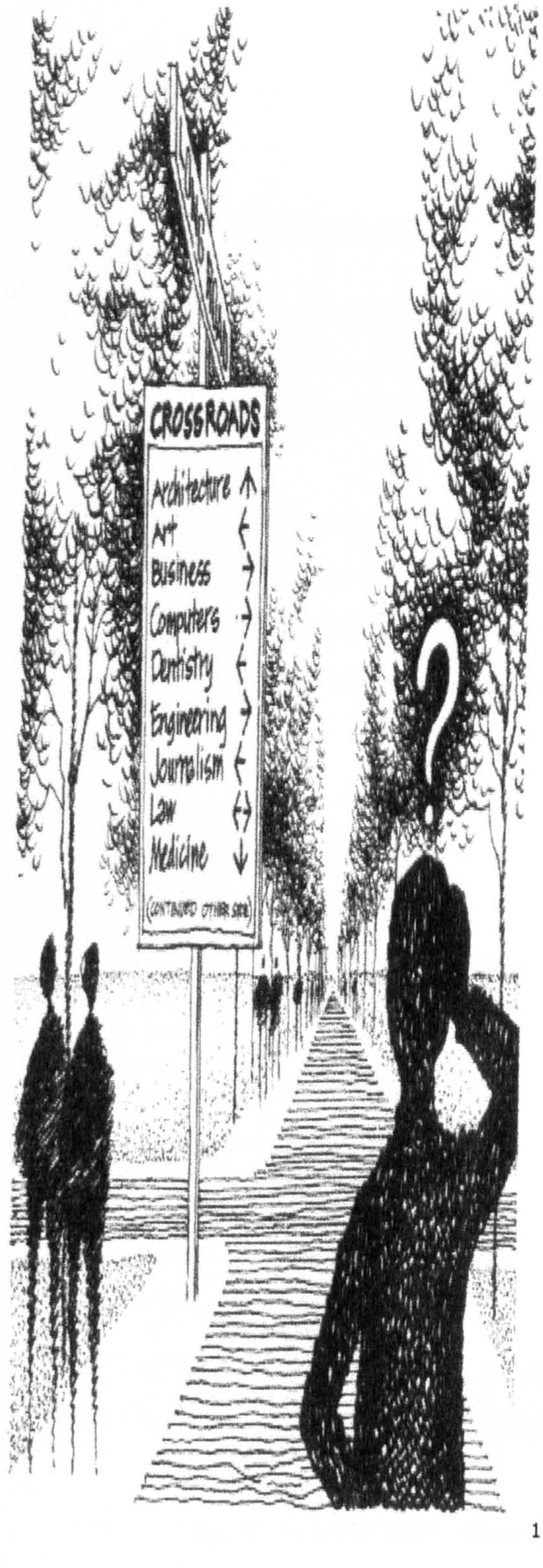

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[1] **Lewis, R. K. (1998).** *Architect? A candid guide to the profession.* **Cambridge, Massachusetts, The MIT press.**

Chapter 5.Methodology

Chapter 5

5 Methodology and Research Technique

In this chapter the different research methods used in this study, the selection criteria and the biases and limitations of the research will be explained. The characteristics of the data obtained and the strategies for analysis and comparison will also be discussed in the following sections.

In Social Sciences research, selecting the appropriate method of research is very important for achieving the type of results required. During the research design, the researcher can ponder the benefits and disadvantages of the different techniques, compare these with the desired outcomes, and select one or a combination of methods.

5.1 Qualitative and Quantitative Research

The Oxford English Dictionary defines research as:

> "The act of searching (closely or carefully) for or after a specified thing or person. A search or investigation directed to the discovery of some fact by careful consideration or study of a subject".

It is usual among researchers to divide social research into qualitative and quantitative. The first is concerned with meaning; the second with measurement (A Dictionary of Geography 1997). Qualitative research is considered useful as a preliminary/exploratory stage of a more quantitative study. However, in the Social Sciences it is sometimes used as the only approach to research.

Qualitative research is concerned with an individual's point of view on various subjects, and with his/her attitudes, opinions, motivations and behaviours (A Dictionary of Geography 1997).

The most common method used in qualitative research is participant observation, which entails the sustained immersion of the researcher among those whom he or she seeks to study with a view to generating a rounded, in-depth account of the group (Bryman 1996). This immersion in the group is designed to give a deeper understanding of the social group. However, there is concern about how much the researcher should intervene and how this intervention could bias the results of the research. (A Dictionary of Geography 1997, Bailey 1994, Bryman 1996).

Interpretation of qualitative data can pose problems as the researcher has to explain what the subject's interpretation of a social reality is, i.e. explain something through another person's perspective. As Bryman points out: Why one interpretation rather than any other? Nevertheless, this type of research can be repeated by other researchers, who can confirm the results obtained.

Unstructured interviews are also widely used in qualitative studies. The researcher provides minimal guidance and allows considerable latitude for interviewees. Some researchers try to quantify the responses and observations. However, most prefer to arrange the data into qualitative categories with distinguishing names (Bailey 1994).

Qualitative research embraces different ways of collecting data and many styles of observation, in contrast to surveys and experimental research where the studies are more uniform and quantifiable.

Quantitative research is most often defined as the collection and analysis of data. Bryman mentions that there are many methods of collecting data in quantitative research. However, surveys are favoured in the Social Sciences as they are useful for collecting quantifiable data on large numbers of people (Bryman 1996). Experiments are the classic research approach in quantitative studies, although there are other methods such as the analysis of previously collected data, structured observation and content analysis.

Bryman describes how supporters of each approach (qualitative and quantitative) discredit the others' research style:

> "Quantitative researchers demand that data should be objective, non-reactive, representative, and should be collected using standard measures. They reject qualitative research as subjective, unrepresentative, unsystematic, and inconclusive. Qualitative researchers might counter that an individual's behaviour can only be understood if that individual's perspective is known and understood in context, and that quantitative research is artificially shallow and misleading scientifically" (Bryman 1996).

The fact is that all types of research can be useful, depending on the outcome wanted. Both qualitative and quantitative research can produce relevant, important information and knowledge about different topics and aspects of society.

In figure 5.1, some differences between quantitative and qualitative can be seen. As Weisberg points out:

> "Different social research situations call for different methods and the best format is often one that involves the use of several methods focused on the same topic" (Weisberg, Krosnick et al. 1996).

		Quantitative	Qualitative
(1)	Role of qualitative research	Preparatory	Means to exploration of actors' interpretation
(2)	Relationship between researcher and subject	Distant	Close
(3)	Researcher's stance in relation to subject	Outsider	Insider
(4)	Relationship between theory/concepts and research	Confirmation	Emergent
(5)	Research strategy	Structured	Unstructured
(6)	Scope of findings	Nomothetic	Ideographic
(7)	Image of social reality	Static and external actor	Processual and socially constructed by actor
(8)	Nature of data	Hard, reliable	Rich, deep

Figure 5.1 Some Differences Between Qualitative and Quantitative Research (Bryman 1996).

Choosing one type of research over another is a matter of deciding which is more suitable to answer the questions for which answers are required. However, if qualitative and quantitative research both have advantages and disadvantages, then a good approach is to counterbalance them by combining them.

This study is primarily of a qualitative nature since no other research of this type has previously been done. Data were needed to compare students' and teachers' opinions and preferences in Environmental Design and Sustainability learning. Qualitative research is often a necessary precursor to quantitative research, if a field is not ready for quantitative assessment. The qualitative data help you to pose questions that can be addressed quantitatively. The study was carried out through interviews and focus groups. However, an e-mail questionnaire was also distributed in order to give weight to the findings obtained through interviews and observation. This questionnaire generated some quantifiable results.

In this chapter the choice of research methods, and the way in which these methods have been used to obtain data, will be explained.

5.2 Research Design

As previously mentioned, choosing a research style is important for the outcome wanted and designing the research is useful as a guide to the process of collecting and analysing information. It also allows the researcher to infer whether the results can be generalised to the whole population.

Some researchers divide research into exploratory, descriptive and experimental research (Frankfort-Nachmias and Nachmias 1992, Bryman 1996).

In exploratory research, the main interest is in understanding the subjects to be studied: their environment, attitudes and background. Qualitative research methods are usually applied in this type of research design, as it is more focused on people's view and behaviours than the other types of research.

In exploratory research, the idea is to explain a social phenomenon by specifying why or how it happened. The researcher would also like to be able to predict when the event will occur again. If this research predicts reoccurrence correctly, he/she will be able to study the causes of the event and hopefully understand what triggers or prevents that event from occurring (Bailey 1994).

As in exploratory research, descriptive research has no hypothesis. In descriptive research, the aim is to emphasise more the relationships between variables than between fixed phenomena (Van Dalen 1973). For example, comparing teaching methods between different Schools of Architecture or teachers and students' opinions about the same topic.

In contrast, experimental research is based on a hypothesis which aims to be proved through a comparison of experimental groups. These groups are subject to the same conditions. One or many of the groups, except the control group, are exposed to a different condition (the independent variable to be tested). The groups are then compared before and after the new variable is introduced, with a view to finding out what causes significant differences between groups.

In the Social Sciences, experiments are not common, as they have a more rigid structure. Thus social scientists frequently use designs that are weaker in drawing causal inference, but more appropriate for the types of problem they examine.

In order to design a research project according to any of these research styles, it is important to know (1) which type of information is required and (2) which resources are available for the research.

A variety of methods appear appropriate for this research. One reason for using a variety of methods and techniques of collecting data is that it allows inference drawn from one data source to be corroborated or followed up by another (Bryman 1996).

In the following sections some of guiding questions stated to find out the kind of knowledge wanted and the appropriate research method to use. These questions derived from the literature reviewed in Chapter 1-4, and from the issues of interest to the author.

5.2.1 The Perspective of the Design and Technology Teacher

The following list shows some of the issues and questions raised with teachers of environmental subjects:

Teaching strategy

- Do you invite environmental experts to the class? If so, does this create a problem by reducing freedom and autonomy in the class?
- Do you think about these issues but don't do any specific work on them because they are time-consuming and require longer preparation?
- How is the course structured?
- How do you usually teach these subjects?

Motivation

- How motivated are you towards environmental issues?
- How important do you think these issues are?
- How aware are you of these issues?
- How concerned are you about environmental change, the effects of pollution on the environment, energy expenditure, conservation and re-use, and recycling?
- Do you consider these issues when you are confronting a design problem, giving an exercise, or making corrections to students' work?

Students learning

- Do you think students enjoy their environmental classes?
- What is the feedback from the groups?

- Are your students more aware, more interested and more motivated to implement what they learn in Design projects?

Integration

- Have you discouraged your students from considering a green solution?
- Are you a practitioner and do you apply these issues in your offices?

Teachers' preparation

- Do you feel prepared to cope with a problem that needs environmental solutions in class? Or do you feel you need more knowledge on the subject?
- Do you think that environmental design will take more time?
- Do you need to be more prepared to deal with these issues?

5.2.2 The Perspective of the Design and Technology Student

Similar questions were raised with students:

Teaching strategy

- Have you been discouraged from considering a green solution at any stage?

Motivation

- How motivated are you towards environmental issues?
- How important do you think these issues are?
- How concerned are you about environmental change, the effects of pollution on the environment, energy expenditure, conservation and re-use, and recycling?
- Do you think about these issues but don't do any work on them, as you just need to pass?
- Would you like to know more about this area and apply it in your designs?
- Do you take any interest in subjects related to environmental design?
- How do you like these subjects?
- What is your opinion of the class and the teacher?
- Are you afraid of or do you dislike the subject?

Students learning

- Do you learn something on these courses?
- How do you usually learn these subjects?
- Do you have some preconceptions about new technologies and the environment?
- How do you prefer these subjects to be taught?

Integration

- Do you think about these issues when confronting a design problem?
- Do you think environmental issues will take more time to apply in the design?
- Do you think you can apply that knowledge in your designs?
- Do you think that this application will be easy?

5.3 Methods Adopted

Most of the above questions refer to attitudes and beliefs of the group. For this type of data, an exploratory research design would therefore be the most appropriate. Moreover, the research has not been based on an experimental hypothesis to be confirmed, but on some supporting statements and suppositions. A non-structured or semi-structured research approach to observe these suppositions in context was therefore preferred on the grounds of giving a deeper understanding of teachers' and students' attitudes and behaviours than a more structured approach.

Such a non-structured research approach has the added benefit of being relatively inexpensive, which suited the limited budget of the investigation.

A descriptive research design was also considered suitable for this research as a comparison between teachers' and students' views is desired and a research of causality from one group's attitudes towards the other is also intended. Therefore a mixture of exploratory and descriptive research design was preferred for this study.

The structure of the research is exemplified in Figure 5.2.

The research structure is summarised in the following way:

1- Primary research (pilot) was carried out to identify the way teachers approach their teaching tasks.

2- A focus group and discussion groups were organised to find a pattern of preference and efficiency from students' points of view.

3- A comparison of teaching methods was also part of the exploratory research. Two teaching methods were compared (workshop and lecture) using a semi-experimental setting.

4- A feedback session followed the comparison of teaching methods to review what students thought about some subjects and the way they should be taught.

5- Qualitative research into students and teachers' learning and teaching preferences was conducted through interview of students and teachers of the same 10 universities participating in the study. Some of the aims were to find out teachers and students' understanding of and motivation for environmental education, through personal interviews.

6- A survey questionnaire based on the qualitative data was given to teachers following the interviews to corroborate the information in a more quantifiable way.

7- The data were compared and analysed and the results and conclusions were drawn.

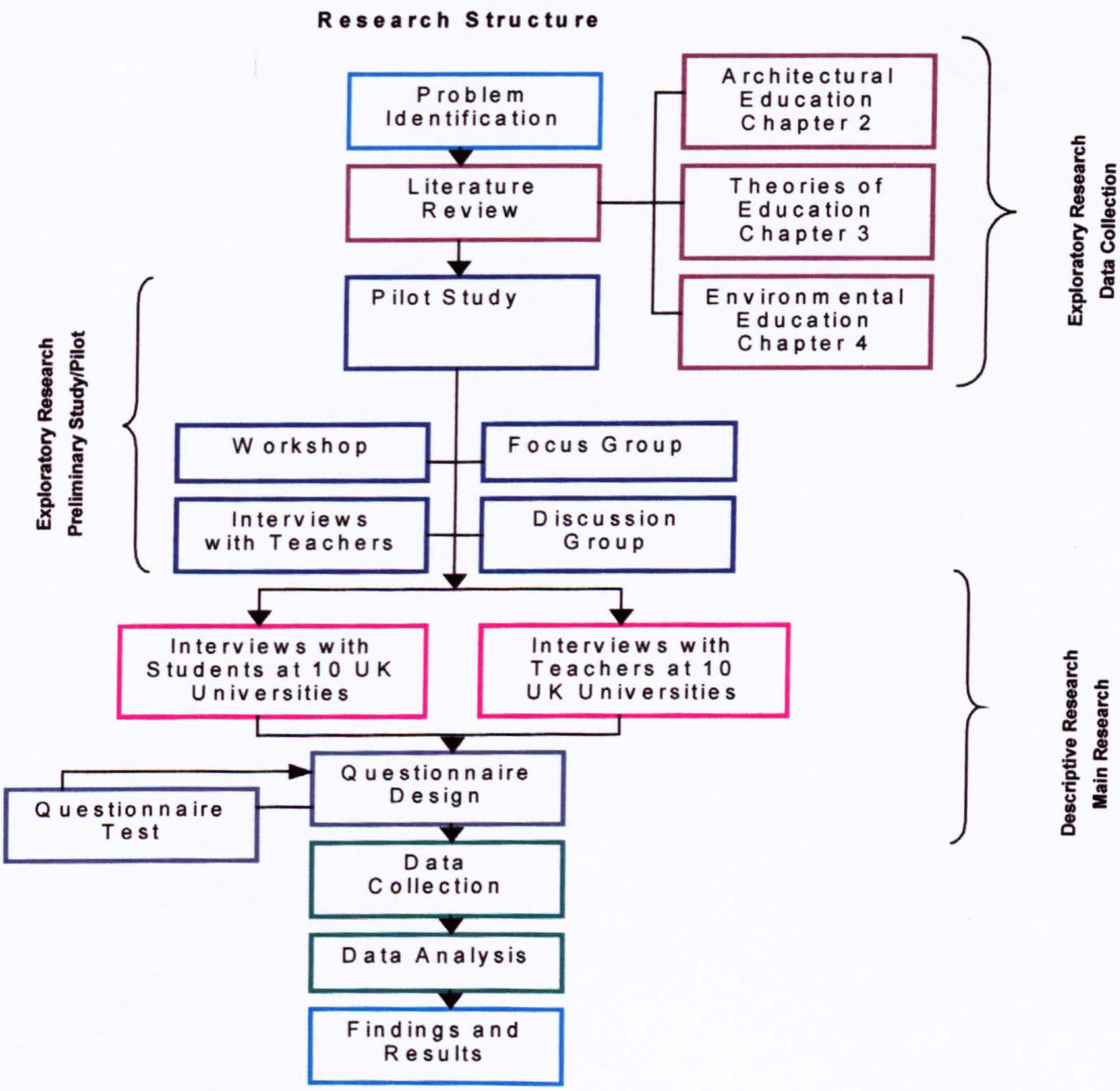

Figure 5.2 Thesis Structure

5.3.1 Pilot Studies

5.3.1.1 Survey

The study was done in order to explore common features, innovative and optimum teaching methods and suggestions of methodologies most commonly used by teachers of environmental courses in Schools of Architecture in the UK.

Thirty-seven universities in the UK were contacted. E-mails were sent to heads of department, who were asked to distribute the questionnaires to course co-ordinators in Environmental Design postgraduate courses.

Postgraduate courses were selected as both teachers and students should be interested in the subject. Teachers should be motivated to promote awareness and the search for knowledge in students, and students' vocational interest should lead them to learn more about Environmental issues.

The respondents were asked to identify the course they teach and its objectives, as well as the teaching methods they use and their frequency. They were also asked to assess the methods with the best learning outcomes and the satisfaction level of their teaching method for them and their students.

From the 37 Schools contacted, 20 co-ordinators/lecturers replied to the questionnaire. The respondents were asked to choose from 10 different but typical teaching methods, those ones that they use and with which frequency: Every Session, Weekly, Every Fortnight, Monthly, in Every Semester, Annually. All the answers were plotted out on the annual basis so that a comparison between the frequencies of each method used could be made. It was assumed that there are approximately 48 weeks of effective teaching in postgraduate courses; also that postgraduate degrees have at least 2 sessions a week.

Considerations of bias

There were different sources of bias in this study. First of all is the fact that not all the respondents were course co-ordinators. In some schools there is no such position as Environmental Design co-ordinator, so the questionnaire was sent to lecturers in Environmental Design courses, Technology or Environmental Sciences. These lecturers could have been lecturers, senior lecturers or professors, etc. Despite this, there was no big difference in the way respondent answered the questions. In addition, as Schools or Architecture are different and structured in different ways, the courses compared also differed. Some Schools, for example, gave the title of Environmental Design to a course which included philosophy of Environmental Design, Lighting, Acoustics, Mechanical Ventilation or, indeed anything related with the Environmental Sciences. Nevertheless, the questionnaire asked teachers of postgraduate courses to state the title and objectives of the course, which facilitated comparison.

The results of the survey were presented in the 'Teaching in Architecture' (TIA 2000) conference in Oxford, and some of the conclusions are explained in section 4.3 of the previous chapter. The main findings of the pilot survey questionnaire[1] were that:

- Teachers feel they have the best learning outcomes using lectures and with a 'combined method' of teaching.
- A combination of teaching approaches, at different times of the academic year, will be favourable to learning. Variety is what maintains the necessary motivation for efficient and effective learning.
- Lecturing is the method most widely used in postgraduate courses. However, there is not complete satisfaction with the way teaching is carried out.
- Students perceive their learning differently to tutors.
- A motivated tutor will promote motivation in his/her students and increase the effectiveness of the course.

Based on these results, a hypothetical supposition was derived. This statement provided the basis for the search for the best ways to learn/teach environmental issues in Architecture. This research was conducted via a workshop and a focus group.

Hypothetical Supposition

If lecturing is the most frequent method used by teachers in architecture, then lectures are the best teaching method in environmental education.

[1] A definition of the survey questionnaire can be found in section 5.3.3.

5.3.1.2 Workshop

The researcher was invited as a participant to a workshop in Sustainability for first year students at Sheffield University. The workshop was used as an opportunity to observe some of the methods employed to motivate students to learn about Sustainability.

During the workshop students were asked to find sustainable ideas and solutions to everyday life situations, through poster making. Students discussed their ideas and drew some conclusions on what Sustainability might be for architects. After the experience, students were invited to sign up for a Sustainability discussion.

5.3.1.2.1 Focus Group on Sustainability

Definition

A focus group or guided discussion is a semi-structured interview method for a maximum of 18 people. Topics and a hypothesis are selected in advance. The actual questions, however, are not specified in advance. The interviewer studies the topic itself in advance, deciding which aspects of it to probe[2].

Guided group discussions are designed to provide information on a certain topic from a generally homogeneous group of people. As a qualitative method, they do not give results suitable for statistical analysis. Nevertheless, they provide quick and low-cost data about beliefs, attitudes and behaviours of the group (Weisberg et al. 1996).

Test situation

Of the 80 first year students who participated in the Sustainability workshop in Sheffield University during the first semester of the year 2001, 12 students signed up for the discussion on Sustainability. The majority were interested in knowing more about the subject, and thought it interesting. On the day of the appointment, 8 students attended to discuss the subject.

Students were asked their opinions about the workshop, their knowledge of Sustainability and how much they thought they had learnt. They were also asked to

[2] A probe will be explained in detail in section 5.3.2.

compare the workshop with other teaching methods they had experienced in their previous schools.

Considerations of bias

There might be some bias from the group that participated in the discussion as the 12 students, from the original 80 who signed up for the discussion in Sustainability, might not represent the whole population of first year students. These students might be a group of students who are motivated about this issue, something confirmed by the fact that, in the discussion, the students said they were interested in knowing more about Sustainability. Therefore these could be biased in saying they preferred the teaching method and enjoyed it.

It is also possible that the full range of ideas and opinions on Sustainability were ignored, as students who were not interested did not sign up for the discussion. However, it could be that the students who did participate in the discussion were those that had more time or better organised their timetables.

Perhaps the group of students were the most articulate or extrovert of the group of 80 first years. However, in the discussion, while all students were interested, not all were articulate or extrovert.

All these biases were considered when taking the opportunity of the workshop to observe the teaching of Sustainability. The results of the discussion were very useful for understanding the teaching method and the attitude of students towards it, and they were used to state a supposition that will be tested in the following section.

Overall, students expressed some satisfaction with the workshop and found it very interesting. A summary of the students' ideas is given below (the complete transcription can be found in Appendix A):

> "We said many things, things we haven't thought of before, but mainly things that were more environmentally suitable, socially and economically as well. It can make you realise how the three interact and how one fact can affect all three."

> "I think a combination [of methods is needed]. You get a lot of information and then you can go and practise that information for yourself. In the lectures you just sit at a table. The teachers are there showing you knowledge."

"Yes, I think the workshop was pretty good. Because it was focusing more on making you think than just focusing on facts, in comparison to the lectures we had in the past about the environment. I suppose teachers are right at the beginning of the lecture course, so they are more interested in solar radiation and things like that and it is harder to get a feel of what is important."

Hypothetical supposition

Through workshops students appreciate thinking about the issues they are learning. Workshops should therefore be the best teaching method for Environmental Design.

5.3.1.3 Contrasting Workshops and Lectures

Eight students (out of 80 first years) said they enjoyed a workshop as a teaching method, and that they learnt from it. The objective then was to contrast students' opinions on different teaching methodologies after experiencing a workshop and a lecture on the same subject.

The topic 'Thermal Response of Buildings' was selected for the following reasons:

1. First year students were the pilot subjects for the previous semester's Sustainability workshop.
2. They were relatively new in experiencing university education.
3. In previous years there were complaints about this topic lecture.
4. The course leader agreed with the experiment.

Both the researcher and course leader agreed on the aims and objectives of the class and the way it was going to be delivered in the hour allocated for the course.

The class was divided into two groups: a big group of about 68 second year students, which remained in the lecture theatre, and a small group of 12 students who were moved to one of the laboratories for the workshop. The number of students for the sample (12) was decided according to the students' own discussion of the right number for a group to be comfortable to ask questions. Students were divided randomly. Once seated and after explanation of the experiment, the group nearer to the aisle was asked to move to the laboratory to continue the class. After the class, both groups were invited to give feedback separately.

Both lecture and workshop followed the same aims and objectives of the course. The difference was that, instead of sitting and listening in the lecture theatre, students in the workshop were asked to search for images and feel materials, and reach their conclusions in the workshop. They were all reassured that the class handout was the same and that this material was not going to be included in the examination, so reducing the pressure from these elements.

The workshop and lecture were structured in the following way:

- **Aims:**

Learn about the thermal response of buildings

- **Course Components:**
  - Thermal (heat) capacity of materials: how the flow of heat is affected.
  - Insulation materials
- **Approach:**

1- By choosing suitable combinations of heat-absorbing (thermal mass) elements together with suitable levels (thickness) and position of insulation materials, we can optimise the building's performance.

These features will be part of the understanding of future lectures:

- Bioclimatic analysis (adapting building construction method to the climate).
- Solar design/passive (taking advantage of solar heat gain).
- Traditional buildings (historical perspective of how buildings evolved in response to climate).
- Thermal capacity effects (handout available).
- Activities.

2- Though for many purposes, we assume buildings to behave in a static way, they are (or can be) quite dynamic in response to heat flows. The task is to harness the dynamics in the most suitable way.

- Consider how heat flows through a structure:
  - Heat absorbed by material

- Time for transfer (time lag)
- Reduction in temperature swing (decrement)
- Characterise for building types:

  -Light weight

  -Heavyweight

- Consider two walls – each has the same materials but reversed. How do they respond?

- Choice of building response for particular uses

5.3.1.3.1 Problems encountered

The workshop:

During the workshop students were reluctant to participate or ask questions and seemed not to like the workshop very much. Afterwards, students complained about the lack of information given, something also mentioned by the lecture group during their feedback meeting. Some students agreed they had learnt some new basic concepts in the workshop.

After the session some tentative conclusions as to why they acted this way could be drawn. Students' reluctance and lack of motivation could be because: (1) The space in which the workshop was held was dominated by heavy equipment, making visual contact very difficult between students and teacher. (2) The students were shy to participate, probably because they were separated from their usual group of friends or because they were selected and not asked to volunteer. (3) A workshop is not the best method to teach this kind of technical content. (4) Students were not used to the workshop leader and did not know how to react.

The lecture:

During the feedback session, there was a consensus that the lecture had been very interesting. However, it was like any other lecture. The fact that the teacher introduced new concepts, and had lots of visual material (slides, transparencies, handouts and notes) was very motivating. Students agreed that they didn't feel sleepy. One reason for this was the fact that they could make notes, which seems to be very useful not only in acquiring information in the class, but also in retaining their attention. Students were disappointed to receive a handout at the end of the class, as they had been copying information during it.

Consideration of bias

The hypothetical suppositions, on which the experience was based, were derived from different levels of education and different groups: postgraduate teachers (for the lecture) and undergraduate students (for the workshop). The teaching strategies for both groups (undergraduate and postgraduate) are usually the same. The difference is in students' perception of the teaching and approaches to learning. The experiment was conducted with undergraduate students. Second year students were selected first for opportunistic reasons, and second because first year students were already exposed to a discussion on environmental issues and teaching strategies. Also, third year students were already used to the teaching techniques used in the university, something which could have added bias to their responses.

Conclusion

The researcher concluded that the expectation of students to have a particular teaching method helped them enjoy that method better. Also, it seems that there are some subjects that are better understood through a more theoretical teaching method (e.g. the lecture). Workshops are better at introducing abstract concepts and for hands-on experience exercises. Moreover, the attitude and motivation of the lecturer is important in keeping the lecture interesting and the use of colourful slides and different images helps to maintain students' attention.

5.3.2 Interview

After the preliminary studies described above, a picture of students and teachers' preferred learning and teaching method was formed. As a consequence, the plan to understand their attitudes and motivations towards methods of learning and teaching Environmental Design in Architecture could now be tested. The methods selected for this were interviews and a survey questionnaire. The first stage is the "exploratory" research; the second is the construction of the "descriptive" research or survey.

There are many advantages of interviews, primarily, the fact that they enable the researcher to learn more about the respondent's attitudes, values and beliefs on the subject. The types of interview used in this research were unstructured and semi-structured interviews. In these types of interview, little or no written prompting of the subject is given in advance to the interviewee. The interviewer selects a topic, conducting a free-form interview by composing the questions as he/she goes along (Bailey 1994).

In this type of interview, a potential problem could be the interviewee digressing from the subject of the research – what Bryman calls "rambling". However, it is a very good way of probing areas that are of central interest to that person. Rambling could therefore be considered interesting as it gives insight into those being investigated.

OPEN-ENDED PROBES:

Anything else?
Any others?
Any other reasons?

PROBES FOR VAGUE OR ONE-WORD ANSWER:

How do you mean?
Would you tell me more about you're thinking on that?
Does a particular aspect of that problem stand out in your mind?
Could you give me more information about your thoughts on...?
Thinking about___ a bit more, what else about it concerns you?
Could you tell me a little more about that?
Would you tell me what you have in mind?
Could you elaborate on ...?

GENERAL REMARKS:

Let me repeat the question?
Let me repeat the choices.
Of course, no one knows for sure.
There are no right or wrong answers.
We're just interested in what you think.

STANDARD CLARIFICATIONS:

Whatever___ means to you.
Whatever you think of as ____.
It is important that the question be answered as best you can in terms of the way it's stated. Maybe I could read it it you again.
Could I reread the question and the answer I've written down just to be sure I have everything you wanted to say?

FEEDBACK PHRASES:

It's important to find out what people think about this.
I see, that's helpful to know.
That's useful/helpful information.
Thanks, it's important to get your opinion for our research

TASK-RELATED COMMENTS:

Let me get that down.
I want to make sure I have that right (REPEAT ANSWER)
We have touched on this before, but I need to ask every question in the order that it appears on the questionnaire.
You've told me something about this, and the next question asks...

Figure 5.3 Standard Probes and Interview Remarks (Weisberg 1996)

Probes or follow-up questions are the way the interviewer goes back to an unfinished or incomplete answer when the interviewee changes the subject, is not sure of an answer, or is rambling in a different direction. Probes can be written in advance; they can also be used when the respondent answers previous questions in a certain way. Some examples of probes can be seen in Figure 5.3 (previous page).

Test situation

Teachers of Architecture from 37 universities in the UK were contacted for a personal interview. Of more than 60 teachers contacted, 22 agreed a meeting. A random selection of students from the same universities as the teachers' who participated was also interviewed.

It was intended to interview a selection of students from different years, but this was not possible in all Schools, as some students were out on trips, while others were not working in the Schools on the days of the visits. Only the students present in the Schools on the days of the visits were interviewed.

This fact can be a source of bias, as the number of students from different years is not equally distributed and students might have been in the School for several different reasons: the fact that they liked to work in the School for example.

Before the interviews took place, both teachers and students were informed of the main objectives of the research: to acquire their opinions on environmental education in Architecture. After setting the background, random questions were asked on their preferred learning and teaching methods, the factors they thought could improve learning or teaching, and their motivation (see Sections 5.2.1 and 5.2.2 for a sample of the type of questions asked).

5.3.3 Survey

Based on teachers and students' responses, and using some of their own phrases and words, the survey statements were expressed. The statements were classified in different subsections according to the intended question outcome (Appendix B includes the structure of students' and teachers' questionnaires).

Surveys in the Social Sciences are used to predict the outcome of an event. They can measure attitudes, preferences, beliefs, prediction, facts and past behavioural experiences (Weisberg et al. 1996). The advantages of the survey are that it provides quantitative data that enable analysis on a statistical basis. The term is often associated with opinion polls. Data are usually collected by questionnaire or interview of a sample of the population (Fowler 1988). This data collection, in turn, enables a researcher to generalise the findings from a sample of responses (Creswell 1994).

In surveys, it is difficult to determine which variable has the most important effect on the results. Also, according to Entwistle (1992), surveys are very difficult to analyse. Nevertheless some statistical tests can be used to determine the most influential variables in the survey.

> "The main weakness of the survey procedure is the lack of control over both the situation and the variables included. The survey is also like a still photograph. It portrays the situation at one point in time and so the relationships established can be evidence of no more than concomitant variation – that certain values on one variable tend to be associated with particular values on another. Yet we are usually more interested in determining causality – which variable is responsible for changes in another. And an experiment is likely to provide evidence of causality" (Entwistle 1992).

However, Frankfort-Nachmias argues that survey research gives data that can be used to examine relationships between variables and to describe the pattern of relationships, therefore enabling a causal deduction to be made (Frankfort-Nachmias and Nachmias 1992).

5.3.3.1 Criteria and Selection of Sample

> "Sampling...aims at obtaining representative groups from which generalisations can be made" (Entwistle 1992).

Sampling can be highly accurate if the selection is carefully made. In addition, selecting the right sample can save time and money. If a sample is correctly selected, it can represent the whole population to be studied.

The sample is an approximation of the whole rather than the whole itself, a number of the population that is selected in a way that represents the whole characteristics of the population. There are different types of sampling methods: random, opportunistic, and captive. Weisberg divided sampling into two groups – probability and non-probability sampling – depending on how big the margin of error. Nevertheless, the more accurate the sampling, the more expensive and complicated it is. (Weisberg et al. 1996; Figure 5.4).

In probability sampling, the researcher tries to ensure that all known elements of the population are represented. By contrast, in non-probability sampling, the probability of choosing a person type is not known, therefore this type of sample cannot be claimed to be representative of the larger population (Bailey 1994). Moreover it is difficult to calculate the degree of departure or sampling error in this type of sampling. Nevertheless, non-probability sampling is less complicated, much less expensive and may be done in a short timeframe, taking advantage of the available respondents. It is sometimes also called opportunistic sampling, convenience or accident sampling, captive audience sampling, and also haphazard sampling (Bailey 1994, Babbie 1990, Hakin 1992, Bryman 1996, Weisberg et al. 1996).

Sampling method	Advantages	Disadvantages
Nonprobability		
Purposive sample	Inexpensive	No estimates of accuracy
	Uses best available information	May miss important elements
Volunteer subjects	Cooperative respondents	Not representative of population
Haphazard sample	Available sample	No necessary relation to population
Quota sample	Willing respondents	Middle-class and other biases
Probability		
Simple random sample	Accuracy can be estimated	Expensive
	Sampling error can be estimated	Interviews too dispersed and full list required
Systematic selection procedure	Convenience	Periodicity in list
Stratified sample	Guarantees adequate representation of groups	Sometimes requires weighting
	Usually decreased error	
Cluster sample	Decreased cost	Increased error
Multistage sample	Lower cost than simple random sample for large populations	Higher error than simple random sample
	Lower error than cluster	Higher cost than cluster

Figure 5.4 Types of Samples (Weisberg et al. 1996).

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. However, many researchers regard 100 cases as the minimum (Bailey 1994). Nevertheless, when the sampling fraction is above 30%, enough of the population has been sampled so that public attitudes are likely to be similar (Weisberg et al. 1996). Bryman argues that having a bigger sample does not affect the results but helps to decrease the sampling error; also that the size or percentage of the sample will depend on the research compromises of time and costs. The sample can be considered of a reasonable size if the results are similar and agree and the results will be relevant or not depending on whether or not the sample was carefully selected.

The research is conducted at a single point in time so that the opinions of all respondents are comparable. However, exposure to a particular external influence at that time could bias the sample. Therefore, replication of the research with a different sample is useful to confirm the hypothesis and demonstrate that the findings are not an accident or coincidence (Bailey 1994).

Also, to validate the questionnaire, a pre-test of it should be done with a small sample, whose responses won't be used in the final results. After the group has been questioned, the researcher should look at: (1) Whether the survey is really measuring the kind of behaviour that the investigator assumes it is (Is it clear, easy to answer?); and (2) Whether it provides an adequate sample of that kind of behaviour (the level of agreement or disagreement in the sample) (Bailey 1994).

In this research, the idea was to interview some teachers and students at different universities, both former polytechnics (new universities) and old universities, those with a more technical focus, and those with a more artistic and classical background, in order to have an even representation of the population.

5.3.3.2 Questionnaire Design

There are many elements to be considered when designing a questionnaire. In addition to elements of presentation and formatting that help respondents to answer the questions, the researcher has to consider the selection of the media to distribute the questionnaire and carefully decide on the questions to be used to generate research answers.

There is a common conception that a short questionnaire will have a better response rate; however, a cramped presentation will look unattractive to respondents. Usually, researchers shorten the margins and reduce the spacing so as to gain space on the page. Nevertheless, some researchers argue that having questions too close together will not only reduce the appeal of answering the questionnaire, but might also cause some questions to be omitted (Dillman 1983, in Bryman, 2001).

Another issue in questionnaire design is the clarity of the questions. They should be presented in an easy way for the eye in order to facilitate the answering of all the questions relevant to the respondent. Also a variety of fonts, print sizes, bold, italics and capitals are recommended, although they must be used consistently to avoid distracting or confusing the respondent.

A questionnaire is generally mailed or handed to the respondent and filled in by him/her with no help from the interviewer.

The type of questionnaire selected was an online questionnaire. This type of questionnaire has several advantages over mailed questionnaires and computer-assisted interviews:

- It saves money and time in sending out the questionnaire;
- It is easy to obtain the responses and secure the information;
- There is less evaluation anxiety from the respondents; and
- It is accessible to many people in remote places.

Nevertheless this type of questionnaire also has the disadvantages of:

- Less flexibility as there is not much interaction between interviewer and interviewee;
- There is always a low response rate, around 10%;
- It is biased towards the people that have computer access and an e-mail account;
- There is no control of the environment where the respondents are answering the questionnaire;
- Many questions may remain unanswered;
- It cannot record spontaneous answers; and
- There is no control over date of response; therefore there could be many days' difference from one response to another.

Moreover, some researchers have argued that the use of this type of questionnaire results in neutral persons (people without a strong feeling about the subject) probably not responding. However others have shown that this objection is either incorrect or overstated (McDonagh and Rosenblum, 1965 in Bailey 1994).

The other problem with questionnaires is the sheer number of questionnaires in circulation. There is saturation in the use of this research tool, and therefore a lower level of responses than ever. Nevertheless, it has been suggested that the number of follow-up questionnaires increases the number of responses. In this research, there were two follow-up invitations to fill in the online questionnaire. However, only a small increase in responses was generated.

The questions were validated through pre-testing the questionnaire in a small sample, which was not included in the final results. Each question and answer was checked; confusing wording of questions was removed or changed. Also, the questions were compared with previous questionnaires and known facts (the preferred combination of teaching methods; the acknowledged room for improvement in teaching, etc.).

The questionnaire will be more effective if it avoids ambiguous questions. Sometimes, the meaning of some words may be known only to a specific group of people (technical words, jargon, slang or colloquial phrases) (Bailey 1994). Questions should be simple and refer to concrete and specific matters.

Questions can be closed–ended questions, where the researcher gives the answers, or a range or selection of answers; or open-ended questions where the interviewee provides answers not predicted by the research (i.e. rambling). All questions used in this survey were closed-ended questions shown as ordinal variables, (also called ordinal scales, thermometer scales, Likert scales or rating scales), which are mostly used to ascertain opinions or attitudes.

The scales used for this type of ordinal variable are subjective and it is the researcher who defines the boundaries and characteristics. Ordinal variables are useful in stating the intensity of a person's agreement or disagreement on a subject (Weisberg, Krosnick et al. 1996). The main advantage of this scale is that it has a zero value in the middle and negative and positive values on either side, thereby giving the respondents the chance to be absolutely neutral on an item and simply have no opinion, or to judge positively or negatively on the subject. The most frequent number used by respondents in such a scale is 5, although 7-9 is also common. However, it is not ideal to have too many variables, as people may have problems identifying the variables and refuse to answer the question (Bailey 1994).

All questions were based on a five-point Likert scale. The answer options used in the survey questionnaire were as follow:

/ Strongly disagree / Slightly disagree/ Neutral / Slightly agree / Strongly agree /

Vertical alignment of closed questions is considered easier and it reduces the chances of confusion between answers, although this problem can easily be solved through proper spacing in a horizontal alignment of the scale. The scale used for this (Likert scale) has the advantage of being pre-coded, making the analysis of the data easier.

- Strongly disagree= -2
- Slightly disagree= -1
- Neutral = 0
- Slightly agree= 1
- Strongly agree= 2

This questionnaire was given to students and teachers of Architecture in the Schools of Architecture included in the study through an E-mail link to an on-line questionnaire previously created and uploaded to the World Wide Web (See Appendix C, Web-based questionnaire). A comparison of the responses of students and teachers at these schools could be made at the end of the research.

The Schools were selected on the basis of members of staff who replied to the invitation for an interview and where an interview date was possible. The Schools of Architecture included in this study are: The Architectural Association, De Montfort University, The University of Dundee, the University of Edinburgh, The University of Liverpool, Mackintosh School of Art, Manchester University, Nottingham University, Sheffield University, Sheffield Hallam University and Strathclyde University.

Considerations of bias

The schools were selected on the basis of the teachers who replied to the invitation for an interview. Therefore, there could be a bias in the sense that teachers interviewed were especially interested in Environmental Design and Sustainability, or were involved in teaching methods. Nevertheless, there were a variety of teachers from different backgrounds – Architecture, Engineering, Mathematics – who were teaching similar subjects and have experience of similar teaching situations. In addition there is the bias of the sample of universities. Are all the universities represented in the sample: old and new universities, conservative and radical, technology oriented or design oriented? It is the author's belief that there is a selection of different types of School of Architecture in the sample, although it was opportunistically selected.

5.3.4 Comparison

After the collection and analysis of interview transcripts and questionnaire responses, the data were classified in the following categories for the analysis of teachers' responses:

- Definition
- Calculations
- Teaching progression
- Teacher strategies
- Tutoring
- Tutors and lecturers
- Students' learning style
- Assessment
- Integration

And in the following categories for the analysis of students' responses:

- Definition
- Motivation
- Assessment
- Teaching Strategy
- Tutoring
- Learning
- Integration

The researcher had to decide which of the issues of the interviews or qualitative data were better represented or studied through qualitative methods, and which were comparable as they refer to the same set of results. The issues selected relate mainly with methods of teaching, attitudes, preferences and integration of Environmental Design and Sustainability into the Design project.

The comparison of data could be biased as the results to be compared were selected and not all the data were used. Nevertheless, the intention of the comparison was to corroborate the main results obtained from interviews with teachers and students of Architecture. The questions that were not analysed could be used for further research in the area. This type of comparison between teachers and students' opinions has not been done before and the strategies used were the best available for the researcher at the time of the study.

5.4 Limitations

The main limitation on the research was financial. The Schools of Architecture whose tutors and lecturers agreed to the interview were visited. However, it was not possible to visit Schools of Architecture more than once, so a follow-up interview was not possible, especially with students. Travelling and research costs were financed partly by the researcher, and partly by the department; nevertheless the funds were limited and the budget for telephone calls, printing and travelling expenses had to be carefully monitored.

The number of questionnaires already circulating in the academic environment was also an important limitation, as respondents are usually reluctant to fill them in when they may have had other recent similar requests. Nevertheless, the questionnaires were sent to the same group of teachers and students that participated in the interviews. Finally, the fact that part of the distribution of the questionnaire's web address had to be done in some Schools through secretarial and academic staff limited the number of people receiving the invitation.

The fact that Internet access might be more difficult in some universities than in others could have biased the sample. Only students from 5 of the 10 universities have open Internet access from their universities and one university was given printed copies to fill in. Also, the results of the e-mail questionnaire could be biased because the questions were anonymous and there was no control over the respondents' academic level, so the sample could include a variety of students from different levels or students from the same year.

Also as Weisberg says:

> "The people that volunteer for questionnaires and interviews may not be typical. Volunteers generally are more interested in the topic of the study than are other people, so this could be not representative of the larger population" (Weisberg et al. 1996).

Despite the limitations, the researcher concluded that this study contains useful information about the Schools of Architecture studied, their students and other UK Schools interested in the integration of Sustainability into Architecture and Design. This study will also be useful as a basis for further investigation on this topic by other researchers.

5.5 Summary

The methods selected in this research and the ways they were used to obtain data were explained in this chapter. An exploratory or preliminary research was carried out and set the basis for a more descriptive research where qualitative and quantitative research methods were used: interviews, focus groups, discussions, observation, questionnaires and experiments.

In the following chapter, the author will summarise the results obtained from this data collection and the ways the data were classified for analysis. Teachers and students' interview results will be tabulated and explained through common phrases and examples (qualitative data in the following chapter). Results from the online questionnaire will be explained through graphs (quantitative data in Chapter 7).

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Chapter 6. Qualitative Findings

Chapter 6

6 Findings and Analysis of Qualitative Data

In this chapter the data drawn from interviews will be explained. The data obtained through interviews will be analysed as grounded theory and the quantitative data obtained from e-mail questionnaires will be analysed statistically using the SPSS program in the following chapter.

The amount of data collected during the research was ample, consequently so was the time spent collecting, transcribing and analysing this type of data. Teachers' and students' examples are extensive, in order to reflect the range of opinions and the length of the study.

6.1 Qualitative Findings:

6.1.1 Grounded theory analysis

Usually the qualitative data deriving from an interview produces a large amount of unstructured text. Interview transcripts and qualitative data in general are not easy to analyse, as it is difficult to find any analytical path through it. Nevertheless, there are some well-known routes for the analysis of this type of data: analytic induction and grounded theory.

Analytic induction refers to the approach where the researcher seeks universal explanations of phenomena by collection of data until no cases are found that are inconsistent with the hypothetical explanation of a phenomenon. Grounded theory, by contrast, is a theory that is derived from the data, systematically gathered and analysed through the research process (Bryman, 2001).

The basic process of grounded theory is to break data into its component parts, both during the process of collecting the data and while analysing it. The data are separated into categories defined as the data emerges and which reflects the researcher's interpretation of the data. These categories are parts of the transcripts or field notes that are of potential theoretical significance and/or that appear to be particularly relevant in the context being studied (Bryman, 2001).

However, grounded theory has several limitations: (1) the fact that knowledge of other theories and literature can make the observations less neutral; (2) the long time required to transcribe interview tapes; (3) the fact that grounded theory is sometimes more a rigorous approach to the generation of concepts and explanation of something other than a theory; (4) sometimes the data loses its narrative flow as it is categorised. Despite these limitations, grounded theory is largely used and it is considered one of the best methods of analysing qualitative data derived from interviews and observation.

6.1.2 Interviews of Lecturers

The categories that follow in the next sections, are derived from the issues and questions outlined below (also in section 5.2.1 in the previous chapter):

Teaching strategy

- o Do you invite environmental experts to the class? If so, does this create a problem by reducing freedom and autonomy in the class?
- o Do you think about these issues but don't do any specific work on them because they are time-consuming and require longer preparation?
- o How is the course structured?
- o How do you usually teach these subjects?

Motivation

- o How motivated are you towards environmental issues?
- o How important do you think these issues are?
- o How aware are you of these issues?
- o How concerned are you about environmental change, the effects of pollution on the environment, energy expenditure, conservation and re-use, and recycling?
- o Do you consider these issues when you are confronting a design problem, giving an exercise, or making corrections to students' work?

Students learning

- o Do you think students enjoy their environmental classes?
- o What is the feedback from the groups?
- o Are your students more aware, more interested and more motivated to implement what they learn in Design projects?

Integration

- Have you discouraged your students from considering a green solution?
- Are you a practitioner and do you apply these issues in your offices?

Teachers' preparation

- Do you feel prepared to cope with a problem that needs environmental solutions in class? Or do you feel you need more knowledge on the subject?
- Do you think that environmental design will take more time?
- Do you need to be more prepared to deal with these issues?

Most of the categories are interlinked, and the quotations used in one section could be part of many other sections. It is the intention to maintain some continuity in the text; therefore, some issues might be repeatedly mentioned in several sections.

There are also more quotations from teachers than those from students in the following sections; this is due to a bigger variety of opinions and not to the number of teachers interviewed.

In these sections, Environmental Design is sometimes cited as Ecology or Bioclimatic Architecture. As previously explained in this study, all these definitions are considered the same despite some having slight differences in their philosophical background.

It is assumed that all teachers of Environment courses are motivated to teach these issues.

6.1.2.1 Definition

It is very difficult to obtain a single definition of Environmental Design from teachers in Schools of Architecture. Some teachers think it is a way of thinking at a philosophical level, some that it is part of the Environmental Sciences, others that it is Architecture.

> "[It is] Bioclimatic Architecture; because it has to do with climate and nature."

> "Watching how nature works and replicating it the way human beings work."

> "[It is] Ecological Design [where human beings are central], instead of being Sustainable design or Environmental design."

"Sustainability is not only about high-tech, it's about how people use technology."

"We call it Bioclimatic Architecture, but it is essentially passive environmental control of buildings."

"[Environmental Design is] trying to provide in the design process what is recycling, green issues, energy, provision; or to increase the awareness of Sustainability."

"I practically believe that Architecture is Environmental Design. So the problem is all architecture – structure, and daylighting.... You shouldn't call it 'Architecture Environmental Design' but 'Architecture'."

In order to call Environmental Design 'Architecture' there should be a consensus in the definition of Architecture and Environmental Design. Nevertheless, the author agrees with some of the lecturers and tutors in thinking that Environmental Design is Architecture, as many other areas are also Architecture, such as theory, history, structures, construction and expression. However, it will be confusing to generalise as many lecturers and tutors do not agree with this view.

The variety of ideas from teachers is greater than the ones from students, and this can be explained because some of the ideas behind teachers' definitions are based on philosophical thoughts. Some of the teachers interviewed think Environmental Design and Sustainability are a way of thinking. Nevertheless, some teachers think that often this way of interpreting life is being imposed by its followers.

"In general [Environmental Design] has a cult almost requiring a conversion to a way of thinking. Sustainability is like a belief – it is already presuming we are in need of sustainable environments. Whereas Environmental Science has other connotations – mathematical studies, aspects of architecture with the environment, you don't need to think we are in any crisis or that issues of responsibility have to come in to it. Sustainability has connotations of being holistic – all these aspects of design: ecological design, responsible design, society..."

Although Sustainability might have been enforced in some areas, some teachers agree with the philosophies it implies. Moreover, some see this philosophical grounding as an evolution of the subject into a deeper understanding of Architecture.

"Environmental Design as I see it is maturing to the point where it is as sophisticated both in a philosophical and technological sense as are the traditional areas of architecture – History, theory – and it is not accepted yet, just in a few big cities' universities."

"The units are quite philosophically oriented, they are all detail oriented, so it's a combination of abstract thinking and technology which is quite unusual."

Defined as thoughts and ways of interpreting reality, Environmental Design and Sustainability could have a long-term effect in architecture and in people's lives. Some teachers think the impact of Sustainable thought is one of the greatest of the 20th century and therefore one not likely to disappear as a fashionable tendency. Whereas other teachers think it, like many other ideas, will be substituted by other ideas in the near future.

"I've taken the view that this is the environmental impact of the 20th century..."

The idea of Sustainability is defined over time. Sometimes the idea of Sustainability might seem a utopia; nevertheless it is the aiming for an ideal condition that is relevant. Time will determine the success of the integration of Sustainable ideas into architecture and society, as it is time that defines Environmental Design and Sustainability.

"A lot of the things to do with Environmental Design happen over time."

"Modelling is not a very true way to see what is happening in a building, it is a snapshot in time and pretends that something happens all the time."

"What we call Bioclimatic Architecture, it is not energy in Architecture, it is not really Sustainable Architecture in the sense that we are more interested in using the environment to create buildings. You cannot derive a building purely from the climate, it has to respond to other things as well."

But the concept of Sustainability is not the only element that determines Environmental Design in Architecture. There are many elements that need to be addressed for a design to respond to the site, the climate, the occupants' and clients' needs.

"We are trying to build something that has fundamental principles; within these principles different solutions are equally valid because the principles of Sustainability Design do not in any way prescribe the architectural solutions."

"I see it's a big core, but that's a natural bias. Because most of the problems you see are certainly global buildings in the built environment. But these are

> social, political, economic and ecological dimensions which extend well beyond my own discipline."

> "Energy efficiency and all that but at the end of the day it's political."

> "Some people criticise some of the solutions saying they have too much technology or too much art and you argue that this [construction] has to be made, people need jobs, isn't that sustainable too? Sustainability does not only involve energy, it involves jobs and other things."

Therefore Sustainability extends outside the mere design and construction of the building to more social, economical, cultural and political aspects.

However timescale and the elements to which Sustainability extends are not the main divisive element among teachers of Architecture. Usually, teachers of Architecture disagree on teaching methods and on the theory-practice balance of environmental teaching. As previously mentioned, some teachers think Environmental Design is part of philosophical thoughts that explain many parts of Architecture. Nonetheless, there are others that think Environmental Design is more a practical, scientifically oriented subject that has to be taught in a scientific manner with scientific principles.

> "I would not describe it [Environmental Design] as theoretical, more like scientific principles rather than the design aspect, where those principles are going to be applied later on. We are trying to get students to understand the basics [first]."

> "This debate about sustainable and not sustainable is not relevant on the basis that Sustainability is based on cycles of nature."

> "Environmental Architecture tends to get a bit more theoretical than any other kind of architecture in general; because it have to have some kind of connection with science, or because of the nature of the topic."

Consequently Environmental Design can be considered theoretical or practical depending on the teacher and his/her teaching strategy.

> "I can't separate participatory design from sustainable design; it is really about having a dialogue with the client."

Of course in many Schools there is an attempt to leave space to all approaches to Environmental Design and Sustainability.

> "We are really high-tech and there are others in the college who believe in less high-tech solutions and we both agree that both things have a place in sustainable architecture. We say there are lots of different ways to do

> sustainable architecture, but we don't really know which ones are sustainable."

In the same way that students like freedom to decide on integration of subjects, teachers like freedom to decide what, why and how to teach Sustainability. And these will be the choices students will have to make – between learning or not learning the subject and creating their own definitions and relevant connections.

Summary of lecturers' view

- **Environmental Design and Sustainability definitions will depend on how teachers perceive the subjects: as philosophical thought, as a way to interpret reality, as equal to Architecture or as technology.**
- **Teachers interviewed think time is relevant in defining Environmental Design and Sustainability.**
- **Teachers think Environmental Design and Sustainability have and will continue to have a big impact on Architecture.**

6.1.2.2 Calculations

One of the biggest misconceptions of Environmental Design and Sustainability is that they are full of numerical calculations, equations and mathematical problems. It is true that some numerical knowledge is needed when specifying equipment, and estimating areas and ratios, but it is not the basics of Environmental Design, as is believed by many students.

> "The idea is of being creative with the environment rather than being limited by calculation."

> "The appeal is that you don't need to know anything about calculations just about being responsible and knowing where your resources are coming from and what they are costing. You don't need to do calculations to know that some buildings and construction are not sustainable."

Many lecturers agreed that calculations are useful at some stages of the design but the ideas are more important. Also, that when Environmental Design is taught wrongly it is plagued with calculations, and that is the teaching strategy that students dislike and that leads them to a poor understanding of the subject.

> "There are presuppositions about what Environmental Design is all about. A lot of people think it is about doing sums and numbers, it is scientific and, in the worst cases when it is poorly taught, it is like that."

However, lecturers and teachers are clear about the apprehension of students of Architecture towards mathematics and numerical knowledge. And many, if not all, have decided to reduce the mathematical side to the minimum possible.

> "Architectural discipline has a problem with numeracy, they are uncomfortable with equations. Anything related to numbers is complicated and scientific."
>
> "If that [Environmental Design] is connected with engineering people they don't want to know about it. If it looks like science, people don't want to know about it. So people won't understand it if it looks like it has anything to do with mathematics."
>
> "...Even with engineering students, some of them didn't understand [calculations], that came as a bit of a shock to me. Now with Architecture students, you don't even try with calculus; the less numeric the better."

It is difficult to understand why this predisposition against mathematics and numbers exist. However, it is a real situation in Schools of Architecture that affects not only Environmental Design and Environmental Sciences courses, but also Construction and Structures among other architectural areas.

To try to tackle this, in almost all Schools of Architecture calculations are postponed until the second and sometimes the third year when students have already learnt the basic principles of Environmental Design and are comfortable with the ideas.

> "You don't need a calculation in the first years, you are trying to connect with various things that impinge on architectural design."

Summary of lecturers' views

- **All teachers of Architecture agree that there is a suitable progression for students to learn calculations and other numerical topics.**
- **Teachers interviewed think the ideas and principles of Environmental Design and Sustainability are more important than calculations.**

6.1.2.3 Teaching progression

> "You can't run before you can walk and to get people walking you have to give them the tools to learn how to walk."
>
> "The good thing is that everything is sequential, everything is one step to reach the other step."

In all Schools visited, the curriculum is structured in a way that students in their first years learn about the basics and principles of things, start being in contact with design and drawing and the least numerical knowledge possible. Usually, during the first two years students receive lectures in Sustainability and environmental principles, with the hope that students will integrate these issues in their designs during the last year of the degree or at diploma level.

> "Obviously, in the beginning we have to lecture them on the basis of issues of environmental issues and strategies and later we get to cover optimistic construction, eco-house, passive solar, daylight, ventilation, micro climate: the global issues. And we feed them projects so they can feed that in, so the projects they have to do involve some calculation design. I think first and second years need to see the relation of what you teach them and what they have to use in the projects. This integration I think comes at 4,5 years."

It is not only the level of difficulty that increases over the years, but also the course over one academic year is structured in a way that students can learn the development from simple to complex, from individual issues to an integrated response.

> "We start in the first year looking at amazing scientific concepts. We are moving through the three years of the BA course gradually from basic science to design."

Moreover, according to some lecturers, students learn more easily if they understand the scale they are working with. They start teaching the personal surroundings around students, private architecture and the issues around it, and then slowly move to public, and after this, global architectural issues.

> "Putting the person at the centre of design I think is a good exercise architecturally, but it is also logical environmentally, because you talk to them of environmental issues. I mean, there are the global warming issues but there is also a personal environment of the human being, the comfort of the person."

<u>**Section Summary**</u>

- **Teachers think they must adapt to students' learning requirements and preferences.**

- **Teachers interviewed think teaching students in a way they can follow the natural progression of design and other processes works well for students of Architecture.**

6.1.2.4 Teaching strategy

"Our job is not to teach it is to motivate."

There are many strategies for teaching Environmental Design in Architecture: some emphasise integration; others see it as a separate subject. There are also many different ways of delivering the subject.

One special issue in teaching Environmental Design and any other area of Architecture is the fact that students come with their own ideas from previous education. Students in the first years prefer to be directed as they were at school. Obviously, students have experienced a variety of teaching experiences and lecturers and tutors of Architecture have to deal with this variable background as well as they can.

> "We might be in conflict with conventional ways, because we have no time to correct previous teaching mistakes, but only to work with them."

There is no good and bad teaching method, but only the method that works at a particular moment. Nevertheless, each teacher has adopted particular strategies, sometimes not because they believe it is the best way to teach a subject but because it is the feasible way at present in the School.

> "This is all delivered in a lecture, mainly because of the time constraints and the amount [number] of students, which has increased with the years."

> "Lectures are efficient because it's a lot of people in a short time, but it is only efficient if we are trying to encourage students to learn and that may not be the case. There might be better ways: seminars focused on the work students are doing as examples."

Usually the number of students has determined the way many subjects are taught today. This is especially the case in Construction, Design and other practical learning where part of the teaching time used to be spent on field trips, and now they have been reduced due to cost and the number of students. However, this has been partially solved through case studies, which invoke part of the contact with the real site or building.

"We tried to draw out the basic principles; we did this by case studies and did a couple of good local visits."

Despite this, not all Schools seem to consider student numbers detrimental to teaching strategies. They considered that Environmental Design and Sustainability are best taught in the studio, as part of the design, and as an individual learning.

"We have Studio, which I think is different from what others do. But I think it is the best way. The members of staff and the students are working together. It is not an oppositional system, but a cohesive system. We try to have a meeting of minds in the studio."

"This is all studio based, there are also lecture programmes in Environmental Design and Environmental Theory. There are about 10 Environmental lectures in the 1st year and the other 10 on Precedent Studies; seeing how someone else solved the problem."

"We're trying to teach through projects, taking advantage of the site. So we use the projects as a vehicle for teaching."

In the studio, the idea is to integrate Sustainability in the design process from the beginning, at planning stages. Students have the opportunity to meet with many teachers, not only Design tutors but also with lecturers in many subjects, such as Structures, Construction, Environment, Services and History.

"The ethos of this school is that everybody knows something about everything, and therefore you don't teach in a little narrow vacuum, you obviously make the connection between windows and daylighting and thermal properties and solar gain and overheating, and environment."

The idea of using the design as a vehicle to learn Sustainability is to make it relevant to students and as a result help them learn about it. Students of Architecture mainly learn through design and understand the importance of design as a defining element of their career. Therefore they see more relevance when something is included in the design project.

"You can either do it as an abstract topic which will be very dry, uninspiring and so on...or you can make it, you can relate it to something which students can actually understand. And using the project or the brief is one of the ways students can see the relevance of what you are trying to deliver."

"We get together and plan the delivery and use projects or at least try to use projects as the vehicle to deliver the material."

Nevertheless, the majority of the teachers agree design on its own is not enough to make students aware of environmental issues. Therefore, lectures are a good way to complement the design process, synchronising the practical learning with some theory and principles. However, this relationship between theory and practice is symbiotic; it is not only the lectures that support the studio, but also the studio that supports the lectures.

> "An environmentally based studio project is good, but it needs to be backed up by a certain amount of specialist briefings."

> "We are focusing their attention on the studio because they have to reflect on it. That has been successful. What is being done in the studio should be used explicitly to reinforce some of the fundamental teaching we are doing in the lectures."

> "The main thing is having consultation – theory teachers working as consultants to the studio."

It would be ideal if all teachers agreed with the methods, but not all agree with teaching environmental issues and Sustainability as part of the studio project; exclusively or supported by lectures. Some lecturers think more rigour is necessary to learn these issues than the freedom promoted in the studio and therefore students need this strict learning to understand the scientific principles behind Environmental Design.

> "But you couldn't teach all the things they need for the studio. You can't teach this in the studio, this needs some rigour. Now, we can't keep pace with what is happening in the studio."

Even so, this view is held only by a minority of the teachers and a mixture of methods is considered ideal for learning and integrating environmental issues as a fundamental part of Architecture.

Lectures are not the only way of teaching the theoretical side of Environment and support the studio. Many teachers use a combination of strategies: workshops, seminars, case studies, field trips, discussion groups and assignments.

> "Environmental teaching is mostly taught by seminars and small group teaching. We try to have the Environmental Design lecturing staff who are not based in the studio, but who are involved in a specific project in the undergraduate course, so they are part of the reviews."

"There are many ways to teach. You should have time to co-ordinate more, so lectures and tutorials are in context. We give themes... and have workshops with the lecturers. I do think there is a case for looking at case studies."

"The other one we've done with some success is the technical study, one technical study is Structure or combined with Environmental Science."

The main idea is to vary and not to repeat the same method all year round. This is advantageous in many ways, but especially because not all students learn in the same way and varying the teaching strategy helps to balance the inequalities of learning abilities and preferred methods.

"I don't have any fixed method – whatever gets the message across. But usually I use computer presentations in all my lectures."

"A combination of teaching methods is best – discussion groups, tutorials, studio review, lectures... As teachers, we have to be opportunistic as well."

Some teachers may argue that separating Studio and lectures is one of the reasons for the disconnection of environmental issues from the design in the long term. Others that students are mature enough to understand the importance of environmental issues and make their own links between different architectural areas and the design project.

"The other way to do it is to deal with issues as separate issues, then let the student make the connections."

In general teachers agree that students in higher education should have a commitment to learn, and having this commitment will make a big difference in students' interest and learning of a subject. Teachers have come across many ways to motivate students and make them feel involved in what they are designing through experience.

"I think there should be less content in lecturers and more encouragement for application; to actually do something. If you do something, that's the way you know."

"We made learning an experience by making students find out."

In some of the Schools visited, students are encouraged to participate in Design competitions, not only internal competitions but at regional, national and international level. Student competitions are a very useful teaching tool. Students can engage in projects outside their School and show their classmates and staff how sustainable projects are considered of high quality in other places. Also, that sustainable design does not necessarily mean it is not aesthetically appealing. Moreover, if sustainable projects win competitions, the work would be exposed in the Schools and others would see them as part of the Schools' discourse, which is an important part of architectural knowledge.

Travelling is another way students will feel more involved in a project as they experience the environment to be studied with their senses.

> "We are trying to get away from that technical information to more of what the material can do architecturally, approaching more from the senses side of it, which materials are more appropriate in a certain situation; and it involves research, particularly design research. Each study trip links between specialist subjects and teachers with what is happening in the studio. The actual travel is very important [as an educational tool]."

> "We are trying to get them to reflect on their design work through design reports. Field trips are incredibly important, you have to get students into buildings. You can tell them about something but when they see it, feel it, smell it, they will understand it; it has to be phenomenological, experiential."

The main benefit of experimenting and with experiencing real projects and competitions, or dealing with real situations and clients, is the creation of motivation and relevance. Moreover, students learn how to deal with people, stop using jargon and listen to others whose priorities might be completely different from the architect's.

> "I think the first things we ask students to do is to listen to people. Try to get on board what those people are saying. That's one of the fundamentals."

The other advantage is small numbers. Having a real project, students can be divided into groups to deal with several problems which will feed in to the final project. In this way students can experience collaboration in the company of other groups with different ideas and agendas, but understanding that they all have the same aim and working towards that.

> "Having a small group of students means that you are able to work at different levels and aspects of sustainability."

Many teachers agree on the inclusion of environmental aspects in the design and believe experience is an excellent way of learning. Nevertheless, teachers do not know how this learning will be reflected in the future of architects' design and some years will have to pass before the effects of the teaching strategies followed today can be seen. Many teachers believe in experimenting with new techniques and teaching approaches, which not only created variety in the class, but also increases the chances of raising awareness in students.

> "We don't know the answers to Sustainability, so we might start with an outrageous idea; because the idea of continuing with the same path is not going to solve things."

> "Architectural Education should be taught differently in each School. There are 37 schools, why should we all do it the same way? Lets help each other [complement each other]."

Prescribing a method to be followed in all Schools is not the answer to the teaching of Sustainability and Environmental Design. I believe students and teachers appreciate variety and therefore the public might appreciate a variety of architects with different skills and ideas. Students should nevertheless have a grasp of the principles of Environmental Design and an awareness of environmental conditions of surroundings and their occupants.

Section Summary

- **According to teachers interviewed there is no single preferred teaching method for Environmental Design and Sustainability but a variety of methods.**
- **Also teachers think students enjoy practical experience; and that**
- **The studio Design project is the best approach to learning Environmental Design and Sustainability.**

6.1.2.4.1 Tutoring

The increasing number of students in Schools of Architecture is not only affecting the teaching method but the contact time between lecturers/tutors and students. This affects students' learning, as there is less time to deal with individual problems and learning difficulties, and also because teachers have no time to dedicate to other subjects' joint projects, or to participate in the studio/lectures.

> "We don't have enough staff at the moment. I certainly know that the less contact with students at early stages, the worse learning experience they got. Not only will it become more difficult for them to achieve the learning outcomes, but it will also affect they way they handle the course and the

way they progress in the course as they will be getting less guidance at an early stage."

"Some schools have very big groups: 50 or 60. I have 15 minutes for each student, very pressured and very exhausting. The difference is when it's a smaller number of students, [therefore more time to spend on each student during reviews and tutorials]."

Schools of Architecture resort to part-time staff, not only to increase the contact between Schools of Architecture and professional practice, but also to augment the student-teacher ratio. Part-time teachers provide a great amount of experience to the Design studio; however, they also present a problem. Part-time teachers are not always aware of the objectives of the course, as they have no extra time to co-ordinate teaching strategies with other tutors and lecturers. Consequently, sometimes full-time teachers think part-time teachers present a conflicting view of the objectives of the course.

"Studio depends on part-time staff. They are willing to commit to come, but it's difficult to keep them on message. We don't have enough direct contact to be able to share with them what our teaching objectives are".

"In general the studio teams aren't engaged with these issues, you're engaged but not completely. There are full-time and part-time staff and not everybody has been on message when it comes to sustainable issues. There are tensions."

Nevertheless, the benefits of part-time teaching outweigh the problems they might bring to courses. Moreover, many teachers agree that having less contact time with students is more a problem of politics. Besides teaching activities teachers have to do administrative work for the Schools, do research projects and join in many committees. Not all teachers enjoy these extra activities, but an equal problem is being overloaded with tasks, which reduces the time they can dedicate to students and their learning.

"The big problem is there are too few of us. We have many academic committees, but the more time you expend in committees, the less quality time you can expend with students."

Another issue with tutoring is that students have less time to dedicate to their education. This was more evident in the Scottish universities visited, where a higher number of students complained about expenses and lack of time. A large number of the students interviewed have to work to support themselves, therefore it is not only a problem of teachers having no time for students, but also of students being unable to dedicate as much time as they wish to tutorials and their education.

> "Students need to survive financially, so they have less contact [they have to work to survive]."

> "Students are learning many things, especially in presentation, animations, but the length of course is the same as 10 years ago. Students now are working part-time. They manage to do it because they cut in some areas where we don't concentrate, and it is not the students promoting this, but the Establishment."

There are many factors which decrease student-teacher contact time and are consequently detrimental to students' learning. The increasing number of students is one of the main ones, together with teachers having less time available to teach and make contact with other lecturers/tutors.

Section Summary

- **Lecturers interviewed think schools have to increase teacher-student contact time and reduce the teacher-student ratio. Reducing teachers' extra-curricular tasks is one way.**
- **The authors conclude there should be a training or introduction of the aims and objectives of the Schools to part-time and other teachers.**

6.1.2.5 Tutors and Lecturers

Although all tutors and lecturers have similar teaching objectives, there are some differences in how importantly tutors and lecturers rate Environmental Design and Sustainability. There is a set of information that students should know which is prescribed in the RIBA guidelines (Section 2.2.2). Therefore, each School has more or less the same curriculum. Nevertheless, the way a teacher understands the subject and interprets ideas is individual. This individuality, apart from enriching the discourse in a School, also causes disagreement and separation between staff in the Schools of Architecture.

> "It is not a question of how much can we do, but how much we all want to do. Other people of the department have different agendas, they want to develop different things, they are not interested in environmental design."

> "I've noticed in other universities that they do very good lectures on Environmental Design, but that's one subject... But the tutors have no

> sympathy for the buildings [apart from the aesthetics of them]... Here we are in the studio and we remind students of these issues."

According to some teachers, the teaching ideal is when all teachers in the School have similar ideas of what to teach and how.

> "All members of staff should be engaging to some extent with the philosophy of the School, and I am afraid we don't. In most multi-teach (sic) teaching, each member has a very pure understanding of the other's disciplines."

Nevertheless, it is common that lecturers and design tutors do not share the same ideas about particular subjects like Sustainability. This in a way could be due to the fact that usually tutors and other lecturers do not have the same educational background. Whereas tutors are mainly architects, the rest of the faculty is frequently from a variety of professional backgrounds other than Architecture.

> "The people who teach Architecture are often, almost always, architects or planners, and they have a different way of thinking. And it is not often that you find people who were both trained in the scientific paradigm and in an architectural sort of paradigm. If you have one or two people like that in the department, you are ok. It is not because most of the other people don't share the same frame of references, it is just very difficult to make the bridge between the two."

> "We talk to each other, but we don't particularly get on. They are quite different [tutors], we have done a lot of research together [but in teaching terms we disagree]."

But it seems that it is not only as a result of different backgrounds that teachers of Architecture do not communicate with each other and share ideas and strategies. Some teachers argue that it is the School's tradition which is affecting this dialogue by promoting traditional schemes (Drawing, History) at the expense of newer topics (Sustainability, Technologies).

> "[Not integrating Environmental Design,] I think [is due to] the self-image of the School. [The image] is of a Design School and I think there is a reluctance on the part of many Design teachers to embrace technology, not only Environmental Sciences, but Building Construction, Structures... [and] they are just part of Design."

> "There is a lot of prejudice against sustainable things in general in Schools of Architecture."

On the other hand, some tutors argue that it is just the fact that environmental issues are part of a more theoretical area. Tutors prefer practical subjects like Design and, probably due to time constraints, have no time to understand and introduce these issues in a practical way, thus they discard them altogether.

> "Design teachers decided to take design as an academic career, it's rare if they tend to be so enthusiastic about environmental matters. What they are not enthusiastic about is that the approach to Environmental Sciences comes through the lectures [as] extreme, so they might take more holistic designs."

> "Designers are trying to fence out and keep separate other aspects of Architecture [like Sustainability and Environmental Design] and keep the formal, [such as] aesthetics, [as the] primary acting discourse."

All teachers agree with having some dialogue to understand others' issues, although previous differences in ideology appear to have created the division between Schools' staff, which was evident in all the Schools visited. A few Schools have managed to deal with the ideological division through cohabiting and compromising. Nevertheless, this has not solved the communication gap or disagreement between ideologies and teaching strategies. Moreover, staff are certain that any consensus reached will change when new staff are introduced to the School, bringing with them new ideas and controversies.

> "If the staff change, the college will be different."

The idea behind university teaching and learning is the universality of thoughts and differences in opinions and ideas on how to teach and how to approach a subject are often what enrich students' learning. Nevertheless, having a dominant group of ideas will marginalise any other kind of discourse and thoughts in the School, potentially making the teaching indoctrinating and not discerning.

> "But if all people, the head of the School, the visiting professor or the RIBA, ...don't take it [Sustainability] seriously, then why should students, no matter what the individual tutor says?"

It is obvious that teachers will not deny the importance of Sustainability. But what teachers say and what they do and apply in their classes are not necessarily the same.

"Everyone is politically correct in terms of Sustainability. No one will say it is good to drive your car and spend lots of petrol or to waste energy, but what they say and what they do are two different things."

Having a variety of discourse in Schools of Architecture is beneficial for students' learning and staff integration, as students are exposed to many ideas and ways of interpreting architecture. Having a predominant ideological line in the School will be equally acceptable in terms of a harmonious working environment; nevertheless, students will not benefit much this way. The ideal situation is where there is no unique system, teaching strategy or ideological thought, and where all ideas are treated as equal, leaving students to decide what to learn, who to talk to and how to apply this into their designs.

Section Summary

- **Teachers think there is a communication gap and disagreement on ideologies and teaching methods between lecturers and tutors.**
- **Lecturers believe there should be more motivation for Architecture teachers to understand Environmental Design and Sustainability.**
- **The author concludes teacher training in collaboration skills is needed.**
- **And that the presence of different ideas in Schools enriches Architectural discourse and gives choices to students in how they learn.**

6.1.2.6 About Students Learning

Teachers have a positive impression of students starting Architectural Studies, as the majority of students come with high expectations and motivation to learn.

"We have very highly motivated people, and think it is because they are aware of environmental issues that they decided to study."

"Students come with high expectations and motivation to learn."

Nevertheless, the students seemed to need extra guidance during the first months of their studies. Probably, they need an adaptation period from school.

"They rely heavily on being guided. I don't think necessarily it has anything to do with their abilities, I think it is because they come from either school or college, being taught in a certain way, and they got used to a certain learning process."

Nonetheless, students learn the system very quickly and start demanding the information they find relevant. After the second semester of their studies students can decide what areas are important and relevant for them, and which are not.

> "They [students] have to have a purpose to do something."

Teachers agree that from the first semester, students show a preference towards practical subjects like Design, and prefer this practical teaching strategy to others. Students can do things in the studio instead of being told how to do things or how others have done them.

> "Students have lectures as well, but we are sure it means more if it's integrated in their designs."

> "The key thing is [if] you tell students this is important, they'll forget. If you show them, they have got a reasonable chance of understanding what is happening, but if they do it themselves they will remember."

It seems students have a predisposition against lectures and more theoretical methods. Some teachers think students just come with the idea that lectures will be boring or useless so they do not try to pay attention to them.

> "I cannot honestly say that there is one single method that students will simply want. Probably from lots of a number of students' point of view, they will skip the lecture and come to the tutorials and the labs, but I presume there are other reasons, they might think that the lecture is useless. For me, all the methods are equally important."

> "It is a struggle for students because they go to the lecture with their minds blank."

However, lecturers try to make classes more interesting for students so they will engage with the subject. However, some lecturers see the problem as not being the lack of exciting examples and ideas, but the lack of real examples in the UK, so students can understand Environmental Design and see it applied. If it is not applied in the locality, probably it is not as important as the lecturers say.

> "You need to engage students in architecture. So what is interesting for students as they engage? I select what I show to students, I wouldn't select something regarded as important design if I didn't think they wouldn't engage with it, if they would find it boring. Some designs are counterproductive. It is opportunistic, some designs are engaging at whatever level [and I use them]."

> "Students are not seeing things happening to be able to engage with them [things happening in the real world, in their nearer context, UK, politically or physically]."

Another reason students dedicate extra time to design could be the fact that there is more attention dedicated to the individual student during tutorials than in the lectures, which are more impersonal. Although a relatively short time is dedicated to each student during tutorials, they can ask questions about design and also other subjects.

> "In tutorials there are opportunities for students to have a one-to-one consultation with the tutor. They also have some material to go through on their own, but if they have questions even outside that material [they can come and ask us]. And issues which come out of the lecture, or as part of the project they can ask about."

But all methods should be important in students' education. The fact that students tend to spend more time designing in the studio than researching or working for projects or other subjects outside Design is not directly promoted by the Design tutors. It seems students prioritise their subjects, with design being the first. The fact that Design is more complicated and demands more elements each time could be the reason for the neglect of other subjects like Environmental Design, Sustainability and others taught in lectures.

> "Students don't find some of the things particularly interesting in lectures and they don't do enough work on them. Studio represents at least 50% of the whole of their year's work and they expend 78% or 90% of their time in the studio."

Moreover, students are generally offered the chance of working in pairs or groups to reduce the workload, but the majority refuse this option.

> "They have the choice of working as groups or as individuals. They have the chance to visit the site, arrange meetings with architects, to understand the climate."

The fact that group work and peer interaction is reduced during the design is regrettable, as a great part of students' learning comes from classmates and other students in related courses such as Landscape, Urban Planning, Product Design, Engineering and Surveying.

> "Students learn as much, if not more, from one another than from staff. It's a kind of self-learning."

"The other interaction is in projects with surveying and engineering students. It's very interesting to mix Architecture students with people that don't think like them."

There are also many opportunities for students to integrate environmental issues in the design; nevertheless they are not willing to apply them. Sometimes, because they have already designed something and either they or the Design tutors do not agree with changes; or because it implies a holistic approach from the beginning of the project and they are not ready for the change in design strategy and extra work.

"Students came to see me asking what they needed to do to pass Services, and I said: 'This is useless, it is stupid to service this building, it doesn't make any sense environmentally!' [Of course the tutors disagree with my opinions and the consequent bad mark to students.] You can't add stuff at the end. It's got to start right from the first idea until the end."

"Students develop a mastery of a particular design approach and then try to impose that. It is self-referential, and it doesn't matter where the buildings are. A lot of the Ecological Design courses are still not grasping the big issues of culture and place as underpinning the technology."

Students seem just to dedicate a few minutes at the end of the project to accomplish the requirements to pass, rather than making a thorough study of environmental issues, structures, services, etc...

"When you look at all the effort put in for all those six credits, for taught lectures, this is 24 hours before the reviews; so it's very difficult to show the external examiners that the students are interested in other things but Studio."

Teachers of Environmental Design are somehow disappointed because it is during the study years when students will have the chance to experiment and play with all the issues involved in architecture. After graduation, many students will find a working reality where few will have the chance to design anything but a particular type of building within a restricted budget.

"Sustainability desperately needs more experimentation and the best place to do it without damaging the environment is college. It's the best place to practice."

The majority of students know what Sustainability is and how to design environmentally friendly buildings, nevertheless they seem not to have the time or the interest to apply this knowledge.

> "Students are aware of this area. But they don't think about how much energy or carbon dioxide..."

However, there are a few students who really learn these issues and apply them in their designs. Usually this happens in Schools of Architecture which promote more student control over the design solutions and offer students choices to learn and practise what they think more important.

> "It's good because students are responsible for their own learning contract."

Students' approach to learning has a lot to do with the teaching strategy and the priorities students have set for their studies. Nevertheless, the way they learn also has a lot to do with the level at which they are studying and which learning style they find easier to understand.

6.1.2.6.1 Learning Style

There are many ways Architectural students prefer to learn. As previously mentioned, they have a preference for experiential and practical subjects, where they can do things. Teachers agree that students feel more motivated when they have a real challenge and extra responsibility to deal with.

> "Students are very motivated because they know they will spend lot of time working with the community, unpredictable time, and debatable things."

The experiences students had in the past will help them solve new problems and learn new things. This can be beneficial or not, as students can repeat the same project over and over again, but some will use the previous experiences to learn from their mistakes and help them solve things in a different way.

> "Students try to associate immediately with something they have done before which looks the same."

Also many students, especially in the last year of their studies, prefer to have less guidance from teachers and find information for themselves. They appreciate it when the course is self-directed.

> "Half of the course is self-directed learning, they find information for themselves and then use it."

At the end of their studies students value independence in what they do and this is part of their maturing process. Teachers have seen them start applying all the information learned in theory classes in their projects more frequently than students in the first years. Sometimes this application is teacher-induced, but it also appears to be as students' own initiatives.

> "Students in the last years may use other techniques of exploring the application of the theory into the design, so they can take a section of the building and reveal [part of the building] in terms of Sustainability and Environmental Design."

Architecture students are not only experiential and independent learners but also visual learners. Students tend to like it when the visual impact during a class is high.

> "The ideas and information of architecture are transmitted through visual images. A lot of stuff to do with Environmental Design is not intuitive and it is difficult to visualise."

During Studio design, most of the communication is through images and in many lectures there are lots of slides and projections to illustrate information. Nevertheless, there could be some problems in terms of students' learning: one is when the information is not easy to transpose into an image; the other when there is an overload of images, which can have a similar effect to no images at all or a low visual impact.

Section Summary

- **Teachers interviewed think students prefer to learn through design, as it is more practical and visual.**
- **Also teachers think there is a predisposition against lectures and theoretical methods.**
- **Teachers think students have more satisfactory results when they are in control of their learning contract.**
- **The author thinks there is a lack of multidisciplinary group work that develops students' interpersonal skills.**

6.1.2.7 Assessment

Many lecturers in Environmental Design complain about the assessment double standards: student design seem to have more value and weight over other subjects like Sustainability. Probably, when projects are set, part of the brief has to reflect different areas like Construction, Structures, Services, Functionality and Sustainability. However, the double standard refers to accepting a project which is completely inadequate in sustainable terms or in structural terms, because it complies with the other requirements.

> "People will say it is sensible to do sustainable studies, but people will still get a good mark in a project that uses reinforced concrete, which is difficult to insulate and might be the total antithesis of sustainability, but it is still considered as good piece of design."

Of course, the opposite case would be setting false assessment values; for example, assessing projects as a 'pass' just because they have some environmental features when they have other faults. However it seems that this is not a problem in Schools of Architecture – students with significant design faults in their projects can fail easily or have a bad mark even if the environmental issues and impacts are assessed as perfect.

> "The review team is tutors or three members of staff or an outside person. We can't predict that a very good environmental solution has problems in other ways. Some of these issues get lost in the noise."

The problem is that good environmental solutions can get lost because of poor integration of the design components. Also, Environmental Design can get the label of usually being of poor quality and getting students bad marks.

Some teachers think the solution is giving the same percentage to all the areas of the brief. However, this raises the question of whether to fail students if they do not fulfil all the areas of the design or how much of the representing grade should be marked down in the case of a major fault in one of the areas.

> "We need an assessment weight in the Studio related to environmental issues, so students will be forced in a way to integrate them. I would have a project and part of the percentage is in Environmental Design. Which will change if it's Structure or Services. I would have a project with 20% for architectural design, 10% for presentation, 20% for environmental design."

The main problem with the assessment of environmental issues in the design is that there is no clear weight given to these issues in the assessment. As a result, students are not motivated to apply them, as it will not make an apparent difference in their final results and it implies more work.

"Students are very bright to see which bit matters in order to pass and get the degree they are looking for. And those things are not going to give them a first class mark. Then no matter how exciting you make it, how practical or involved you get, it is still a problem to make them take it seriously."

Students know that it is still the visual impact of their projects that will make the difference in their grades and they work towards that. Many teachers are trying to promote other ways of assessing students and get away from the 'aesthetically appealing photo-realistic image' by moving towards a more process-based assessment.

"You are in a course where the thing valued is what's up on the wall."

"Architectural education is very object-focused and is not process-focused or network-focused, and I am very interested in time, the notion of time, time and design, which means process and how buildings change and design changes, which means you are not always focused on the result, the product."

"The projects in the second year were quite exhibiting, but the environmental part was quite dodgy. There were a few token gestures but it was not fundamentally [environmental]."

Nevertheless, it will take a long time before all Schools give the same priorities to other important aspects of design.

Some tutors are also worried about environmental issues and Sustainability being left aside by students, not only because they are not designing in a sustainable way, but also because the external examination is undergrading students' work because of the poor quality of these issues in the design.

"Complex issues and energy efficiency come as secondary, and we end up being criticised by the external examiners."

Section Summary

- **Teachers think assessment has to be progressive with students' knowledge.**
- **They also think the best way for students to meet all aspects of design is to concentrate more on the process, ideas, and holistic design than on the visual impact of the final presentation.**
- **The author thinks the best solution is for a fair assessment of all design aspects to be discussed and agreed with the course co-ordinators before the beginning of the project.**

6.1.2.8 Integration

The problem of integrating Environmental Design into the studio project comes back to some issues discussed in section 6.1.2.4.1. Design tutors and lecturers have problems communicating and agreeing some teaching ground rules and granting the benefit of doubt to other ideas.

> "We have tried [to talk with the science teachers and agreed to work together and have a project focused on environment] in the past, but generally it does not tend to work in this School."

> "It is a problem, I think in Schools of Architecture because these things work best when they are linked somehow in the studio, it's all about application. The challenge is always not only to deliver good theory and teach students what they need to know, but to give them opportunities to apply in the studio context, and all of it requires studio teachers who are also enthusiastic about these issues."

Despite this, teachers are trying to integrate Environmental Design and Sustainability into the design, trying to make students and other teachers understand that they are also a part of architecture.

> "I think it is a design project, presented as that, and not separated, as something else. It is always welcomed by students. You have this design with all these problems. It is not Environmental Science it is Design."

> "A good deal of success during the years is down to the fact that we are trying to link the studio process with other subjects."

> "We have a philosophy of Environmental Design and we try to include that in students' projects. Apart from the Environmental Design teaching in lectures, we reinforce it in the Design studio. That's where students pay more attention to these issues. If it is seen as a fundamental part of design then it's more likely they'll pick up on it."

Moreover, there are other ways of integration. In some schools there is a tacit agreement to give students all the information and let them link design aspects and theories themselves.

> "There are two different ways to think about architectural Design: lecture and design; lecture projects with their own assignments and energy calculations, they teach all that as a [separate] category [to] leave to students to make the links."

Obviously, all members of staff try to be in contact with what others are doing in their own subjects, this is not only in order to know what is happening in the rest of the courses but to complement and support teaching.

> "We are trying to integrate teaching, we are looking at Construction and how they teach Environmental Design."
>
> "In any particular lecture they make reference to other disciplines, we are trying not to compartmentalise."

Integration can be very successful when a balance between theories and how they are applied is achieved. Students of Architecture, in principle do not enjoy theories. However, when the theories are introduced in a practical, applicable way, they seem to accept the knowledge and learn.

> "So it could get very frustrating as architects are not used to this scientific approach to the projects. But the thing is that you can combine it in a very intelligent way, theory and practice, without the students being too bored of theory, not arbitrating in terms of design and having nothing to do with theory. The whole point is try to balance theory and practice."

Sometimes, lecturers have combined teaching with engineers and architects, so all aspects of Environmental Design and Design are explored and explained by both sets of professionals during the lectures. This method attempts to prove that issues of engineering are relevant to architects in the same way that architectural issues are relevant to engineers and helps to reduce the distinctions between technological aspects and architectural aspects.

> "Next year we are going to change some of the visits, or combine some of the examples; it changes each year. The course is unusual in the School as it is delivered simultaneously by two people, one talking about architecture and the other about engineering and vice versa. That way students get the idea that Environmental Science and Architecture are actually the same thing."

On the other hand, when the lectures are not combining aspects during the class but depend on the design projects to put into practice the theoretical learning, it is very important that lecturers and tutors agree on objectives and aims from those projects. It is not uncommon that, by the middle of the semester, some tutors have forgotten the objectives or have changed them, either opportunistically looking for a better project or visit, or for many other good reasons. Even so, this can clash with what other teachers are doing, especially lecturers who could be counting on this design support.

> "Sometimes tutors lose sight of the objectives of the year's work and the thing is downgraded or they've forgotten about it."

Environmental Design and Design are separated in the way they are referred to as different things. When a nominal division happens, the integration in the design process is more difficult and it seems to work better when Environmental Design is taught outside the studio and the design decision is left to the students. Nonetheless, many teachers support the idea of integration: when there is no difference between what is Environmental Design and what is Design.

However, some teachers have expressed their apprehension about integrating environmental issues in the design as this would introduce too many issues for students to grasp.

> "I don't think it has been very successful, the studio programme is very complex and students don't get enough time to see other issues. They spend all the time solving programmatic problems; they never reach materials and details..."

> "There is a design position and an environmental position as well."

> "[We're trying to make it perfect.] It's never going to be completely satisfactory."

Tutors and lecturers in Design and Environmental Design agree that many of the integration issues are not only the consequence of professional differences, or differences in content or name, but also of political issues in the Schools of Architecture. Sometimes, because Environmental Design appeared after the consolidation of architecture as a university discipline and the organisation of the Schools usually classify Environmental Design issues and Sustainability as 'technology issues', this classification is not helping to see Environmental Design as Design.

> "The problems of Sustainability are not just of integration, or how to define it or teach it. Some of the major problems are political problems, in the Schools, in the institutions like the RIBA and in the government."

> "The problem is the relationship of the programme and studio. There have been some institutionalised problems too. The studio is very demanding and it represents an almost all-the-year demand."

> "It has got a lots of strands in it, which kind of meet together. It has not just got to do with actual teaching and learning, but also with the administration bit, the corporate values of the educational establishment, the interpersonal dynamic of the institution."

Although integration of Environmental Design issues in the design seems a matter of balancing technique and technology, theory and practice, science and philosophy, there are many other aspects which make integration more than a simple compromise of including Environmental Design in the Schools' curricula. Some of these aspects have to do with disagreement among tutors and lecturers, some with time constraints. Others are political and administrative elements deeply embedded in the Schools of Architecture themselves.

Section Summary

- **Some teachers interviewed think time constraints imposed by the curricular structures are not helping integration.**
- **Teachers also think multidisciplinary projects and teaching help to narrow the conceptual gap between the Design project and environmental issues and Sustainability.**
- **Lecturers and Design tutors depend on each other's courses to complement their teaching.**
- **Teachers need to communicate and agree teaching objectives.**

Summary

There are many ways of interpreting Environmental Design and Sustainability, and each teacher in Architecture has his/her own way of defining it; either in philosophical terms or as a more scientific subject. What is important is that all agree that Environmental Design and Sustainability are important in Architecture.

Because there are many definitions, there are also many ways to teach Environmental Design and Sustainability and this is the best situation possible as students learn in different ways and at different speeds. Teachers perceive that students have a preference for more practical and experimental subjects, like Design, over more theoretical subjects, like Sustainability. They believe Design is one of the best ways to make Architecture students learn about environmental issues and Sustainability.

Environmental Design and Sustainability are regularly taught in lectures and students have a predisposition against lectures, as well as against calculations and numerical knowledge. Teachers in Architecture are trying to move away from Mathematics and concentrate on ideas and principles to motivate students to learn, and eventually to teach them some calculations – learning is better if it is done gradually.

Tutors and lecturers need to agree on teaching objectives and strategies, especially assessment. Moreover they need to start communicating and collaborating so as to complement each other's lectures. The best way to integrate Environmental Design and Sustainability is through this communication between staff. Collaboration between faculties with multidisciplinary subjects is also beneficial for student's learning experience.

Overall Summary and Conclusions of the Sections

Based on teachers' interviews, some of the main conclusions are outlined as follows:

1. Environmental Design and Sustainability definitions will depend on how teachers perceive the subjects: as philosophical thought, as a way to interpret reality, as equal to Architecture or as technology.
2. Teachers interviewed think time is relevant in defining Environmental Design and Sustainability.
3. Teachers think Environmental Design and Sustainability have and will continue to have a big impact on Architecture.
4. All teachers of Architecture agree that there is a suitable progression for students to learn calculations and other numerical topics.
5. Teachers interviewed think the ideas and principles of Environmental Design and Sustainability are more important than calculations.
6. Teachers think they must adapt to students' learning requirements and preferences.
7. Teachers interviewed think teaching students in a way they can follow the natural progression of design and other processes works well for students of Architecture.
8. According to teachers interviewed there is no single preferred teaching method for Environmental Design and Sustainability but a variety of methods.
9. Also teachers think students enjoy practical experience; and that

10. The studio Design project is the best approach to learning Environmental Design and Sustainability.
11. Lecturers interviewed think schools have to increase teacher-student contact time and reduce the teacher-student ratio. Reducing teachers' extra-curricular tasks is one way.
12. Teachers think there is a communication gap and disagreement on ideologies and teaching methods between lecturers and tutors.
13. Lecturers believe there should be more motivation for Architecture teachers to understand Environmental Design and Sustainability.
14. Teachers interviewed think students prefer to learn through design, as it is more practical and visual.
15. Also teachers think there is a predisposition against lectures and theoretical methods.
16. Teachers think students have more satisfactory results when they are in control of their learning contract.
17. Teachers think assessment has to be progressive with students' knowledge.
18. They also think the best way for students to meet all aspects of design is to concentrate more on the process, ideas, and holistic design than on the visual impact of the final presentation.
19. Some teachers interviewed think time constraints imposed by the curricular structures are not helping integration.
20. Teachers also think multidisciplinary projects and teaching help to narrow the conceptual gap between the Design project and environmental issues and Sustainability.
21. The author concludes there should be a training or introduction of the aims and objectives of the Schools to part-time teachers.
22. Also that teacher training in collaboration skills is needed.
23. And that the presence of different ideas in Schools enriches Architectural discourse and gives choices to students in how they learn.
24. The author thinks there is a lack of multidisciplinary group work that develops students' interpersonal skills.
25. And that the best solution is for a fair assessment of all design aspects to be discussed and agreed with the course co-ordinators before the beginning of the project.
26. Lecturers and Design tutors depend on each other's courses to complement their teaching.
27. Teachers need to communicate and agree teaching objectives.

6.1.3 Interviews of Students

The categories in the next sections are derived from the issues and questions outlined below (also in section 5.2.2 of the previous chapter), which were concerned with students' perceptions:

Teaching strategy

- Have you been discouraged from considering a green solution at any stage?

Motivation

- How motivated are you towards environmental issues?
- How important do you think these issues are?
- How concerned are you about environmental change, the effects of pollution on the environment, energy expenditure, conservation and re-use, and recycling?
- Do you think about these issues but don't do any work on them, as you just need to pass?
- Would you like to know more about this area and apply it in your designs?
- Do you take any interest in subjects related to environmental design?
- How do you like these subjects?
- What is your opinion of the class and the teacher?
- Are you afraid of or do you dislike the subject?

Students learning

- Do you learn something on these courses?
- How do you usually learn these subjects?
- Do you have some preconceptions about new technologies and the environment?
- How do you prefer these subjects to be taught?

Integration

- Do you think about these issues when confronting a design problem?
- Do you think environmental issues will take more time to apply in the design?
- Do you think you can apply that knowledge in your designs?
- Do you think that this application will be easy?

6.1.3.1 Definition

There is a problem in defining Environmental Design, Sustainability, Ecology and Bioclimatic Architecture among students. Obviously this is a reflection of the name given to the courses in their Schools of Architecture and also how their teachers define the terms. Nevertheless, even after being influenced by their tutors and lecturers, students formed their own ideas around it and interpreted what they had learnt in a personal way.

> "Some [tutors] think it [Environmental Design] is a separate thing from architecture and don't give it much credit, others that it should be part of the process."

> "Here Bioclimatic Design has nothing to do with Ecology" [with Bioclimatic Design very technical and Ecology more human-oriented].

It is interesting to note that only a few of the students considered architecture as something related to the environment and to Sustainability. Moreover, in some Schools of Architecture, it seems students understand Environmental Design as a contamination of the design process.

> "Here we just do pure architecture" [in contrast to Environmental Architecture or Sustainability].

In students' minds, architecture is divided into 'designing architecture', and a 'technical architecture' which includes services, structures, construction and materials, etc. It seems that students perceive the 'technical architecture' is contaminating the 'designing architecture' in the sense that technical issues limit their design decisions, in other words their aesthetic freedom.

> "[The lecturers] are not bothered how [the design] looks. I suppose [Environmental Design] is quite boring. I mean, in the sense of a 'green house', using the rainwater, solar gain and all that, is about as much as you can do in that sort of project."

> "Bioclimatic Architecture restricts you in a way [in the design] but it's good to clear your ideas" [about environmental issues and how technology works].

> "Some people take it to an extreme where it is all ecological" [leaving no space for design].

Nevertheless not all students think Environmental Design considerations are detrimental to the design process. Some Architecture students considered these issues as a normal part of their discipline, and show disapproval if other students design without considering the environment.

> "It is an integrated part of the design. In other schools they design and then you can retrofit to make it environmentally sound, obviously that's completely the wrong way around."

Some students believe these issues have more to do with ideas rather than actions, or at least a very carefully analysed action.

> "A lot of ecology is about ideas, and you can never get to do the whole building in the School. It is concepts; it is more about ideas than the actual realisation of the idea unless you are doing the whole working drawing and the building, but you can't manage to do it during the year."

> "Being aware of the CO_2 doesn't guarantee the success of the projects" [There are more things involved in the design process].

However, those who believe in Sustainability and environmental issues as a part of Architecture Design are in a minority. The majority of the students 'just' know about them, but refer to them differently, and a small group of students interviewed had no idea what Environmental Design is.

> "We have touched on it in lectures about Sustainability."

> "Sustainability? Environmental Design? Yes we've done some of that. Services, isn't it?"

> "I haven't a clue...No... we definitely haven't had anything like that."

Environmental Design and Sustainability are more related to numbers, calculations, equations and tables than to anything else. Sometimes students' liking or disliking of the subject has much to do with their numerical abilities.

> "Well, they don't ask you [about Sustainability], you are expected to know it, but obviously no one gets enough depth. I think we need to do more calculation" [in order to understand].

> "We just want to get ideas, not math. It is intense but it is interesting sometimes."

A group of students, especially from the last year of the degree, have contradictory feelings about Environmental Design and Sustainability. There was no particular emphasis during their first years, but during the last year of their course they were required to be 'sustainable' in their design approaches. The general attitude is to ignore the new sustainable requirements and continue designing, as they were accustomed to doing.

> "RIBA says: all schools must teach Sustainability. Before it was not necessary and now we must study Sustainability! But until now there is nothing that said that we have to be sustainable."

Section Summary

- **Students have an idea of what Sustainability and Environmental Design are, but they are not defined as Architecture.**
- **Students perceive Environmental Design and Sustainability as calculations and equations.**
- **They also think the ideas of Environmental Design and Sustainability are important.**
- **Students' understanding depends on the way they are taught and their reaction to the subject, and consequently their application in the design.**

6.1.3.2 Motivation

Among all the aspects that make students design environmentally or introduce sustainable thoughts in their projects (good grades, time, teachers' attitudes, resources in the School, among others) the main element that will determine if Sustainability is important is if students think it is relevant or not. Students are motivated by various factors; however, they will make a bigger effort if they believe they are taking the right design decisions.

> "It is important, the obvious things like solar shading, orientation, all this is quite a major element. You have to take it seriously!"

Moreover, if the teaching staff think these issues are important, the chances students will be more motivated are higher. Students will not only copy the teachers' ideas but they will have some teaching support to help them understand and learn more. As mentioned in Chapter 2, students who understand a subject make that subject meaningful and therefore worthy of study.

> "The good thing about this university is that we are encouraged to think about environmental issues at the strategic level, before we start designing."

"You have learnt quite a lot and you come out with a very good knowledge and understanding and, in terms of acquiring new knowledge, perhaps we have learnt the most of any unit."

Imitation is important to appreciate Sustainability; it is helpful to motivate students to find out more and learn more about it. That is why visiting lecturers and guest practitioners have a big effect on students' opinion of what is the real world, and what is really important outside the School.

"Even now, every week we have guest lecturers, and often they talk about Sustainability, how green issues are important and stuff like that. Maybe because other people are doing it, it might be important, you are influenced by architects that are actually doing it."

"In the courses there is a big chunk [a big group of people] who recognise Sustainability in architecture. It should be an important area for technology and green issues, everybody works in a group and the teachers are quite good about that. You learn more about it as you become more interested."

However, students have the impression that learning about these issues will not make them more employable at the end of their studies. Therefore students' consideration of pursuing Sustainability further in their final years depends on the demand for expertise in this area in the world of work.

"Some practices are scared of Ecology not for itself but because they think it is detrimental to other aspects."

Nevertheless the big influence comes from schools, and not all the staff and visiting lecturers are motivated and interested in Environmental Design and Sustainability. This is also reflected in students' responses:

"We don't have precedent in environmental strategies, and even the [visiting] experts don't know how well their buildings have performed."

Also, students respond better when they are given a level of freedom to decide to learn and do research on Environment and Sustainability. The role of teachers is to stress the importance of the subject for them, motivate students, and not only in words but also with projects, leaving the final decision about the project to the students. Many students believe they will research and learn more about Environment and Sustainability if they are interested in the subject.

"You do it subconsciously [the application of environmental issues in the design project] to a certain extent, but you don't specially go and think about the building environment. Some people do it if they are interested."

> "It depends on the individual, if you want to do well or not. It's all about you, and the lecturers tell you this: If you want to do it [have an environmental approach to your design] then it's up to you. And there are a majority who do, so we are doing it [in this School]. We have to stay late but the lecturers are always here to help. But it is good, it's good stuff, I am enjoying it."

> "We don't do a great deal of green issues. If you are interested, you'll look it up and you will work on it."

> "You don't [usually] teach yourself, but you can motivate yourself in what you want to learn in the five years you are here. [If] you are interested in that you'll go along that path. We're obviously only taught basics, but if you want to learn more about it, [e.g.] do an autonomous house, you'll do it, but that is not something I'm bothered about."

But being motivated is not enough. Some students feel marginalised, as they appear to be isolated in their interests from other students and tutors.

Also some students think their interest in Sustainability is not enough to acquire all the information they want.

> "I would like to have done more about the efficiency of buildings. I am still a bit unsure of how to make a building a bit more energy efficient."

However, opinions are split among students. Third and fifth year students' opinions generally vary between thinking they should have learnt more and that they have been forced to learn it, and therefore are not interested. First and second year students generally think they need to learn these issues and that they are important, although sometimes they really don't know, and are not really interested in finding out, as it involves more work.

> "It sounds like work, work should be done doing something else" [Something more important?].

Another element that influences students' motivation towards Environmental Design is the fact that the course is expensive and learning about new things will involve more money and time. In some students' words, this is not a sustainable way of learning! To try to be more involved and 'be more sustainable', some students have started their own studio recycling campaign, but there is no information on how successful these campaigns were.

"It's quite expensive in here, it's buying and buying. We all have to get a part-time job. That isn't environmental, it requires more materials, uses more resources. Things are used once, maybe twice, boxes, material..."

Sometimes, if not most of the time, students decide to include Sustainability and environmental issues, or not, on the basis of the teacher's reaction and the grades awarded and not because of a real interest in the subject.

"I've just said they were there [the environmental issues in the design] and some passive ventilation and they said, that's ok. But no one really cared. The people are very heavy [proud] when they say this is my air-conditioning and my big water chillers in the roof; and then, everybody says Wow!"

"I did it for the sake of the exams" [applied and learnt about Environmental Design].

"The lecture didn't make anyone think, Oh I must design sustainably! It is more like I must go to this lecture because I need ten credits out of it!"

Therefore, some students are not really interested in the subject but in the outcome of their studies. This is a lateral motivation to learn environmental issues, and this could lead to an eventual real interest from the students. However, it is probably not the best way to raise awareness.

Section Summary

- **Students think they will learn to design environmentally if they are motivated to do so.**
- **They will be more motivated if they have a degree of freedom to make the choices on what to learn, rather than being forced to learn something.**
- **Teachers motivated towards Sustainability and Environmental Design will promote motivated students.**
- **Graduation and grades play a large part in students' decision to learn or apply environmental issues in their designs.**

6.1.3.2.1 Assessment

A motivated student will work hard to integrate environmental issues into the design; however the institution and the teaching have a bigger influence on students' attitudes. Students may be convinced of the importance of Sustainable thought and an Environmental Design approach. However, their main aim is to obtain a degree, and to do so they need to follow the rules of the School. In other words students need to pass the courses and obtain credits. Therefore if the school is not giving much importance to environmental issues and Sustainability, students will have the same attitude.

> "If you are interested you will learn [despite the method]. If not you just do the bare minimum to pass and move on."

Sadly, part of students' motivation to learn a subject is how they are going to be assessed, and students are very good at recognising the minimum needed to pass.

> "Ecology is not recognised [when evaluating projects in the school]."

> "The problem is not that teachers are not agreeing on what Sustainability is, that wouldn't be a problem in itself, except that ultimately someone has to mark the projects and if you decided to use a strategy they don't agree with, you'll get a bad mark."

Also when students study environmental issues and try to incorporate them in projects they do it because they are asked to do so, and not because they have a real motivation to learn. Moreover, if students do not include environmental elements in their designs, it is not completely due to Design tutors' ideas and evaluation. It is also due to lectures' conditioning them to memorise facts and pass exams.

> "To be honest, they [lecturers] don't say a great deal [about environmental issues] and the only important part is the exam."

Through the interviews, it seems that in Schools of Architecture with an old tradition the situation of Sustainability and Environmental Design is worse than in new Schools. The aesthetics tradition seems to dominate and does not give a chance to Environmental Design attempts in the design. However, neglecting environmental elements in the design is also part of former polytechnics' culture.

> "Most people are just bothered about it looking good, they [the tutors] are not bothered whether it is green at the moment."

> "It [Environmental Design] just doesn't seem to get you the marks in this sort of school. There are other things they look at more."

The problem seems to be a partial evaluation of the design, where beauty and presentation are the elements biasing the assessment. Nevertheless, different schools have different biases toward various subjects: sometimes the School evaluation is structure-focused, history-focused, metaphor-focused, etc. This would not be a problem if biased evaluations of the work changed on each evaluation. However, it seems that a particular bias characterises each School during the academic year. It is the author's opinion that, in order to maintain a variety of architectural thought and design, there should be more understanding between teachers, and the same value given to all aspects of design. The use of teaching conferences and fora should be more extensive for the exchange of ideas in Architectural Education and their assessment. Because, sometimes things that are important and a priority in one design is not as important as in another. However, all aspects have to be evaluated and considered equally for students to appreciate their value and importance.

> "Nobody really thinks it's that important [Environmental Design and Sustainability]. Even if you are asked to do some work in Sustainability they won't look at it in detail and see how much you've done. They are much more interested in working out how good your building is in terms of structure, functioning, expression and things like that; Sustainability is not important."

Ideally, all design would be sustainable and designed with respect for the place and the people, but there are other aspects of Sustainable Design, like culture, cost and needs, that should be also taken into consideration. Introducing more Sustainable thought into Schools of Architecture will not diminish the aesthetic qualities of design, nor will it be completely contrary to what architects know today or the way they design. It is the author's belief that, on the contrary, this will enrich the design possibilities.

Section Summary

- **Students think schools favour some areas of Architecture over others. As assessment is biased by Schools traditions, in aesthetics or technology, etc.**
- **Teachers have a big role in students learning superficially or deeply.**
- **There should be exchange of ideas and assessment methods between teachers.**
- **Students and architects do not need to include all elements in one design. All designs are unique, in the same way that all clients, users and climates are unique.**

6.1.3.3 Teaching Strategy

There are several issues that arise when asking students about teaching methods. One is their preferred teaching method and another is how they rate the teaching they have at present.

Many students think the way they are being taught is not appropriate for them; in many cases they express contempt. Students prefer studio work over other types of teaching strategy and sometimes anything that is not design work is considered boring and of limited value.

> "Lecturers and everybody [students] think [environmental issues] have nothing to do with the work [design project], so they should cancel the lectures!"

> "Design studio: that's the main thing - the others are more like secondary subjects."

Students lack motivation to learn. The theoretical bases on which almost all Environment courses are based are boring for those students who need more challenge and activity. Nevertheless, many students recognise that the content of the course is important.

> "The lectures are quite boring, especially the Environmental ones, three hours on Friday mornings. But that is it, we just have lectures, we don't have any tutorials, just certain projects, examples. We go to the lecture and they say, 'learn', and that's it. I think it is not that bad, if you are interested you'll learn. I don't know if because they are green issues they should be enforced."

Students do not appreciate passive learning. Nevertheless most of the teaching in Schools of Architecture is through lectures and only a few lectures seem to stimulate students' learning.

> "This is a business with a lot of talking and not a lot of doing."

> "They have a course about theory, about the Environmental concepts, and how several people throughout the year have thought about it, it helps you understand more deeply what is environmental thinking and concepts related to Architecture and the city."

When asking students about the teaching strategy in the Schools, not all the answers are about teaching methods but about the teaching environment. Being in the same room all the time is boring for them, no matter which method is used to teach. Students like variety to stimulate their senses and motivate their learning.

> "The studio is [the] best. I fall asleep sometimes [in lectures]. This semester is better, because we are not stuck in this room for all our lectures and tutorials. This semester we can get out in different groups."

As for many students, the key for learning Environment and Sustainability is doing something different, having some real projects, or design activities involving some time outside the classroom. Probably the struggle to learn, combined with the extra tension to reach the deadlines in projects involving other people, clients and users, gives students more meaning and understanding to learn.

> "It is good as it is all studio-based and I don't like lectures."

> "If you know only theory you never know what it's about [Environmental Design and Sustainability]. This [practical method] makes things clear to you."

> "It's experiential learning [learning Sustainability], it's not only theoretical knowledge. But you have to do it, really go there and struggle and do it."

Moreover, being left alone to work and do research seems to be a very useful learning strategy – students can prioritise and be more independent in what they look for and learn about.

> "We had to try to research, go to the library and find out by ourselves, to do presentations, supplemented by lectures."

> "It is cutting edge in Ecological Design, looking at new ways of doing things. There are two aspects – a theoretical and a research side."

Once students are involved in Environmental Design, they consider the inclusion of Environmental elements in the design process are very important.

> "I think we tend to separate environmental issues from Architectural Design, but this is what we need to overcome. We need to think both things together; it should come under the skin, so you always remember it."

Also, some students see the lectures as they were originally intended; as reinforcement to the Design studio:

> "In terms of environmental teaching, we have a lecture once a week and we have some seminars with smaller groups of people just regarding the actual building we are designing with reference to the lecture."

However, not all students are happy with lectures and the benefits of mass teaching and support for the design. Apart from the facts already mentioned, students have some problems with the technicalities of environmental issues, like calculations of thermal factors, glazing ratio, etc...

> "The lectures are always teaching us as if we know, and they forget that we are learning. It is very technical and they don't slow down so we can [look] back and review the physics and practise a few things."

Nevertheless, students continue learning, some for the assessment and others believing this learning will be useful for their futures, after graduation.

Section Summary

- **Students think the teaching methods presently used to teach Environmental Design and Sustainability are not appropriate.**
- **Students do not like passive learning. Students prefer studio teaching, real projects, activities and going out of the classroom.**
- **Being in contact with real people involved in real situations is more meaningful for students and gives them understanding to learn.**

6.1.3.3.1 Tutoring

The didactic role of the teachers is very influential in students' attitudes towards Sustainability and their learning, not only because of teachers' ideas, but also because of the contact time and dedication to the students.

Especially during their first year, students seem to need some extra guidance and more contact time than students in their final years. This is probably part of the transition from school to university; however, having extra dedicated time from teachers seems to help them to learn and focus on their work.

> "The tutors try to guide us if we go to the wrong side, if we do too much calculation or too much building. They say, 'No, you should change your way a little bit'. They are directing us, they are not leaving us too alone, they let us go our own ways, but we have some tutoring... they are available most of the time to help."

> "The nicest thing is that you get in contact with the tutors all the time. They join at any stage of your work. It's a small group so you can ask. It is all studio-based and you can try to work in groups."

> "If you haven't [a talent in design or any other area] you can ask them [the tutors]. The teachers will help anyway, tutors are excellent."

Teachers' dedication makes students more comfortable with the subjects and gives them more confidence to ask teachers and peers and facilitate the learning of Environment and Sustainability. However, teachers' dedicated time to students is not the only element affecting students' learning. The differences in positions and beliefs, from the teachers' side, on how and why Environment and Sustainability should be included or not in the teaching of architecture, have the bigger effect on students.

> "We have environmental lectures but when it comes to the advice we get it's highly personal. Every person [teachers in particular] has their own opinions about Environment and Sustainability, and they won't argue with the next person [another teacher] that comes to talk to you [the student]."

Some students are confused and do not really know what they should do. Previously we mentioned that students are influenced by grades, and they will follow the advice of the teacher who is more likely to mark the work. Nevertheless, there are some students that feel a conflict between the advice of different members of staff.

> "A problem is that we are taught a lot of these subjects in lectures but they seem to be special subjects on their own. But when you are trying to carry out an aspect of it through your studio work, sometimes your tutors in design work may not see things in the same way. I think it's sometimes an ambiguity. It's quite difficult. It is a collision of environmental aspects and design and sometimes design aspects winning out over environmental aspects."

Other students at the end of the course have a different kind of problem – it is not which advice to follow, but the frustration of having followed a path and being misunderstood and undermarked by tutors.

> "The members of staff [design tutors] have not much knowledge about it, and they are the ones marking. I think there is a misconception of what Ecology is. They have a fixed idea in terms of looking at it as daylighting, natural ventilation, and then when you do something different they don't understand it."

Section Summary

- **Students are very sensitive to teachers' attitudes.**

- **Teachers' dedication seems to help a lot in building students' confidence and learning.**
- **Students think it is their responsibility to discern what is good for them to learn.**
- **There should be a change in the formal approach to marking, and in the objectives of the courses and exercises. These should be more explicit, so students will not learn only to pass but to achieve those learning objectives.**

6.1.3.4 Learning

When asking students which is the best method for them to learn something, especially Sustainability, the first answer always comes as 'integration in the studio', or 'learning through design'.

> "From half of the units that we do, the best for me is the studio where you do projects, you work and take in the direction you want to go, following your particular interest, environmental issues [if you want]. The things that I find difficult and quite boring are learning Materials and Building Technology. I don't know them really; it took me quite a lot for me to understand. Also people find it difficult to learn the terminology of the buildings".
>
> "I think [I learn] better if it is actually incorporated in design, part of the course and not just a lecture where it stays at the back of you head.... They put up some calculations but you don't actually really understand it as well. They just tend to tell you but if they actually do some examples you'll remember a lot better."

This preference for design and practical exercises is not only because of the interest students have in doing things, but also because they enjoy the freedom to choose different aspects in the design.

> "Design studio; this is the one you get more enjoyment out of, because it is project-based. You have more time, and it's up to you, you determine what the outcome will be. Whereas the others are more answers of right or wrong, [like in lectures on] Urban Studies, Economics, Materials".
>
> "We are completely on our own. We go where we want to go, and they just give us tuition. There isn't really a green agenda unless you want to address it."

And design is becoming more and more linked with Environment and Sustainability in some schools, especially in old polytechnics.

"Now it [environment] is becoming less of a separate entity in itself, it's becoming more sort of amalgamated into design, and as you learn more and more, it becomes more natural to use."

But as mentioned earlier, Architecture students prefer to work alone. This leads to all the problems related to working unaided: big workloads and little contact with peers for discussion and the exchange of ideas.

"We were given the option of working together but we really didn't try to make it work out, and now we realise it's a lot of work."

"There are no students in here, and that's the beauty of the computer, everybody works at home."

"We don't see what other units are doing, we don't learn very much from other units and people in them. And there is a point where we all benefit. If we cross feed, they can get part of my ecology ideas and reflect them in their schemes and I'll do the same with their ideas on mine. You can get input from others. We don't need to become experts on everything but knowing and understanding what they are doing. We are trying to have some interaction but their timetables are as bad as ours."

This seems to be partly a consequence of computing technology, nevertheless students repeatedly prefer to work alone than in groups or pairs. And the only way to search for peers' help and advice is at night when most Architecture students prefer to go to the studios for quiet work.

"If you want to talk to somebody you have to come at night."

Many students think there is too much work involved in Architecture, and that including environment or another emphasis will reduce the time for developing their designing skills. However, this belief is counterbalanced by that of other students who think they should have more teaching time to enjoy and learn other issues apart from design.

"I think right now we are overloaded with information; all with Sustainability in the projects."

"We have sustainable projects and we don't want more, I think one is ok. It takes too much time and effort."

"I wish we could have more time to go to evening lectures; we don't have time to see everything. I guess that the other thing is that they don't talk very clearly about environmental things; they pass over some things because we have not enough time."

> "I think we should do more, especially for people that haven't done it before. I think more lectures on bioclimatic stuff, concepts, procedures, it's complicated, but I think it's brilliant."

Time is also a constraint for doing all the environmental aspects students are asked for in the design. As these issues are still considered secondary in the studio, they are left aside until students really have some extra time to discuss some ideas and put them into practice.

Students appreciate the time to do projects which apply the theoretical learning of the lectures in the design projects.

> "Lectures are really good. We did a very interesting project in it [Environmental Design]. I think we need more lectures on Sustainability. We get handouts with pictures on them. It would be nice to have more written information on them, not only pictures. They need to tell us what to do with all the environmental sheets, factors and forms."

Students like to do more practical work and, if they have to learn something, it has to be an aspect they can relate to the design, which is the subject they feel is the final aim of architecture. Students need time to understand and learn more about, not only Environment and Sustainability, but also many other subjects apart from Design. Final year students like to think, they appreciate being pushed to analyse and question the knowledge given to them and discuss with others.

> "It is a very good way of putting everything together, theoretical aspects, questioning the way you think about things. The unit has been pushed to question what you do and why you are doing it."

Section Summary

- **Students think that the best way to learn Environmental Design and Sustainability is through integration in the Design studio.**
- **Students like practical work, experimenting and having control over their projects.**
- **Students need to understand there are other subjects apart from Design, even though studying them will increase their work load.**

6.1.3.5 Integration

There are two things that divide architectural design and its environmental aspects. First is the lack of design projects addressed in the studio and second the separation of the lecturing staff and the tutoring staff, which in a way might be what prevents more environmental projects in the Design studio.

> "The thing is that instructors, staff, they are separated groups. They never talk to each other, the lecturers from one side never talk to the tutors: they are very separated."

Some students cannot understand the reasons for the disintegration of Environment teaching in Architecture. What they understand very clearly is that it is not a priority in the Schools' agendas.

> "We don't apply it much. It was mentioned in the studio but never seriously."

> "It is not really high on the agenda of this School, they don't really care about practical stuff. It is very theoretical; I think we never do a particular exercise."

> "I think it is how it is structured as a separate thing, but you have to see it as something attached to Architecture!"

Some students believe architects in general do not have high expectations from environmental issues. Nevertheless, they are also conscious of the increase in work related to environmental issues in Design, and this could be one of the main reasons for not applying them in the projects.

> "Architects think it is generally boring [Environmental Design] they are just lazy!"

> "I am applying it in the design project, but it is very tiring to do all this work, I did some research."

However, not all students think the same, with many students integrating environmental issues in their designs. Some believe Environment is part of Architecture despite the fact that in their Schools is it separated from the Design course.

> "They should integrate it more in the projects."

> "Usually the submission is in the form of technical study. It's problematic, it's something you have to do, it's part of the brief which is quite good. You have to think about it from stage one of your design, because it is also the studio course and apart from that, it is the lecture course. I don't find it as enforced as it should be to integrate it in the Design course. It is usually a separate study you have to hand in."

In some Schools, there are attempts to make all staff members work together in the studio; however there are only a few examples of a successful integration of teaching staff and projects.

> "Integration starts to come naturally; it is not only the way [the project] looks. You can start saying this is a beautiful building but it is not efficient. They are trying to bring all together, when we have a design project we see the Design tutors and the Structural and Technology teachers, so everybody is around, it is good that the Technology teachers are architects – you can ask about environmental questions but also Structure and Design as well."

Section Summary

- **Students' motivation is a spur for integrating environmental issues in Design, as is the integration and collaboration of teachers and the presence of environmental projects.**

Summary

Architecture students prefer to learn through the design process, because it is practical and gives them the opportunity to experiment and have control over the elements they want to develop. Nevertheless, one of the biggest motivations to learn is obtaining a degree. There should be some evaluation mechanisms to ensure they have a solid understanding of issues of Sustainability and not a superficial one designed only to obtain a credit.

Students of Architecture are highly influenced by teachers' attitudes towards environmental issues when defining or applying these in their Design projects. Teachers' and Schools' commitment to Environmental Design and Sustainability will determine if students think they are important or not in Architecture, especially during their first years of university education.

Students have the general ideas that although Environmental Design and Sustainability are important, they consume a lot of their time, limit their design freedom, and include many calculations that are difficult and boring. However, not all students think this way and many include environmental considerations in their designs and try to integrate Architecture with sustainable thinking.

Overall Summary and Conclusion of the Section

Based on students' interviews, some of the main conclusions are outlined as follows:

1. Students have an idea of what Sustainability and Environmental Design are, but they do not define them as Architecture.
2. Students perceive Environmental Design and Sustainability as calculations and equations.
3. They also think the ideas of Environmental Design and Sustainability are important.
4. Students think they will learn to design environmentally if they are motivated to do so.
5. They will be more motivated if they have a degree of freedom to make the choices on what to learn, rather than being forced to learn something.
6. Teachers motivated towards Sustainability and Environmental Design will promote motivated students.
7. Students think schools favour some areas of Architecture over others. As assessment is biased by Schools traditions, in aesthetics or technology, etc.
8. Students think the teaching methods presently used to teach Environmental Design and Sustainability are not appropriate.
9. Students do not like passive learning. Students prefer studio teaching, real projects, activities and going out of the classroom.
10. Students are very sensitive to teachers' attitudes.
11. Teachers' dedication seems to help a lot in building students' confidence and learning.
12. Students think it is their responsibility to discern what is good for them to learn.
13. Students think that the best way to learn Environmental Design and Sustainability is through integration in the Design studio.
14. Students like practical work, experimenting and having control over their projects.
15. The author thinks students' understanding depends on the way they are taught and their reaction to the subject, and consequently their application in the design.

16. Also that graduation and grades play a large part in students' decision to learn or apply environmental issues in their designs.
17. Teachers have a big role in students learning superficially or deeply.
18. There should be exchange of ideas and assessment methods between teachers.
19. It is the author's opinion that students and architects do not need to include all elements in one design. All designs are unique, in the same way that all clients, users and climates are unique.
20. Being in contact with real people involved in real situations is more meaningful for students and gives them understanding to learn.
21. There should be a change in the formal approach to marking, and in the objectives of the courses and exercises. These should be more explicit, so students will not learn only to pass but to achieve those learning objectives.
22. Students need to understand there are other subjects apart from Design, even though studying them will increase their work load.
23. Students' motivation is a spur for integrating environmental issues in Design, as is the integration and collaboration of teachers and the presence of environmental projects.

6.2 Summary of the Chapter

Although all teachers of Architecture are able to define Environmental Design and Sustainability, and agree on their importance, there is significant variation in how they define these terms.

Some teachers define Environmental Design as Architecture. However, not all teachers or students share this definition. In fact, the majority of students think Environmental Design is something apart and has a lot to do with calculations. In addition, they believe that it is limiting their design freedom as it adds more requirements to, and constraints on, their projects.

Teachers acknowledge that calculations are important for Environmental Design and Sustainability, but agree that ideas are more important for learning and understanding these issues. However, not all students are interested in learning Environmental Design and Sustainability, even if they are progressively taught.

The main element that determines if Sustainability and Environmental Design are considered important and interesting is whether students see them as relevant or not. This relevance has something to do with the attitudes teachers have to the subjects. Nevertheless, the main element that motivates students to learn, or not, is the grades they will obtain.

If Schools of Architecture give little importance to Environmental Design and Sustainability in their curricula, then students will have the same attitude. Moreover, consideration of environmental issues usually adds to workloads and probably leaves less time to think about how to develop the project. Students can therefore think these issues are interesting, but are generally not interested in applying them in the design.

There is also a preference, especially among students in the final years of the course, to have freedom to decide what to learn, in the same way that teachers like freedom to decide what, why and how to teach Sustainability and Environmental Design. Many teachers agree on the merits of using a variety of teaching methods during the academic year, and students welcome this variety. Prescribing a method to be followed in all Schools is not the answer to the teaching of Sustainability and Environmental Design. Teachers agree that, rather than there being a good or bad teaching method, there is instead the method that "works at the moment". Nevertheless, students prefer Studio design teaching and practical experience to more formal lectures.

Once students have understood some of the principles behind Sustainability and Environmental Design, they can engage with the subject and try to integrate it in Design projects. That is why teachers are trying to teach the principles of Sustainability and Environmental Design in a gradual way, so that students can grasp them and be aware of environmental conditions, surroundings and their occupants. This is the same approach teachers are using to introduce calculations and more technical issues in the design: teaching students in a way that allows them to follow the natural progression of design and other processes.

But all methods should be important in students' education. The fact that students tend to spend more time designing in the Studio than researching or working for projects or other subjects outside Design is not directly promoted by the Design tutors, although perhaps students are encouraged to do more work. It seems students prioritise their subjects, with Design being the first. The fact that Design is more complicated and demands more elements (model-making, drawing or computer skills, rendering, structural design, site analysis, etc) each time could be the reason for the neglect of other subjects like Environmental Design, Sustainability, and others usually taught in lectures such as Construction, History, etc... (although the latter subjects also need to be included in the design).

A solution to this could be the integration of Environmental Design and Sustainability into Design projects. At the very least, all design aspects should be discussed and agreed with the course co-ordinators before the beginning of the project, in order to ensure a successful integration of all design aspects (this also includes the marking and grading scheme).

Although integration of Environmental Design and Sustainability issues in the design seems a matter of balancing technique and technology, theory and practice, science and philosophy, there are many other aspects that make integration more than a simple compromise of including Environmental Design and Sustainability in the Schools' curricula. Some of these aspects have to do with disagreement among tutors and lecturers, some with time constraints. Others are political and administrative issues deeply embedded in the Schools of Architecture themselves. Nevertheless, time seems to be the major factor, with teachers complaining that excessive administrative work results in insufficient contact time to improve students' learning.

The increasing number of students is one of the main reasons for less contact time, and the lack of time available to teach and make contact with other lecturers and tutors. Another issue is that of students working and having to juggle full-time education with a part-time job. This is a particular problem during the first year, when students are being introduced to university education, and students appreciate teachers that have time for their problems and doubts.

Contact in Architectural Education is very important as a great part of learning occurs through discourse, not only with teachers but also with peers. Nevertheless, most Architecture students do not like to work in groups or pairs, or to be mixed with other Architecture students, particularly those from other Schools. This is unfortunate, as a variety of discourse in Schools of Architecture is beneficial for students' learning, exposing them to different ways of interpreting Architecture. This contact can be reinforced through school fora and meetings. In addition, a national forum of students, where not only students' representatives but also all students can exchange ideas, will be very useful to increase the contact between students of Architecture and increase the voice of students in their own learning.

This also applies to teachers and tutors who have different views of what Architecture is. Teachers of Architecture agree on the importance of dialogue; however, there is very little agreement and communication between them! Environmental Design and Design are separated and are referred to as different things. When a nominal division like this occurs, integration of the design process is more difficult. In fact, it seems to work better when Environmental Design is taught outside the Studio and the design decision is left to the students. Nonetheless, many teachers support the idea of integration – particularly when there is no difference in their minds between Environmental Design and Design.

Ideally, all design would be sustainable and designed with respect for the place and the people, but there are other aspects of sustainable design, like culture, cost and needs, that should also be taken into consideration. Introducing more sustainable thought into Schools of Architecture will not diminish the aesthetic qualities of design – all designs are unique, in the same way that all clients, users and climates are unique; nor will it be completely contrary to what architects know today or to the way they design. On the contrary, it will enrich the design possibilities.

In the following chapter the quantitative data obtained from online questionnaires will be presented, some comments on the results obtained will be given. However, a more detailed analysis will be discussed in Chapter 8, where the quantitative and qualitative data will be compared. Nevertheless, from the data discussed in this chapter some conclusions can begin to be made: the need for teacher training; multidisciplinary work; collaboration; agreement on teaching objectives; communication among teachers and with students; the need to increase students' motivation and the use of real projects, among others.

References

Bryman, A. (2001). Social Research Methods, Oxford University Press, Oxford.

Chapter 7.Quantitative Findings

Chapter 7

7 Findings and Analysis of Quantitative Data

In this chapter the data drawn from online questionnaires will be explained. At the end of the chapter, a summary and the ideas that developed from the quantitative research will be given.

7.1 Quantitative Findings

7.1.1 Categorical Data Analysis

The data obtained are called categorical data, which means the data have no numerical value as such, but have a value given by the researcher. The results were categorised in the following way:

- Strongly disagree= -2
- Slightly disagree= -1
- Neutral = 0
- Slightly agree= 1
- Strongly agree= 2

Nevertheless, these numerical values cannot be added and the distance between 0 and 1, 1 and 2, cannot be defined as the same. Numerical values are given to facilitate the analysis of the data and not to measure it. The data were analysed using the SPSS program, version 11. Tables of frequencies and percentages, given to the nearest significant figure, can be seen in the following sections. All frequency tables and the graphs derived from each question (teachers and students) are in Appendix D. The frequency tables show the number of students and teachers that answered one way or another as represented in percentages.

In this chapter the results from the online questionnaires are explained. Later they will be used to help analyse the qualitative data and the resulting teaching ideas from the personal interviews considered earlier.

7.2 Questionnaire Results

7.2.1 From Architecture Teachers

The tables that follow highlight some of the issues answered by teachers of Architecture during the online questionnaire. The answers selected will be used to reinforce results from the qualitative data and compare them with the quantitative data obtained from students' online questionnaire.

7.2.1.1 Definition

Teachers of Architecture define Environmental Design and Sustainability issues in many ways. In the online questionnaire, one of the statements intended to determine how teachers perceive these issues was:

Environment and Sustainability are part of Technology subjects in Architecture

Thirty-nine per cent of the teachers rating this statement strongly agree with it. Fourteen per cent slightly agree in contrast with 11% and 4% that slightly and strongly disagree. (Figure 7.1).

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly disagree	1	4	4	4
	Slightly disagree	3	11	11	15
	Neutral	8	29	30	44
	Slightly agree	4	14	15	59
	Strongly agree	11	39	41	100
	Total	27	96	100	
Missing	9	1	4		
Total		28	100		

Figure 7.1 Frequency table question T24

Being part of technology does not mean that Environmental Design and Sustainability are not considered part of Architecture. As teachers stated when asked to agree with the following statement:

Architecture is actually Environmental Design

Thirty-nine per cent slightly agree with this statement and 25% strongly agree. (Figure 7.2).

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly disagree	5	18	19	19
	Slightly disagree	1	4	4	22
	Neutral	3	11	11	33
	Slightly agree	11	39	41	74
	Strongly agree	7	25	26	100
	Total	27	96	100	
Missing	9	1	4		
Total		28	100		

Figure 7.2 Frequency table question T25

These answers indicate that more than 50% of teachers participating in the online questionnaire agree to some extent that there is no division between Architecture and Environmental Design.

<u>**Summary of Ideas Agreed by the Majority of Teachers**</u>

- **Environmental Design and Sustainability are part of Technology and they are Architecture.**

7.2.1.2 Calculations

Teachers of Architecture perceive that students do not understand anything that is related to Mathematics, as data in Figure 7.3 show.

Thirty-nine per cent of teachers slightly agree with the statement:

Students don't try to understand if something looks like it has anything to do with Mathematics

While 25% strongly agree and 18% and 4% slightly and strongly disagree with it.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly disagree	1	4	4	4
	Slightly disagree	5	18	19	23
	Neutral	2	7	8	31
	Slightly agree	11	39	42	73
	Strongly agree	7	25	27	100
	Total	26	93	100	
Missing	9	2	7		
Total		28	100		

Figure 7.3 Frequency table of question T23

The majority of teachers participating in the questionnaire seem to identify a problem with Mathematics and architecture students' learning of Technology subjects.

Summary of Ideas Agreed by the Majority of Teachers

- **Students do not try to understand if anything has to do with mathematics or calculations.**

7.2.1.3 Teaching progression

As discussed in the interviews, teachers proposed a solution to the problem of students being reluctant to learn calculations and mathematical knowledge. They suggested a gradual approach to learning Environmental Design and Sustainability: first the introduction of principles and then, if necessary, calculations.

When teachers were asked to rate the following statement, the majority agreed.

I believe giving the students the principles of Environmental Design and Sustainability will be more effective than giving them calculations of environmental factors

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly disagree	1	4	4	4
	Slightly disagree	4	14	14	18
	Neutral	1	4	4	21
	Slightly agree	9	32	32	54
	Strongly agree	13	46	46	100
	Total	28	100	100	

Figure 7.4 Frequency table of question T12

Forty-six per cent of teachers strongly agreed and 32% slightly agreed with the statement. This would appear to indicate that teachers interviewed and those participating in the questionnaire seem to agree about this gradual teaching of principles.

Summary of Ideas Agreed by the Majority of Teachers

- **A gradual approach to teaching Environmental Design is effective.**
- **Teaching principles is more effective than teaching calculations.**

7.2.1.4 Teacher strategies

Teachers of Architecture agree that the best way to teach Sustainability is through Studio Design. (Figure 7.5).

I believe Studio Design is the best way to teach Sustainability in Architecture

In Figure 7.5, 46% teachers slightly agree with the statement above and 14% strongly agree with it. Twenty-eight per cent of teachers participating were neutral and only 11% slightly disagree with Studio Design as being the best way to teach Sustainability in Architecture.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Slightly disagree	3	11	11	11
	Neutral	8	29	29	39
	Slightly agree	13	46	46	86
	Strongly agree	4	14	14	100
	Total	28	100	100	

Figure 7.5 Frequency table of question T8

Also, teachers of Architecture participating in the online questionnaire agree to some extent with the statement:

I believe in teaching Environmental Design through case studies, by analysing existing buildings

Forty-six per cent and thirty-two per cent slightly and strongly agree respectively (Figure 7.6). This could be interpreted as teachers of Architecture believing that design is the best way to teach Environmental Design and Sustainability, while believing that there are other methods that can be useful to teach these subjects.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Slightly disagree	1	4	4	4
	Neutral	5	18	18	21
	Slightly agree	13	46	46	68
	Strongly agree	9	32	32	100
	Total	28	100	100	

Figure 7.6 Frequency table of question T5

In Figure 7.7, teachers' ideas on the following statement can be seen:

We are teaching how to design things; sustainable design has to start from the first idea, it's not something added at the end

Seventy-nine per cent of teachers strongly agree with this statement. There seems to be a strong consensus between teachers over the fact that Sustainability ideas have to start in students' design from the first moment and not be added as extra issues at the end.

Consequently, although design is the best way to teach Environmental Design and Sustainability, sometimes teachers use other methods for students to learn these issues. The important fact is that they should be present in students' designs from the beginning and not be left for the last minute to be included in the design as a remedial solution.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Slightly disagree	1	4	4	4
	Slightly agree	4	14	15	19
	Strongly agree	22	79	82	100
	Total	27	96	100	
Missing	9	1	4		
Total		28	100		

Figure 7.7 Frequency table of question T27

Probably teachers need to place more emphasis, when a design project is at early stages, on motivating students to think about Sustainability and how this can be reflected in the design process.

Summary of Ideas Agreed by the Majority of Teachers

- **Studio design, case studies and analysing existing buildings are the best ways to teach Environmental Design.**
- **Sustainable ideas have to be present at the beginning of the design.**

7.2.1.5 Tutoring

Teachers of Architecture believe that:

More contact with students at tutorials improves their learning experience

Seventy-five per cent strongly agree with this statement, 18% slightly agree and only 7% are neutral about this issue.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Neutral	2	7	7	7
	Slightly agree	5	18	18	25
	Strongly agree	21	75	75	100
	Total	28	100	100	

Figure 7.8 Frequency table for question T13

During the interviews teachers of Architecture were concerned about larger numbers of students and less contact time, and certainly this is reflected in the questionnaires. Teachers seem to be concerned with students' learning and the effect that less contact time will have on their learning experience in the university.

This could lead to students of Architecture spending more time with Design tutors than with Technology teachers, and the fact that Environmental Design and Sustainability are taught mainly through lectures.

Summary of Ideas Agreed by the Majority of Teachers

- **Contact time with students is important to improve their learning experience and awareness of Sustainability and Environmental Design.**

7.2.1.6 Tutors and lecturers

Design tutors have more contact time with students of Architecture and therefore have more influence in students' learning, as was agreed by teachers of Architecture in Figure 7.8 in the previous section. This is not a problem if all teachers of Architecture have a good relationship and are sharing knowledge and teaching objectives. Nevertheless there seems to be a compartmentalisation in Schools of Architecture that is influencing in a negative way students' learning of issues not taught in the Design studio.

Forty-six per cent and 25% of teachers slightly and strongly agree on this statement:

There seems to be compartmentalisation of knowledge between Environment and other related Architecture subjects, which is reflected in students' learning.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly disagree	1	4	4	4
	Slightly disagree	5	18	19	22
	Neutral	1	4	4	26
	Slightly agree	13	46	48	74
	Strongly agree	7	25	26	100
	Total	27	96	100	
Missing	9	1	4		
Total		28	100		

Figure 7.9 Frequency table of question T18

This is important, as teachers are aware of this difference between areas of knowledge and its effects on students. Moreover, 61% of teachers strongly agree that knowing about what happens in other courses is beneficial to students' learning, (Figure 7.10). This is specifically true when referring to Environmental Design, as lectures need the practical support of Design projects, and also need students to learn different skills and information from other lectures.

I believe that knowing what students are doing in other modules will help improve the teaching of Environmental Design

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Neutral	4	14	14	14
	Slightly agree	7	25	25	39
	Strongly agree	17	61	61	100
	Total	28	100	100	

Figure 7.10 Frequency table of question T15

Summary of Ideas Agreed by the Majority of Teachers

- **Tutoring has a big influence on students' learning.**
- **Tutors should work objectives and teaching strategies together to improve students' learning experience.**

7.2.1.7 Students Learning Style

Forty-three per cent of teachers of Architecture slightly agree and 4% strongly agree with the statement:

The students seem to have problems in understanding Sustainability and Environment in terms of design

Contrasting with 25% and 11% of teachers that slightly and strongly disagree in believing students have problems understanding Sustainability and Environmental Design in design terms (Figure 7.11).

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly disagree	3	11	11	11
	Slightly disagree	7	25	26	37
	Neutral	4	14	15	52
	Slightly agree	12	43	44	96
	Strongly agree	1	4	4	100
	Total	27	96	100	
Missing	9	1	4		
Total		28	100		

Figure 7.11 Frequency table of question T17

This could be due to the fact that students seem not to have daily examples to reinforce their learning in the Schools, as slightly agreed by 46% of teachers (Figure 7.12). Teachers of Architecture think students need more daily and local examples so they will have less difficulty in understanding what Sustainability is and how it can be applied in Environmental Design.

I can see that my students are facing difficulties in understanding Environmental Design because they lack daily examples

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly disagree	3	11	11	11
	Slightly disagree	4	14	15	26
	Neutral	7	25	26	52
	Slightly agree	13	46	48	100
	Total	27	96	100	
Missing	9	1	4		
Total		28	100		

Figure 7.12 Frequency table of question T16

Summary of Ideas Agreed by the Majority of Teachers

- **Students need daily examples to understand Environmental Design and Sustainability in terms of design.**

7.2.1.8 Assessment

Almost 70% of teachers agree to some degree with the statement:

I think the assessment weight in the studio related to environmental issues should increase

This could be a reflection of the fact that there is not enough weight in the design assessment of these issues. This is probably due to the fact that the studio project and Environmental Design and Sustainability are usually taught as separate things and not integrated as one.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Slightly disagree	2	7	7	7
	Neutral	7	25	25	32
	Slightly agree	14	50	50	82
	Strongly agree	5	18	18	100
	Total	28	100	100	

Figure 7.13 Frequency table of question T32

Summary of Ideas Agreed by the Majority of Teachers

- **The assessment weight of Environmental design and Sustainability should increase in the Design project.**

7.2.1.9 Integration

Nevertheless, when asking teachers of Architecture how they teach Environmental Design and Sustainability, 64% affirm that they:

...Use design projects as the vehicle to deliver the environmental material, so they tie the teaching with the design (Figure 7.14)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Neutral	2	7	7	7
	Slightly agree	8	29	29	36
	Strongly agree	18	64	64	100
	Total	28	100	100	

Figure 7.14 Frequency table of question T4

Moreover, in Figure 7.15 almost 90% of the teachers agree, to some degree, with... **teaching Environmental Design through integrated projects.**

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Neutral	3	11	11	11
	Slightly agree	11	39	39	50
	Strongly agree	14	50	50	100
	Total	28	100	100	

Figure 7.15 Frequency table of question T9

A large majority of teachers of environmental courses believe in the integration of projects, and the use of design as a way to teach environmental issues and Sustainability. It is difficult to recognise the reason why students are not understanding environmental issues and Sustainability in terms of design, if teachers of this subject strongly believe in teaching these issues through integrated projects.

<u>Summary of Ideas Agreed by the Majority of Teachers</u>

- **Integrated design projects are the best way to teach Environmental Design and Sustainability.**

Summary of Ideas

1. Environmental Design and Sustainability are part of Technology and they are Architecture.
2. Students do not try to understand if anything has to do with mathematics or calculations.
3. A gradual approach to teaching Environmental Design is effective.
4. Teaching principles is more effective than teaching calculations.

5. Studio Design, case studies and analysing existing buildings are the best ways to teach Environmental Design.
6. Sustainable ideas have to be present at the beginning of the design.
7. Contact time with students is important to improve their learning experience and awareness of Sustainability and Environmental Design.
8. Tutoring has a big influence on students' learning.
9. Tutors should work objectives and teaching strategies together to improve students' learning experience.
10. Students need daily examples to understand Environmental Design and Sustainability in terms of design.
11. The assessment weight of Environmental Design and Sustainability should increase in the Design project.
12. Integrated design projects are the best way to teach Environmental Design and Sustainability.

7.2.2 From Architecture Students

The following tables correspond to students' answers obtained from the online questionnaire. The answers selected will be used to reinforce results from the qualitative data, and to compare them with the quantitative data obtained from teachers' online questionnaire. This comparison will be better explained in the following chapter.

7.2.2.1 Definition

Students of Architecture do not have a clear idea of what Sustainability and Environmental Design are.

Thirty-nine per cent of students slightly agree and 37% strongly agree with the statement:

I have to do some extra research to understand what Environmental Design is about (Figure 7.16).

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly disagree	7	3.9	3.9	3.9
	Slightly disagree	14	7.7	7.8	11.7
	Neutral	21	11.6	11.7	23.3
	Slightly agree	71	39.2	39.4	62.8
	Strongly agree	67	37.0	37.2	100.0
	Total	180	99.4	100.0	
Missing	9	1	.6		
Total		181	100.0		

Figure 7.16 Frequency table of question S11

Even though students are not clear on defining Environmental Design and Sustainability, 41% slightly agree that they:

...Always consider Environmental Design and Sustainability in their projects because they believe they can be a design generator

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly disagree	11	6.1	6.1	6.1
	Slightly disagree	22	12.2	12.2	18.2
	Neutral	41	22.7	22.7	40.9
	Slightly agree	75	41.4	41.4	82.3
	Strongly agree	32	17.7	17.7	100.0
	Total	181	100.0	100.0	

Figure 7.17 Frequency table of question S6

Students seem to recognise these issues are important, and that they can generate design ideas and solutions. Nevertheless, students cannot understand Environmental Design and Sustainability very well and think they will need more study and research to be able to fully understand them.

Summary of Ideas Agreed by the Majority of Students

- **Environmental Design and Sustainability are important.**
- **Environmental Design and Sustainability are design generators.**

7.2.2.2 Motivation

Students of Architecture are heavily influenced by what tutors and other architects say and do. Figure 7.18 shows this through 28% and 41% of students slightly and strongly agreeing with the statement:

Sustainability should be an important area as there is a big group recognising Sustainability in Architecture

Students might recognise that if architects and other professionals design sustainable buildings and have considerations from the environment, firstly, these issues must be important; secondly, it is viable to do such designs and, thirdly, it might be convenient to learn these skills before graduation.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly disagree	4	2.2	2.2	2.2
	Slightly disagree	13	7.2	7.2	9.4
	Neutral	39	21.5	21.5	30.9
	Slightly agree	51	28.2	28.2	59.1
	Strongly agree	74	40.9	40.9	100.0
	Total	181	100.0	100.0	

Figure 7.18 Frequency table of question S8

More than 70% of students think that Environmental Design is also very interesting.

In my opinion Environmental Design is a very interesting subject

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly disagree	5	2.8	2.9	2.9
	Slightly disagree	19	10.5	10.9	13.7
	Neutral	21	11.6	12.0	25.7
	Slightly agree	68	37.6	38.9	64.6
	Strongly agree	62	34.3	35.4	100.0
	Total	175	96.7	100.0	
Missing	9	6	3.3		
Total		181	100.0		

Figure 7.19 Frequency table of question S37

Thirty-four per cent and 38% strongly and slightly agree with this statement (S37). In the interviews students also thought that these issues were interesting, especially when they have attended a forum where an invited architect has talked about his/her projects.

Summary of Ideas Agreed by the Majority of Students

- **Environmental Design and Sustainability are interesting and important.**

7.2.2.3 Assessment

During interviews some students expressed their discomfort with lectures, particularly the fact that they seem boring and difficult. Some students commented that they just attended the lecture because they needed the credits. Nevertheless, more than 60% of students participating in the online questionnaire disagree about attending lectures just to pass.

Understanding Environmental Design is secondary. I mostly go to lectures because I need to pass the subject

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly disagree	76	42.0	42.2	42.2
	Slightly disagree	37	20.4	20.6	62.8
	Neutral	27	14.9	15.0	77.8
	Slightly agree	29	16.0	16.1	93.9
	Strongly agree	11	6.1	6.1	100.0
	Total	180	99.4	100.0	
Missing	9	1	.6		
Total		181	100.0		

Figure 7.20 Frequency table of question S17

Forty-two per cent and 20% of the students strongly and slightly disagree with this statement in contrast to 16% and 6% that slightly and strongly agree with it.

Although assessment has a lot to do with the final motivation of students to learn and attend courses, students of Architecture seems to have other reasons for attending or not attending lecture courses. As mentioned before, they find Environmental Design and Sustainability interesting and this might be the motivation to learn more about it.

<u>**Summary of Ideas Agreed by the Majority of Students**</u>

- **Students' motivation to attend a course is not only the final grade.**

7.2.2.4 Teaching Strategy

Ninety-three per cent of students agree with this statement:

I generally prefer the lecturers/tutors who explain to me how what we learn relates to the outside world

Twenty-one per cent slightly agree and 72% strongly agree. As explained in previous chapters, students learn better if they think the information or skills are relevant to their lives, and students of Architecture are no different.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly disagree	3	1.7	1.7	1.7
	Neutral	7	3.9	3.9	5.6
	Slightly agree	38	21.0	21.2	26.8
	Strongly agree	131	72.4	73.2	100.0
	Total	179	98.9	100.0	
Missing	9	2	1.1		
Total		181	100.0		

Figure 7.21 Frequency table of question S19

Relating the information learned in a lecture or project to students' reality, will produce a deeper learning and understanding of the subject.

I can understand environmental issues better if there are slides showing the buildings

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly disagree	2	1.1	1.1	1.1
	Slightly disagree	2	1.1	1.1	2.3
	Neutral	13	7.2	7.3	9.6
	Slightly agree	63	34.8	35.6	45.2
	Strongly agree	97	53.6	54.8	100.0
	Total	177	97.8	100.0	
Missing	9	4	2.2		
Total		181	100.0		

Figure 7.22 Frequency table of question S30

Also Architecture students' learning seems to be based on visual images and information. Thirty-five per cent and 54% of students have a better understanding of environmental issues if, during the explanation, there are slides showing the building examples. Students learn in different ways; however architecture students seem to prefer more visual ways of approaching learning.

Summary of Ideas Agreed by the Majority of Students

- **Relating reality to the studio project, (through slide presentations for example), is the way students prefer to be taught environmental issues.**

7.2.2.5 Learning

Sixty-two per cent of students of Architecture strongly agree with the statement:

I better learn Environmental Design when lectures combine practice with theories

Students of Architecture prefer learning that has a direct link with how knowledge/skills are applied in real working life; students learn better through experiencing. (Figure 7.23).

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Slightly disagree	2	1.1	1.1	1.1
	Neutral	10	5.5	5.6	6.7
	Slightly agree	54	29.8	30.2	36.9
	Strongly agree	113	62.4	63.1	100.0
	Total	179	98.9	100.0	
Missing	9	2	1.1		
Total		181	100.0		

Figure 7.23 Frequency table of question S16

Forty-six per cent of students strongly agree that:

In order for me to understand Environmental Design better, I need to visit and look at the building examples. (Figure 7.24).

Thirty-eight per cent also slightly agree with this statement.

Students need to see the applications of knowledge in order to understand Environmental Design better.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Slightly disagree	7	3.9	3.9	3.9
	Neutral	19	10.5	10.7	14.6
	Slightly agree	69	38.1	38.8	53.4
	Strongly agree	83	45.9	46.6	100.0
	Total	178	98.3	100.0	
Missing	9	3	1.7		
Total		181	100.0		

Figure 7.24 Frequency table of question S29

Students seem to learn better if they can visualise the issues they are learning:

When I learn something I try to see in my mind how things fit together with other subjects

Forty-one per cent and 39% of students agree, slightly and strongly, about this statement (Figure 7.25). They need to organise and fit ideas together in order to learn. This is interesting as students participating in the online questionnaire approach learning in a deep way, or at least they recognise this approach as the best way for them to learn something. Students should be thinking critically and organising their ideas on Environmental Design and Sustainability before applying them in their designs.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Slightly disagree	10	5.5	5.6	5.6
	Neutral	25	13.8	13.9	19.4
	Slightly agree	74	40.9	41.1	60.6
	Strongly agree	71	39.2	39.4	100.0
	Total	180	99.4	100.0	
Missing	9	1	.6		
Total		181	100.0		

Figure 7.25 Frequency table of question S18

Fifty-four per cent of students also need a variety of teaching methods during the year in order to understand the information given. They strongly agree with the statement:

I understand better if we do different things in class, (lectures, visits, projects, etc...) – it's good to change

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly disagree	2	1.1	1.1	1.1
	Slightly disagree	3	1.7	1.7	2.8
	Neutral	9	5.0	5.1	7.9
	Slightly agree	65	35.9	36.7	44.6
	Strongly agree	98	54.1	55.4	100.0
	Total	177	97.8	100.0	
Missing	9	4	2.2		
Total		181	100.0		

Figure 7.26 Frequency table of question S34

Thirty-six per cent also slightly agree. Although students have a preference for experimental learning, they need to experience different methods and approaches to learning to keep their motivation to learn; they do not like learning/teaching routines.

Summary of Ideas Agreed by the Majority of Students

- **Students learn better through experimental learning.**
- **Students learn better when they experience different methods of learning.**

7.2.2.6 Integration

Thirty seven per cent of students slightly agree with the statement:

While designing, I always think about Environment and Sustainability

Twenty per cent also agree strongly with this statement (Figure 7.27). Students participating in the online questionnaire think about environmental issues and Sustainability while they design. They seem to be engaging at some level with these issues.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly disagree	13	7.2	7.2	7.2
	Slightly disagree	36	19.9	20.0	27.2
	Neutral	28	15.5	15.6	42.8
	Slightly agree	66	36.5	36.7	79.4
	Strongly agree	37	20.4	20.6	100.0
	Total	180	99.4	100.0	
Missing	9	1	.6		
Total		181	100.0		

Figure 7.27 Frequency table of question S2

Summary of Ideas Agreed by the Majority of Students

- **Students of Architecture think about Environmental Design and Sustainability when designing.**

Considerations of bias

As the questionnaire was kept anonymous, there is no way to determine who answered the questionnaire – teachers with lot of experience, new ones or PhD demonstrators. It is not known how many of the teachers participating in the interviews answered the questionnaire or how many 'new' teachers (not being interviewed) were involved. There is also no way to know how many students from each year answered the questionnaire. Only students from a specific year (first, second, third or diploma) could have been prompted by a teacher to answer the online questionnaire when others were not. Nevertheless, some of the ideas from students' interviews are very similar to those of students participating in the questionnaire.

Sometimes there is agreement in the way a question was answered; for example 39% of teachers answered the same way in questions 23, 24 and 25. However, the research did not reveal whether those answering the same way were the same people, and just concentrated on the overall percentage of answers.

Summary of Ideas

1. Environmental Design and Sustainability are important.
2. Environmental Design and Sustainability are design generators.

3. Environmental Design and Sustainability are interesting and important.
4. Students' motivation to attend a course is not only the final grade.
5. Relating reality to the studio project, (through slide presentations for example), is the way students prefer to be taught environmental issues.
6. Students learn better through experimental learning.
7. Students learn better when they experience different methods of learning.
8. Students of Architecture think about Environmental Design and Sustainability when designing.

7.3 Summary

The majority of teachers participating in the online questionnaire agree to some extent that there is no division between Architecture and Environmental Design; while students are not really sure about these issues and need more study of them.

Students need time to analyse the information given in lectures before applying it in their designs. Teachers also think there should be a gradual teaching starting from basic principles and moving to more complex issues, as they identify a problem with mathematics and Architecture students' learning of technology.

Design is the best way to teach Environmental Design and Sustainability. However, teachers use different methods to teach these aspects of Architecture and students prefer to experience a variety of teaching methods during the year. Nevertheless, these methods should include experimentation, local examples and practical exercises, as this is they way they improve their understanding of Environmental Design and Sustainability.

Teachers believe that more contact time with teachers will also improve students' learning. Design tutors spend more time with students; consequently they are central in motivating students to learn. Students are influenced by teachers to learn Environmental Design and Sustainability as they imitate teachers' interests.

Students find Environmental Design and Sustainability interesting. A majority attend lecture courses probably for this reason, although passing the course is also important for them.

More than 60% of teachers teach Environmental Design and Sustainability through integrated Design projects. Students think about these issues while designing.

However, teachers of Environmental Design and Sustainability related courses, believe more assessment weight of these issues in the Design projects is necessary, also that more daily examples are needed to understand Environmental Design and Sustainability in terms of Design. These could indicate students are not applying these issues in their projects and that more work is necessary to integrate Architecture, Environmental Design and Sustainability.

In this Chapter the data drawn from the online questionnaire was explained and some conclusions can be recognised: A gradual approach to learning will help students learn principles and understand better Environmental Design and Sustainability, there is a need to integrate ideas with the design project, also to increase the contact time between teachers and students, teaching and tutoring should improve and teaching should add more reality and experimental exercises to help students to learn, the way they prefer to learn.

In the following chapter, the findings in this chapter and the ones obtained from the interviews (discussed in Chapter 6) will be compared. The responses from teachers and students of Architecture will also be contrasted.

[1]

[1] *Educating Architects for a Sustainable Environment* **(EASE project) (2002) http://www.bsu.edu/cap/ease/**

Chapter 8: Comparison

Chapter 8

8 Comparison of Data

In this chapter the data drawn from online questionnaires, in the previous chapter, will be compared with the qualitative findings. At the end of the chapter, a summary of the research findings and the ideas that developed from the research will be given.

8.1 Quantitative Findings

8.1.1 Categorical Data Analysis

As previously mentioned, the data obtained from questionnaires is called categorical data. Questions are numbered the same way they appear in the questionnaire; 'S' is used to identify students' questions and 'T' for teachers' questions. To determine the extent of agreement or disagreement between students and teachers' responses, the Mann-Whitney U test has been used.

The Mann-Whitney U test provides means for assessing whether two independent samples, with data not normally distributed, are from the same population. U is the number of times a value in the first group (students) precedes a value in the second group (teachers), when values are sorted in ascending order (from SPSS 11.0 tutorial).

Under the null hypothesis, a uniform distribution of the relative number of responses is expected, and hence the statistic is built, by means of finding a measure of the distance between expected results and observed values. The resulting statistical value is associated with a p-value that is used to make a decision on whether or not the data provide evidence to reject the original hypothesis. The smaller the p-value, the stronger the evidence against the null hypothesis and a large p-value, $p>0.05$, for instance, is said to provide no evidence to reject the null hypothesis. When two variables are compared the test provides evidence, or not, to determine if both (lecturers and students) coincide in their responses: if they agree in the way they answered the questions.

determine if both (lecturers and students) coincide in their responses: if they agree in the way they answered the questions.

Graphical analysis through box plots and frequency tables was also done, in order to see the relation between different answers from students and teachers. Box plots are used to compare similar questions and their answers. Fifty per cent of the answers are expressed in a coloured box; the maximum and minimum responses through extended lines showing the range of responses; the median response as a line that divides the box. The box plot is not only used to show relations between responses, but also to show the distribution of the answers through the five variables (strongly disagree, slightly disagree, neutral, slightly agree and strongly agree).

In this chapter the results from the online questionnaires are used to help analyse the qualitative data and the resulting teaching ideas from the personal interviews considered earlier.

8.2 Comparisons

The combination of qualitative and quantitative research is called multi-stage research. Although this study is mainly of a qualitative nature, the use of questionnaire as a mean of confirming the qualitative results falls into the category of multi-stage research comparison. There are many arguments when combining qualitative and quantitative research, some have to do with the commitment with one method and the other with being that two research methods from different paradigms which cannot be mixed. Nevertheless, qualitative and quantitative researches have some common ground in them (Bryman 2001).

The multi-stage research is based in the idea of triangulation. This idea implies that the results of an investigation employing a method associated with one research strategy (interviews) are cross-checked against the results of another method associated with a different research strategy (questionnaire) (Bryman 2001). Triangulation is very useful to corroborate results of an idea through different methods. However, sometimes the results could have inconsistencies and it is the choice of the researcher to investigate further the reasons for these discrepancies, or to exclude one set of results and the research method.

In general one research method facilitates the other. Qualitative research is very useful to provide an in-depth knowledge of a social context, first to find out the appropriate terms to use for questionnaires, and second to provide ideas that can be tested through quantitative research. On the other hand, quantitative research can be a precursor of qualitative research through a methodical selection of the sample that can later be interviewed, observed or studied.

In the following sections the responses of teachers and students will be presented. Some comparisons are made between teachers' ideas and students' ideas and some are made between questionnaire findings and findings discussed in Chapter 6.

8.2.1 Understanding of Sustainability

During the interviews with students (Chapter 6) many of the students said that they did not have a clear understanding of Sustainability, although they were aware of some of the issues raised in discussions about Sustainability.

In Figure 8.1 the distribution of students' opinions about Sustainability is shown. Half of the respondents agree and half disagree with this statement: 'I rate my overall understanding in Environmental Design and Sustainability as high'. This result supports the ideas drawn from the interviews, where some students had an understanding and knowledge about sustainable issues and others had never heard of them or were not interested in hearing about them.

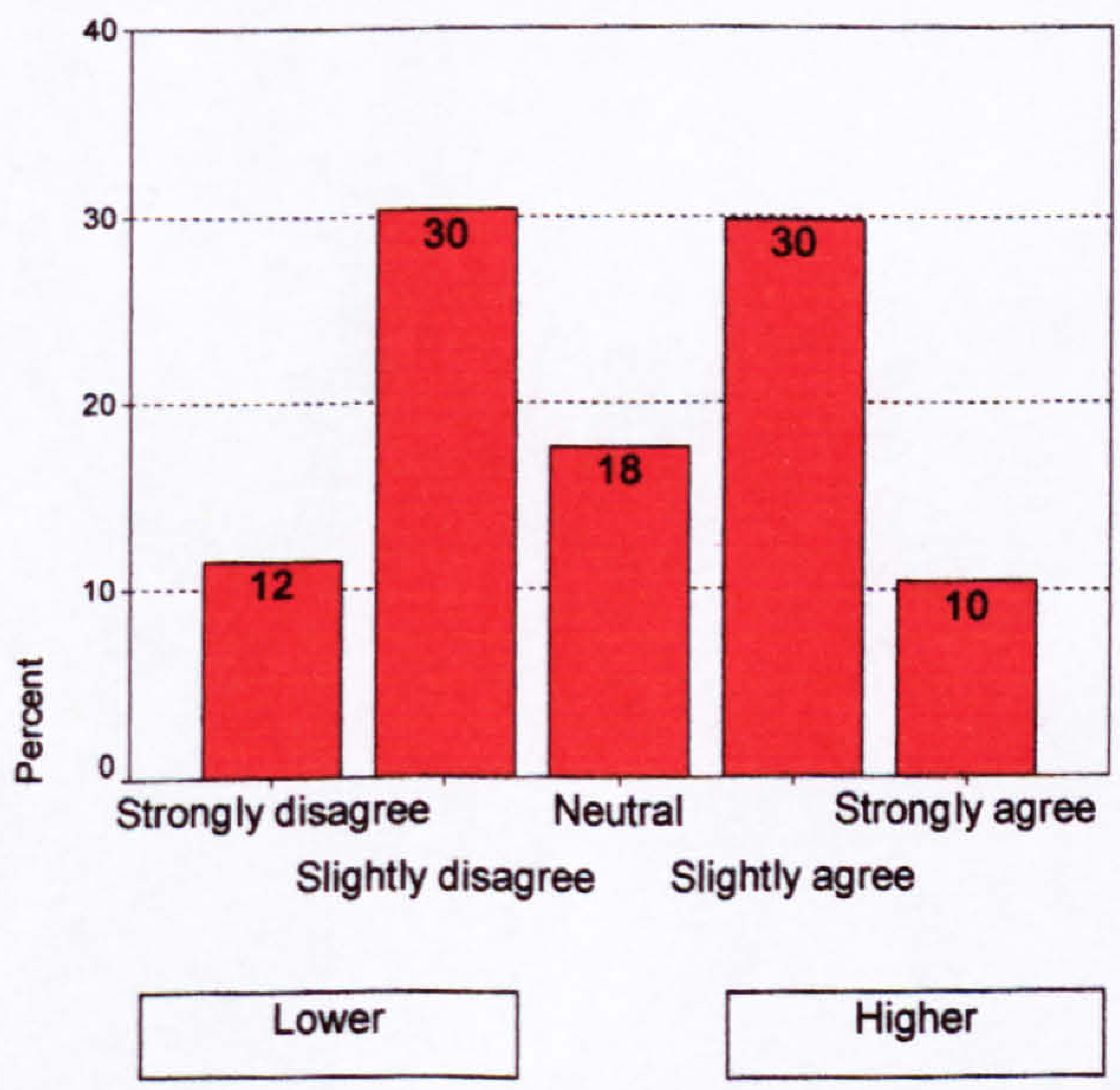

Figure 8.1 Students rating their overall understanding of Sustainability as high

definitions, but all have a level of understanding and engagement with the subject. On the other hand, Figure 8.2 shows how teachers defined and interpreted Environmental Design and Sustainability in teaching terms and ideology. It shows that teachers participating in the questionnaire seemed to agree with the statements T27, T14, T28, as all responses are concentrated above the neutral line (0).

The responses obtained in the interviews (Chapter 6) are obviously more varied than those obtained from the questionnaire (Figure 8.1 and 8.2). Nevertheless, approximately 64% of the teachers participating in the questionnaire agreed at some level with the statement T25: 'Architecture is Environmental Design'. Moreover, almost 68% strongly agree that students will understand the same idea if there is integration with the Design project (T4) and 39% strongly agree that Environmental Design and Sustainability are part of technological subjects in Architecture (T24).

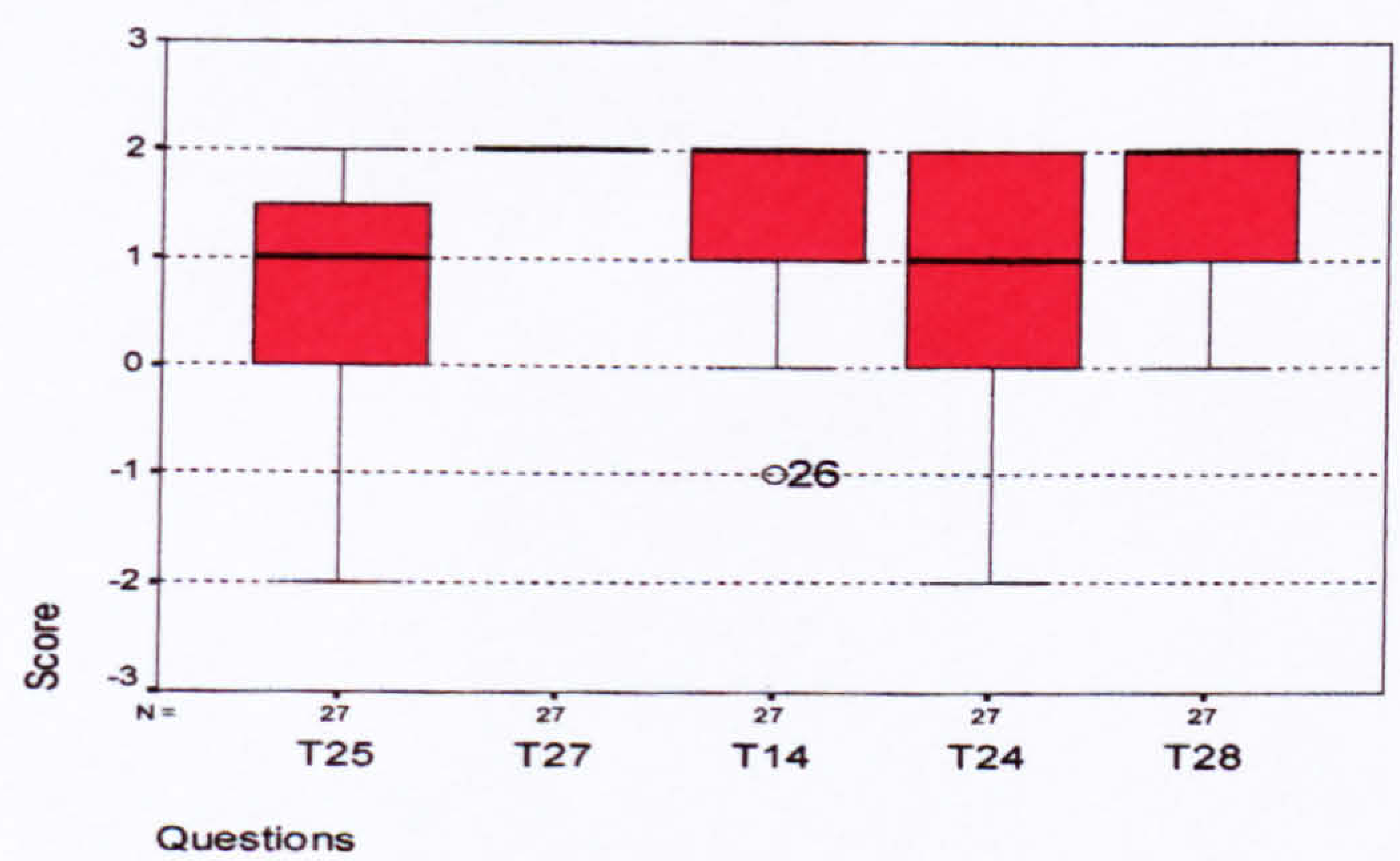

Figure 8.2 Teachers' ideas on Sustainability and Environmental Design (SPSS box plot)

T25: Architecture is actually Environmental Design

T27: Sustainable design starts with the first design idea

T14: Integrating design projects with Environmental Design make students understand that Design and Environmental Design are the same

T24: Environment and Sustainability are part of technology

T28: They are technology and also history

O Number 26 describes an outlier[2]

[2] An Outlier is a value between 1.5 and 3 box lengths from the upper or lower edge of the box. (SPSS program)

Seventy nine per cent of teachers participating in the questionnaire agreed that Environmental Design principles and ideas have to start at the beginning of the design. Also, almost 96% agreed that Environmental Education is not only part of technology, but also of the history of how other people have done design in the past.

During the interviews, many students explained that extra time and extra work are a big problem in integrating design and technology, although they appreciate having environmental projects instead of lectures. In the questionnaire, 72% of participating students are also interested at some level in Environmental Design and Sustainability (Figure 8.3), which can be confirmed by S25 (Figure 8.4), where 69% of the students recognised that they do not apply Environmental Design and Sustainability issues in their design for various reasons, probably the ones mentioned above, but not because they are not interested (S25, S26).

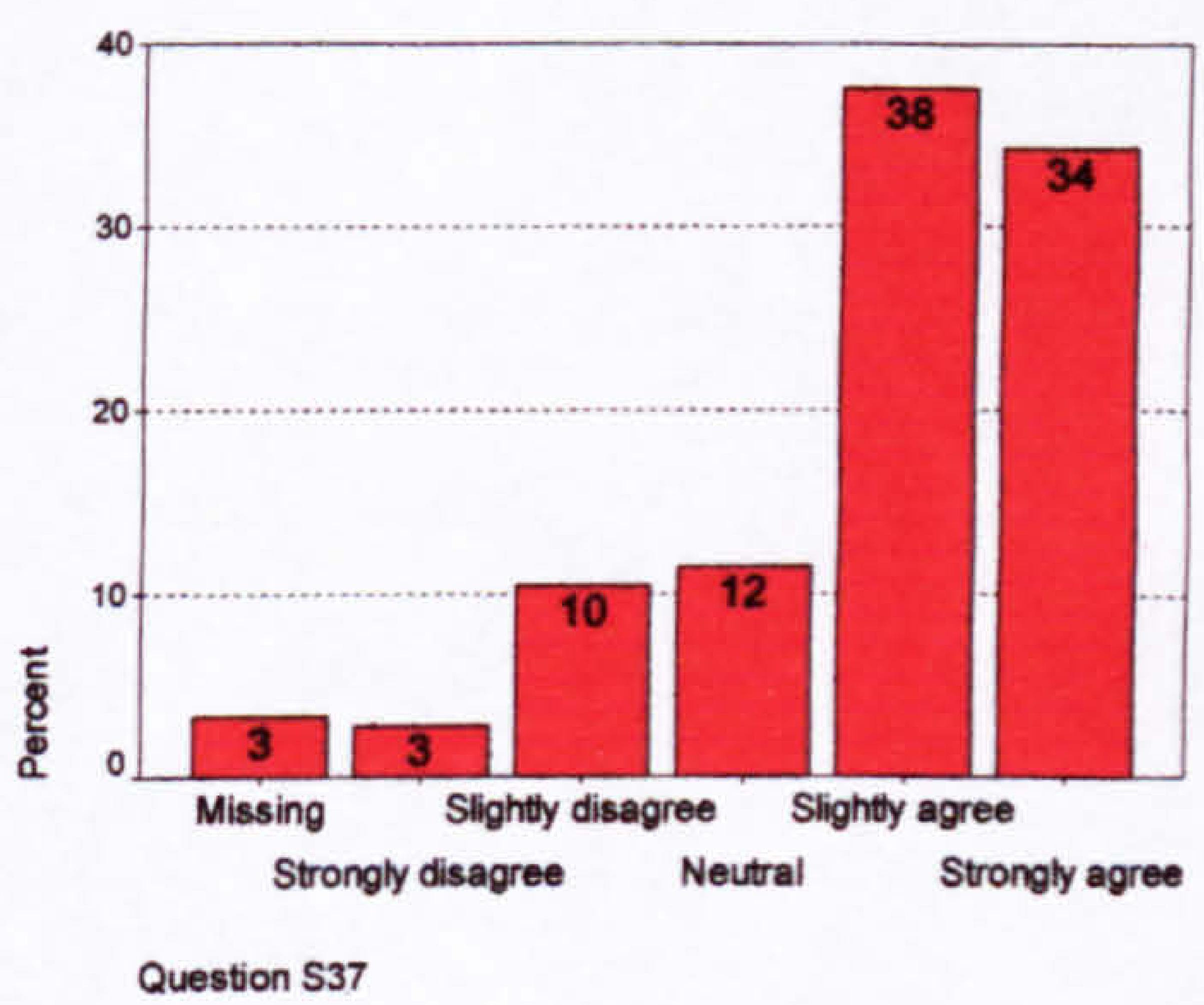

Figure 8.3 Frequency of students thinking Environmental Design is a very interesting subject

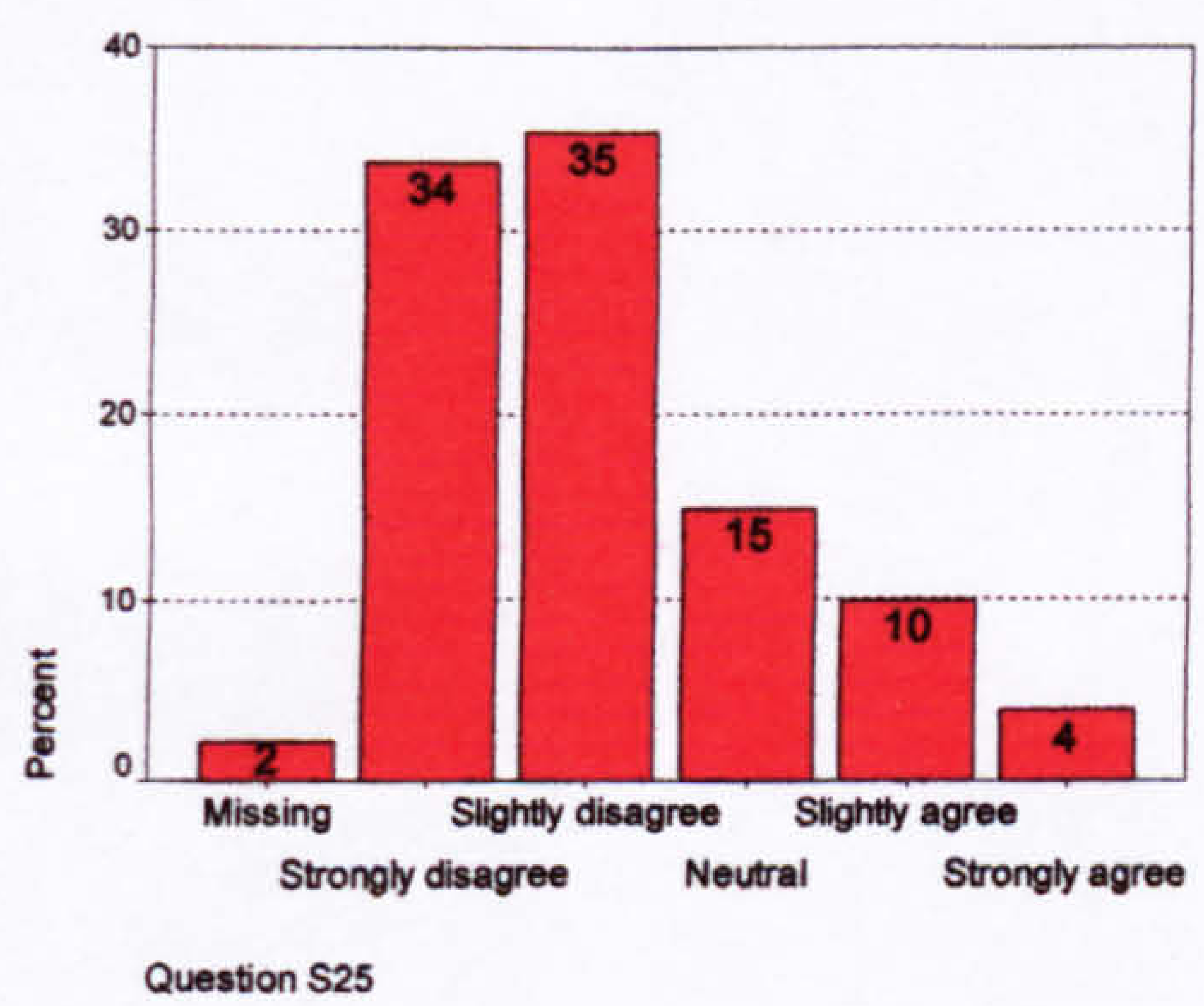

Figure 8.4 Frequency of students not applying Environmental Design because they are not interested

In Figure 8.5, it seems that roughly the same percentage of students that think Environmental Design and Sustainability are enjoyable (S38) think they will discard a design solution if it is not environmentally friendly (S40). This is the same number of students who think their understanding of these issues is high (S1). Although the distribution is very varied (answers range from 2 to −2) the majority agree with answering these answers the same way. Fifty per cent of the students disagree that they have a high understanding of Sustainability. However 48% agree at some level that they enjoy studying these issues, although 43% admit that they do not have them as priorities in their designs.

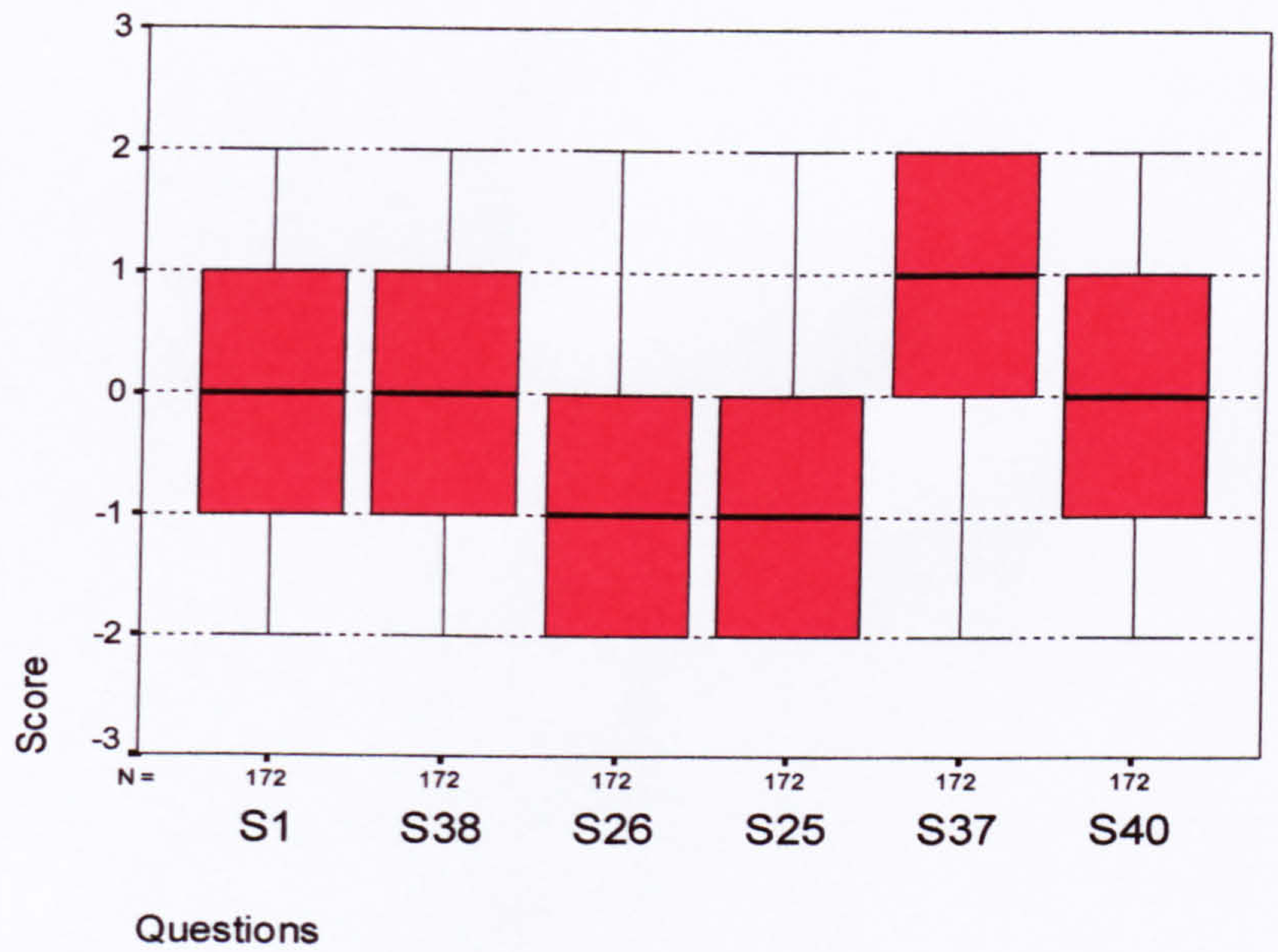

Figure 8.5 Comparing students' interests and understanding of Environment and Sustainability

S1: Rate overall understanding of Sustainability as high

S38: Enjoy these issues

S26: Lecturers didn't make anyone think: I mostly design sustainable anyway

S25: I don't apply Environmental Design because I am not interested

S37: Think these issues are interesting

S40: These issues are priorities in design

Summary

Both students and teachers have an understanding of Sustainability and Environmental Design. Teachers have more ideas than students and they think students will understand when they start applying them in their designs. However, students are not applying their environmental knowledge in the design, although they are interested. As mentioned in Chapter 6, some of the causes appear to be students' motivation, teaching strategy, students seeing limited relevance to their designs, and time constraints.

8.2.2 Teaching Methods Preferred by Teachers

Figure 8.6 shows a variety of responses regarding how teachers prefer to teach Environmental Design and Sustainability and with which frequency. Most of the teachers use, or believe that using, different methods is a better strategy for teaching Environmental Design and Sustainability in Architecture than not using such variety.

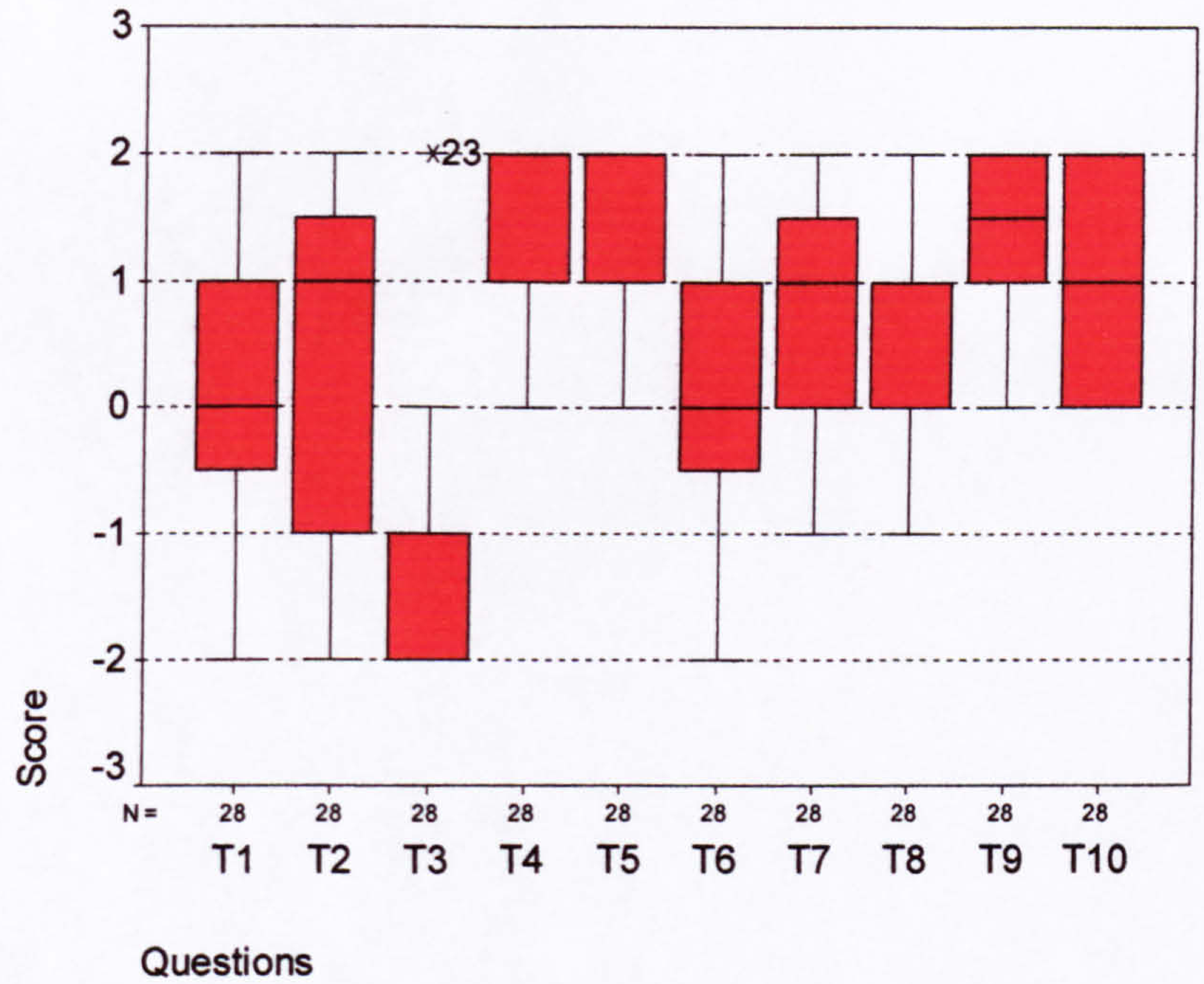

Figure 8.6 Teaching methods preferred by teachers for teaching Environmental Design in Architecture

T1: Most frequent method: lectures

T2: Frequently: site visits

T3: Technology dealt with separately, students make connections designing

T4: Design projects

T5: Case studies, analysing existing buildings

T6: Lab/Experiment sessions

T7: Hand-on-experience/Real projects

T8: Studio design is the best way to teach Sustainability in Architecture

T9: Integrated projects

T10: Small group sessions and seminars

*Number 23 describes an extreme[2]

From the group of teachers interviewed, 89% agreed to some degree (50% strongly agree; 39% slightly agree), that above all, the best teaching method for teaching Environmental Design and Sustainability is through integrated projects, where design, technology and environmental concerns are equal parts of the process of

[2] An extreme is a case with values more than 3 box lengths from the upper or lower edge of the box. (SPSS program)

design (T9). This is confirmed by the responses to question T3, where only a few (18%) agreed with separating technology from the design studio and leaving students to make their own connections. However, during interviews in some Schools teachers thought that this was a good solution for students (section 6.1.2.4), since this was considered a way for students to take control over their own learning; create their own concepts of Sustainability and be committed to learn the subject.

From the variety of responses, it seems that tutors and lecturers answering the questionnaire agree with tutors and lecturers interviewed on the benefits of renewing teaching strategies during the academic year. It can be seen in Figure 8.6, that teaches of Environmental Design courses seem to prefer many methods of teaching, especially Design projects (T4), Case studies of existing buildings (T5) and Integrated projects (T9). In this three questions 50% of the responses are concentrated above 1 (between slightly agree and strongly agree). Nevertheless, some of the answers are not distributed in a regular way; for example, T2 and T10 where 50% of the responses range from two to two and-a-half points in the scale (Figure 8.6). This means that teachers responded in different ways to these questions, there was not unanimity.

I believe Studio Design is the best way to teach Sustainability in Architecture

	T8:
Chi-Square	8.857
Degrees of freedom	3
Asymptotic Significance	.031

Figure 8.7 Chi-Square homogeneity test

Moreover, 46% of the teachers agreed at some level that they frequently use lectures. In addition, even though a big majority of the teachers participating agreed with the question of whether Design was the best method for teaching Sustainability and Environmental Design (T8), there is evidence to reject the homogeneity of the responses (Figure 8.7).

It is likely that many teachers agree that teaching through design projects and case studies helps students through the process of making conclusions and connections about the environment, Sustainability and design. This is supported by the responses in relation to T13, Figure 8.8, where 75% strongly agreed with increasing contact time to improve students' learning experience. This idea was highly supported by teachers and students during the interviews.

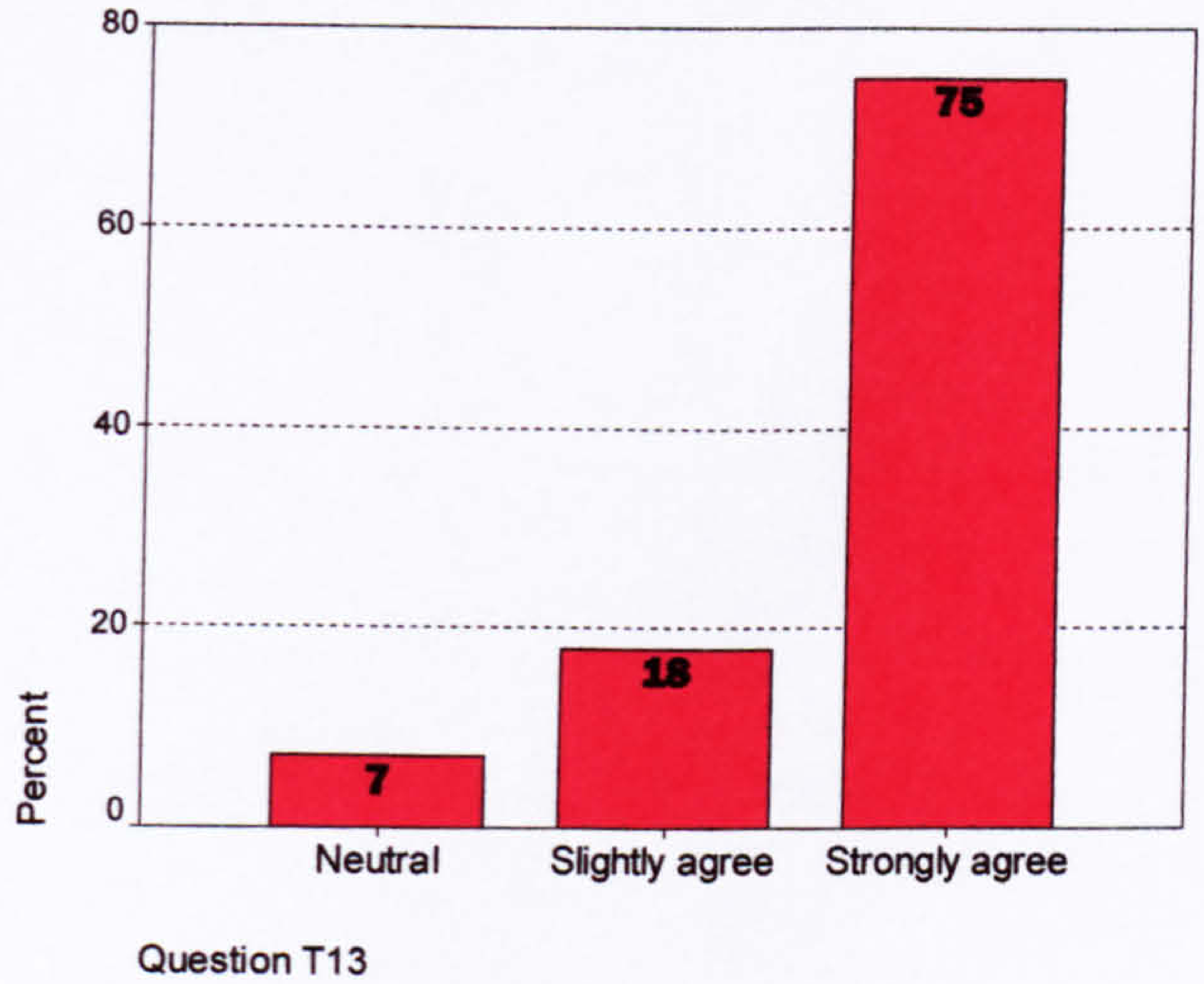

Figure 8.8 Frequency of teachers believing that more contact with students at tutorials will improve their learning experience

This is confirmed by comparing responses from students and teachers participating in the questionnaires (Figure 8.9). There is evidence to suggest that the distribution of students' and teachers' answers is the same, as the p-value equals 0.296.

	Test of Independence of Variables
Mann-Whitney U	2196.000
Asymptotic Significance. (2-tailed)	.296

Figure 8.9 Agreement with the statement: Small groups are good for the learning/teaching of Environmental Design

This means that there is no evidence that the groups are in disagreement in saying that small groups and more tutoring are good for learning and teaching. Therefore, it can be assumed that teachers and students prefer small group teaching and learning, as there is no evidence that they believe the opposite.

Summary

Teachers of architecture prefer to vary the methods they use during the year to teach Environmental Design and Sustainability. The majority agree that using integrated projects is the best method above all. Nevertheless, a big number frequently use lectures and more theoretical approaches to teaching these subjects. Teachers also think increasing contact time improve their learning experiences. Small group of students could be a solution to increase contact time seeing that although teachers and students do not agree in liking small group teaching, there is no evidence to suggest they dislike this teaching method.

8.2.3 Integration of Design and Environment and Sustainability

Teachers prefer to teach through integrated design projects. Nevertheless, 43% think students have problems understanding Sustainability and Environmental Design in terms of design (T17). Seventy nine per cent of teachers have noticed that students ask questions based on their design projects (T19), thus they seem to be interested in the application of sustainable and environmental ideas in the design. The distribution of these questions can be seen on Figure 8.10.

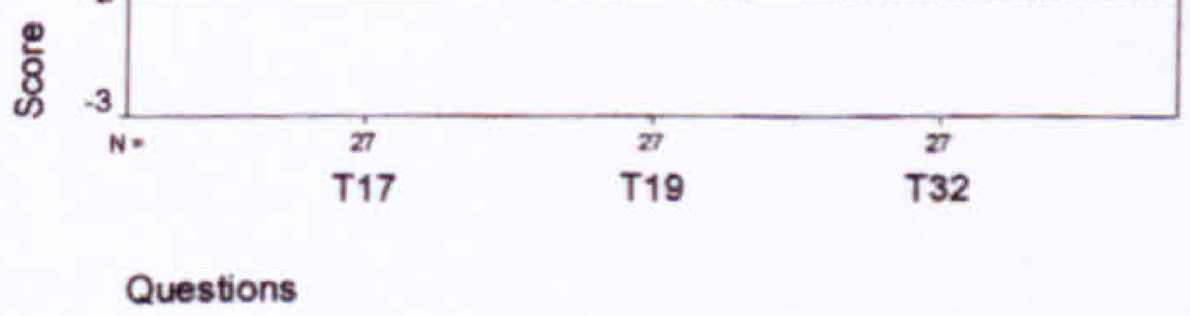

Figure 8.10 Teachers' perception of how students integrate design and Sustainability

T17: Students have problems understanding Sustainability in terms of design

T19: Students tend to ask questions related to their designs

T32: The assessment weight of Sustainability should increase

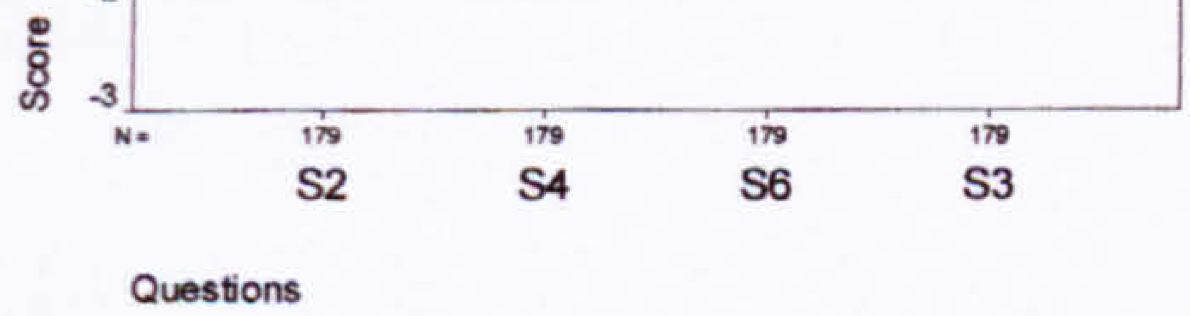

Figure 8.11 Environment and Sustainability integration in the design from students' perspective

S2: Always think about Environmental Design and Sustainability when designing

S4: Always consider them, as I understand them well

S6: Always consider them, as they are design generators

S3: Relate information from lectures in the design. Easier to see the relevance

Students also affirm that they think about Environmental Design and Sustainability when designing — Figure 8.11 (S2: 37% slightly agree; 20% strongly agree). Moreover, 59% agreed at some level that these issues can be design generators and therefore are taken into consideration during the design process (S6).

Through a comparison of students and teachers' answers on integrating Environmental Design and Sustainability into the Design project, it can be seen that there is no agreement between the responses of teachers and students. This disagreement is present when they referred to Sustainability as a design generator and the fact that students include these ideas from the first moment of design (test A in Figure 8.12 with a P-value of 0.000). There is also good evidence of disagreement between students and teachers in believing Environment is as important as any other design factor and the fact that, while designing, students think about the environment and Sustainability (tests C and E). It is important to restate that this disagreement between teachers and students refers to the way they answered the questions. Although the test might show disagreement between students' and teachers' responses, it does not completely show whether they have opposite point of views about the subject.

	A	B	C	D	E
Mann-Whitney U	789.000	2286.500	1809.500	2241.500	1764.500
Asymptotic. Significance. (2-tailed)	.000 **	.607	.025 *	.503	.017 *

Figure 8.12 Agreement on integration of environmental issues in the design

A: Sustainability is a design generator that starts to be present in the design from the first idea

B: Students do not apply environmental elements in their designs

C: Students believe Environment is as important as any other design factor

D: Students understand Environmental Design and Sustainability in terms of design

E: While designing, students think about the environment and Sustainability

* Significantly different

** Highly significantly different

Whereas both students and teachers mostly agree with the statements in Figure 8.12, they agree with them at different levels, teachers think of the integration of these issues in a more categorical way. Nevertheless, there is no evidence to determine that students and teachers are in disagreement about students applying Environmental issues and Sustainability thought in their designs (test B), and the understanding of these issues in terms of design (test D). So it can be inferred that they agreed on these issues of integration, that both think students are applying environment and Sustainability issues in their design and therefore they understand them in terms of design. These results could be due to the fact that although students do not always apply Sustainability and Environmental Design in their projects, they have a level of understanding and sometimes this knowledge is applied by students and recognised by teachers.

Despite students' consideration of Environmental Design, teachers think that there should be greater weight given to environmental issues and Sustainability during the design assessment [68% slightly agree and 50% strongly agree (T32 in Figure 8.10 in previous pages)]. This was also discussed during the interviews, when teachers expressed the necessity of ensuring a greater equilibrium between different areas of design, indeed, giving equal importance to all areas, including Sustainability, Environmental Design, Construction, Structures and Services, among others.

In addition in Figure 8.13 it is clear that students (S9) and teachers (T32) disagree on the weight to be given to assessment of Environmental Design and Sustainability in the Design project (p-value of 0.000).

	Test of Independence of Variables
Mann-Whitney U	616.500
Asymptotic Significance (2-tailed)	.000

Figure 8.13 Agreement with the increase of assessment weight on Environmental issues

First of all, students do not want to have extra elements in their Design projects and especially in the assessment process – as explained during the interviews, students do not want extra pressure and work. Secondly, students think teachers are already putting a lot of weight on environmental issues and Sustainability in their projects.

Fifty per cent of students strongly disagree with the statement that even when teachers ask for sustainable work in their projects, they will not look at it in detail, Figure 8.14. However, many have experienced the opposite situation where tutors do assess these issues in a meticulous way.

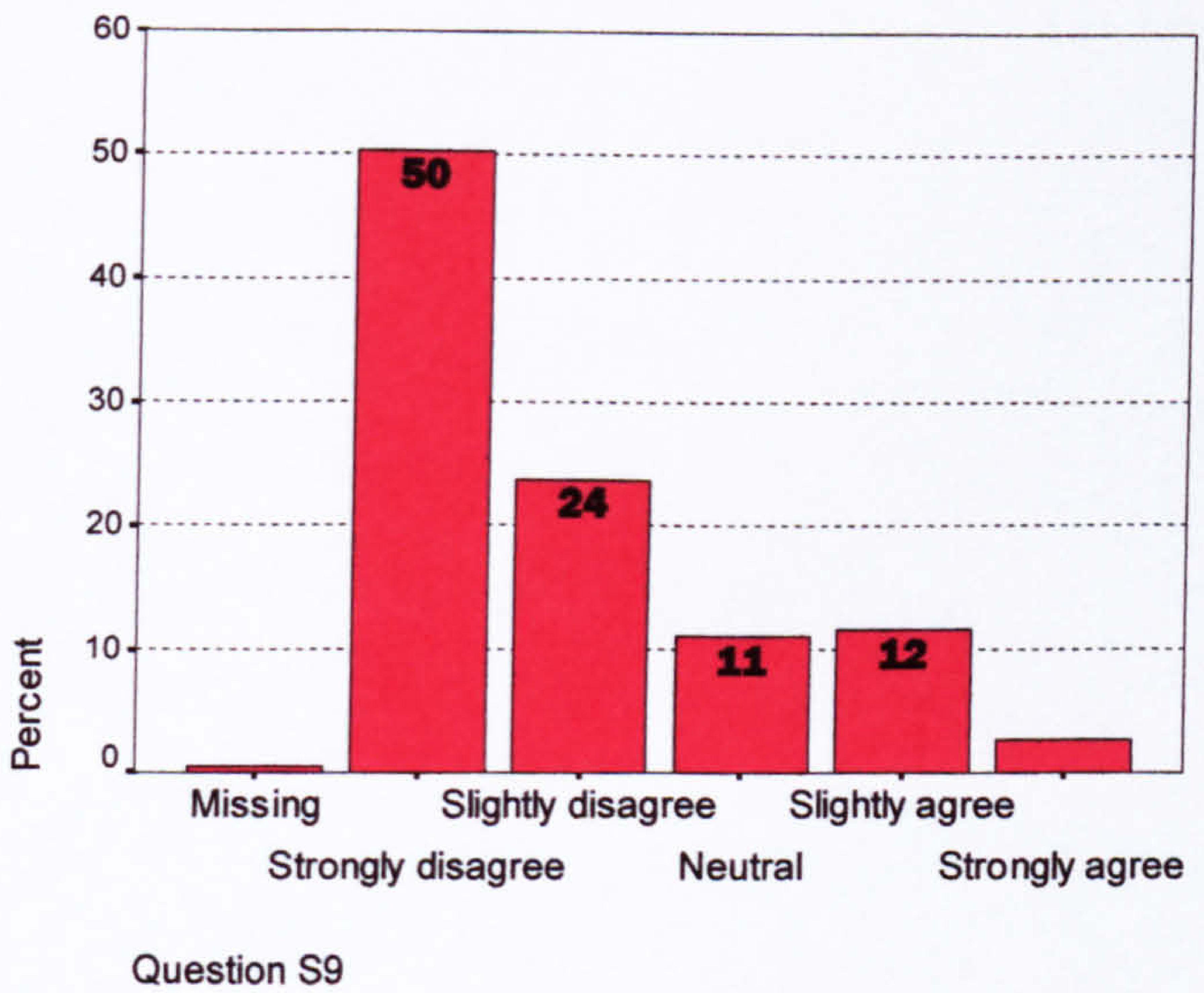

Figure 8.14 Frequency of students believing that Sustainability is not that important; because even if they are asked to do some work in sustainability, tutors won't look at it in detail.

Summary

Students responding to the online questionnaire seem to be interested in Environmental Design and applying the information they learn in their designs. Nevertheless, teachers think students do not understand these issues in terms of design, although they are interested in asking questions that relate issues of Sustainability and Environmental Design to their projects. It seems that more emphasis during the assessment period on Sustainability and Environmental Design, in order to improve the integration of these areas in the Design projects, is welcome by teachers but not by students, who think they are already doing too much of this. This is the first time a comparison between teachers' and students'

perception on this area have been done. In the data obtained from interviews and questionnaires it is common to find disagreement in the way teachers and students perceive aspects of teaching and learning Environmental Design and Sustainability. They disagree in the level of integration of the subject in the design and in the assessment weight they should have in the design process. This is important, since teachers and students do not agree in their perception of the subject; therefore the communication between them is not clear.

8.2.4 Perception of Scientific Subjects and Mathematical Literacy

As mentioned earlier, the difficulty in understanding Environmental Design and Sustainability comes from students' reluctance to learn any subject that resembles Science, Mathematics or any complicated equation. In Figure 8.15 (T22), teachers' opinions differ in how they perceive students avoiding Science subjects (59% agreed and 30% disagreed).

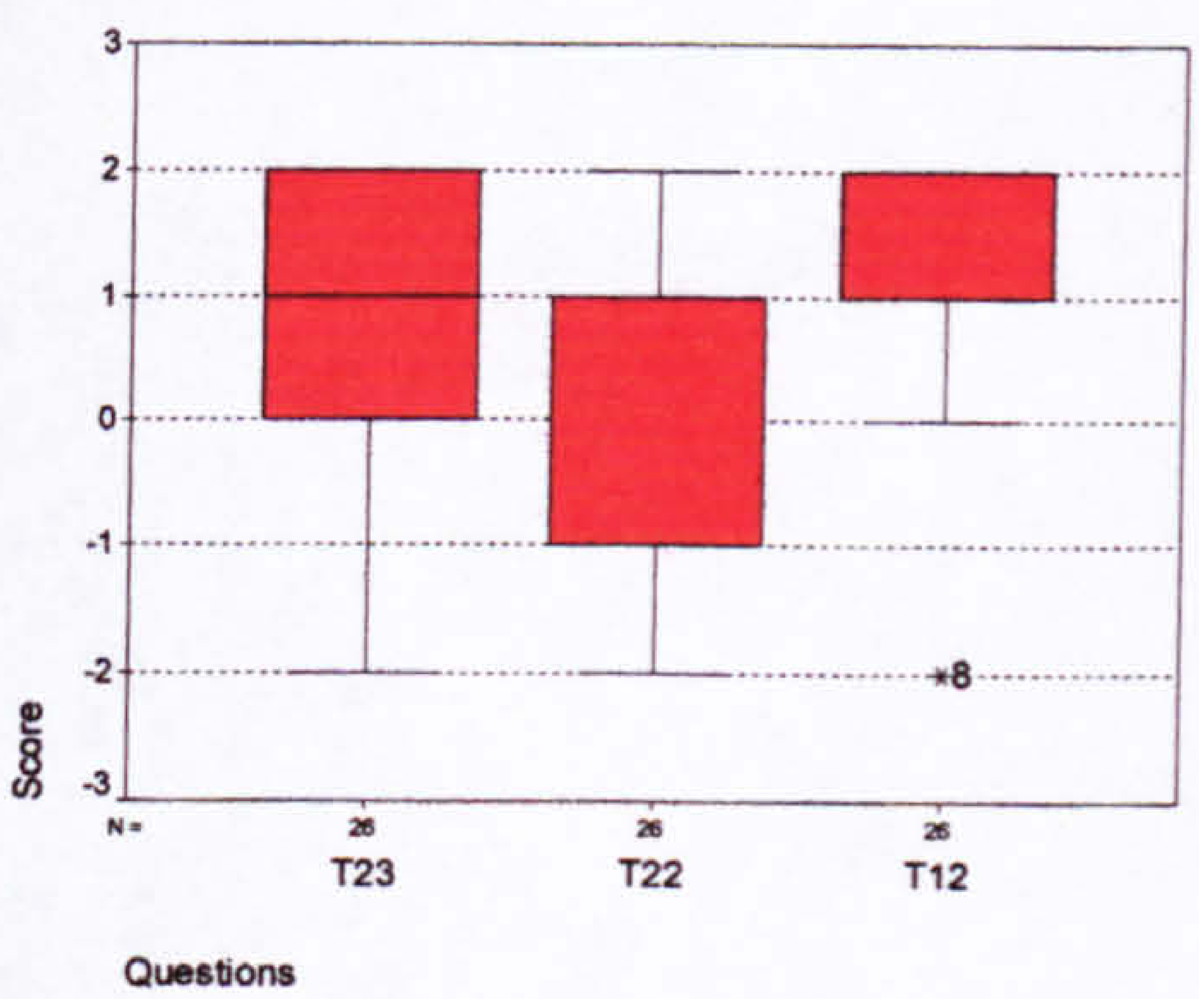

Figure 8.15 Teachers' perception of students' feelings towards Science and calculations

T23: Students don't understand if something looks like Mathematics

T22: Students tent to avoid Science subjects

T12: Teach students the principles of Environmental Design instead of calculations

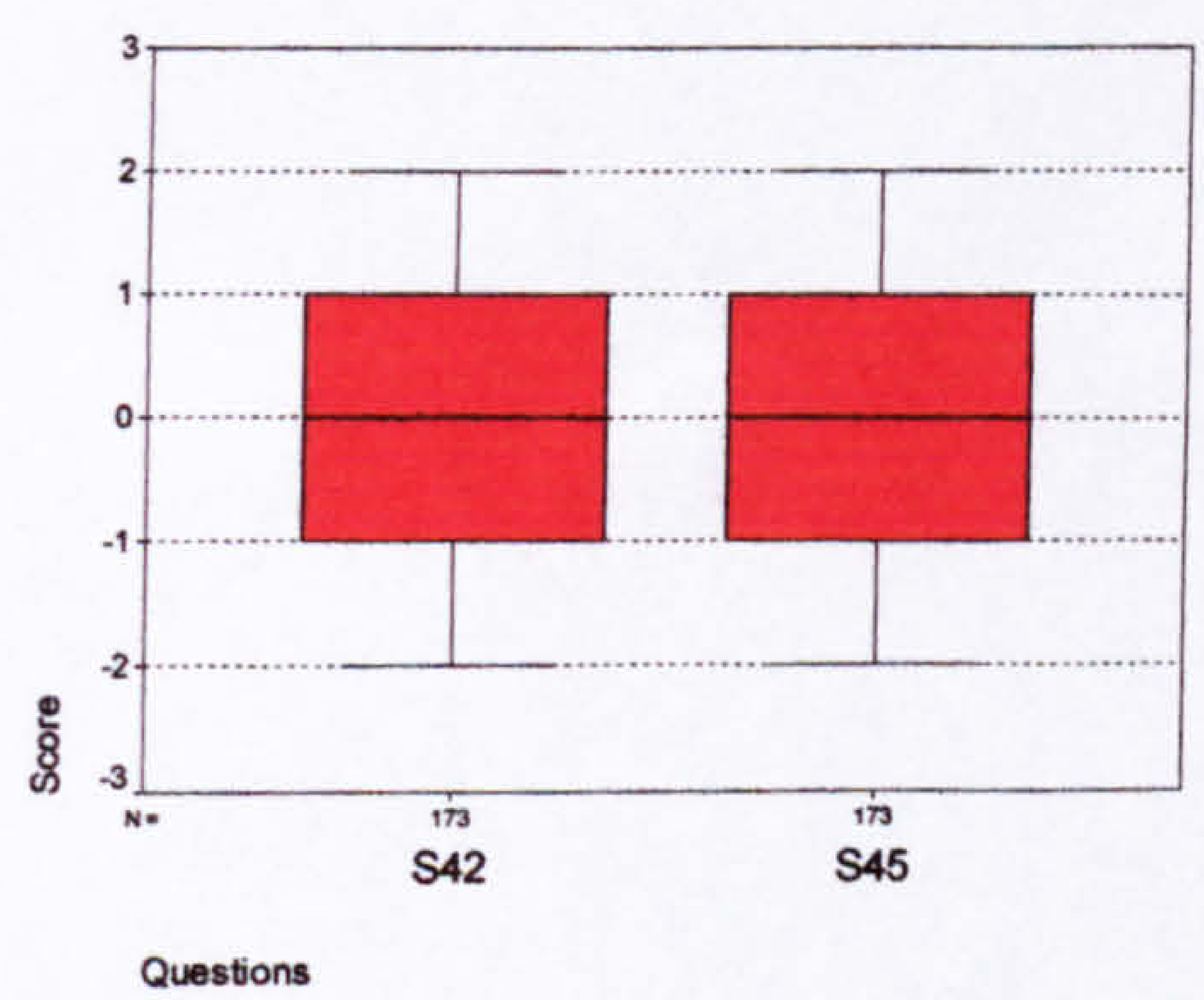

Figure 8.16 Students' perception of calculations in Architectural Studies

S42: Always dislike the fact that Environmental Design has too many calculations

S45: It is difficult to understand because Environmental Design has too many calculations

Sixty-four per cent of teachers agreed that students do not understand scientific subjects (T23). Forty-four per cent of the students agree that they do not understand them because they have too many calculations (S45 in Figure 8.16) and

56% of the students participating in the questionnaire (S42) express a dislike of all the calculations contained in Environmental Design courses.

Both students and teachers seem to agree with the fact that students like subjects that have to do with Technology and Science, as there is no evidence to say they disagree (Figure 8.17 with a p-value of 0.119 which is not significant). Nevertheless, there is evidence that they disagree with the statement that they do not understand Environmental Design because it has too many calculations and too much mathematics.

	Not understanding Environmental Design because it has too many calculations and mathematics	Students like subjects that have to do with technology and Science
Mann-Whitney U	1700.000	1982.000
Asymptotic Significance (2-tailed)	.033	.119

Figure 8.17 Test of independence of variables

On this, the distribution of students' answers is very homogeneous, as can be seen in Figure 8.16 where 50% seem to answer equally, above and below, the neutral line. Although there is a small majority agreeing with not understanding calculations (S45, S42), it would be difficult to say there is predominance in the responses. On the contrary, teachers agree in the way they answer these issues and they agree students do not understand calculations (T23). Despite this, it can be said that, although students seem to like technology and scientific issues, they do not understand Environmental Design and Sustainability, and although teachers blame this on the lack of interest in Mathematics and calculations, students disagree.

During the interviews, teachers explained that students have a better understanding if, during the lecture course, there is more emphasis on environmental principles than on calculations and 78% (T12) of teachers participating in the questionnaire agreed with this statement, too. Moreover, students like gradual learning – as some of the statements during the interviews state, they prefer to have time to think and apply the knowledge before moving to another subject.

Summary

Students are interested in the areas of Sustainability and Environmental Design and, although they appear to dislike calculations, which are always present when Sustainability, Services and Environmental Design factors are explained, students try to introduce some issues into their designs. Nevertheless, they do not understand Environmental Design and Sustainability. Teachers blame this on the lack of interest in Mathematics and calculations and students disagree. Teachers are trying to cope with students' predisposition against numerical knowledge and calculation by starting from simple principles and gradually moving to the more complicated scientific matters needed in the architectural design process.

8.2.5 Importance of Design and Other Subjects

During the interviews the majority of students agreed that Design was one of the main issues in Architecture (Section 6.1.3). Teachers also think it is important, although it takes most of the students' time. Nevertheless, they believe it is not the only important subject in Architecture.

Although there is a tendency towards agreeing that Design is the main subject in Architecture (Figure 8.18), only 22% strongly agreed with this statement (29% slightly agreed), in contrast with 23% and 16% who strongly and slightly disagree with the statement (S5). To support this idea, it is clear that students disagreed with S17: they think understanding Environmental Design is not secondary and that going to lectures is not only to pass the subject (42% and 20% strongly and slightly support the idea).

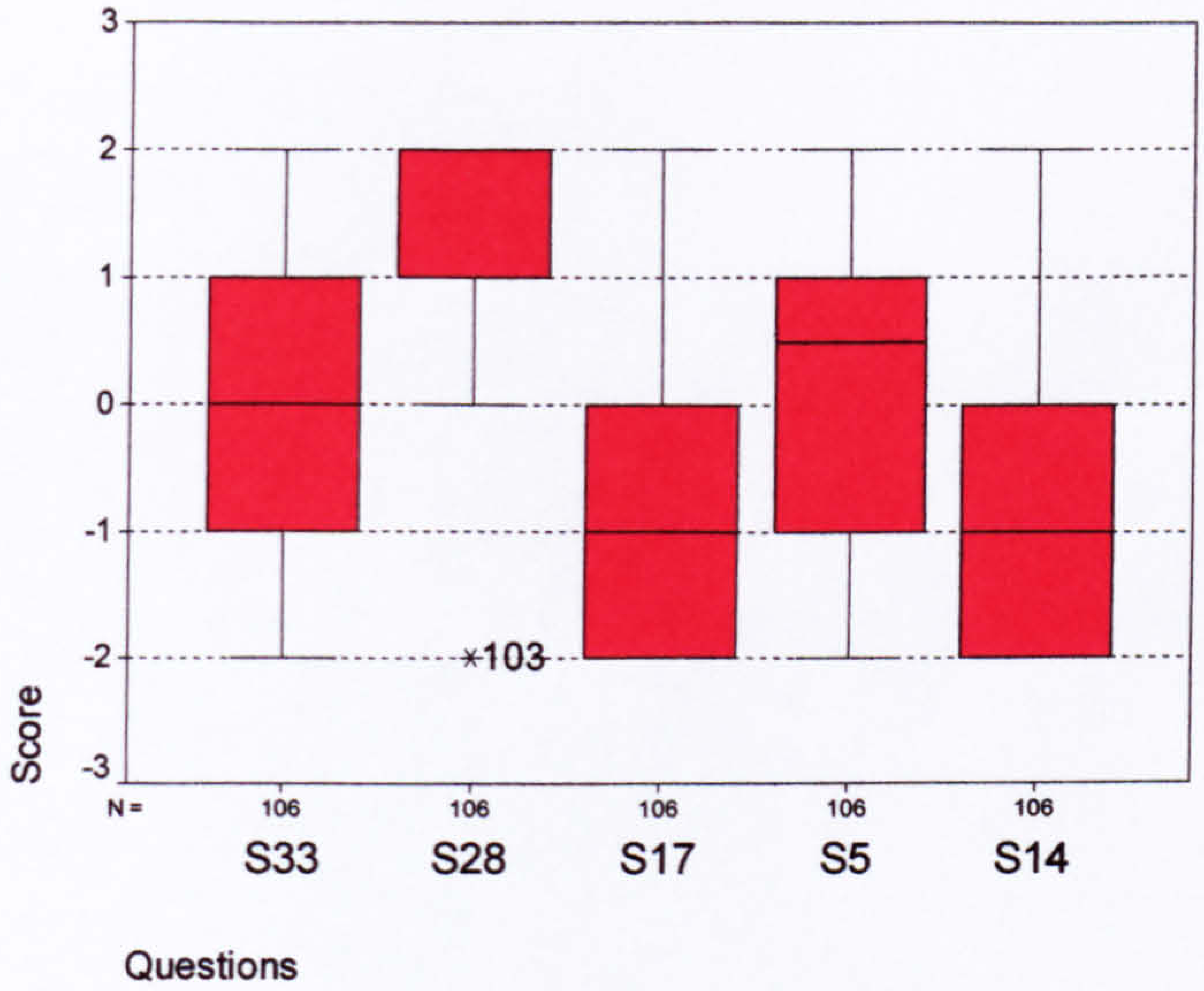

Figure 8.18 How students consider lectures and the Design studio in terms of importance and time expenditure

S33: Lectures are difficult and boring

S28: Students expend more time on design projects

S17: Environmental Design is secondary: just need it to pass

S5: Design studio is the main thing

S14: Just listening to lectures, students can learn all about Environmental Design

* Number 103 describes an extreme

Moreover, students think they need something else to understand the information given in lectures, as listening is not enough to learn (69% percent of respondents to S14 above). Nevertheless, it is clear in Figure 8.18 that students spend more time on Design projects than on any other kind of learning activity (S28 - 56% of the valid responses).

This could be due to the fact that students think lectures are difficult and boring (S33 in Figure 8.18). In contrast, teachers disagree with students (Figure 8.19) as there is evidence against the null hypothesis with a p-value of 0.022.

	Test of independence of variables
Mann-Whitney U	1756.000
Asymptotic Significance (2-tailed)	.022

Figure 8.19 Disagreement of students who find lectures boring and try skipping them

<u>**Summary**</u>

Although students think lectures are difficult and boring teachers think they are not. Nevertheless, there is not a majority of students that agreed with this statement (39% against 33%). Therefore, what is leading students to spend more time on Design could be the fact that they enjoy more participatory courses, and not because of the lectures.

8.2.6 Students' Participation in Courses

Figure 8.20 shows some of the students' preferred learning methods. Most students preferred to some degree those courses that have some practical side to them, such as site visits and projects related to the working world and living environment.

Forty-five per cent of students strongly agreed with being able to understand Environmental Design if participating in an environmental project (36% slightly agreed with the statement). In addition teachers of Architecture also agreed during the interviews that participation of students promotes understanding.

Nevertheless, in Figure 8.21 students and teachers disagree about some methods (visiting, looking at buildings examples or examples from daily life), and there is no evidence against the null hypothesis (p-value of 0.084). This means that students and teachers have different opinions about the teaching and learning environment and Sustainability through projects and examples. As mentioned earlier this disagreement between teachers and students happens despite the fact they mostly answer in a similar way, this could be due to the fact that teachers and students have differences in the way the express their opinions; in this case students tend to have a similar opinion about the questions asked (for example the majority answered 'strongly agree') when teachers, tended to vary in the way they answered the questionnaire, having an almost homogeneous distribution of answers between the five variables.

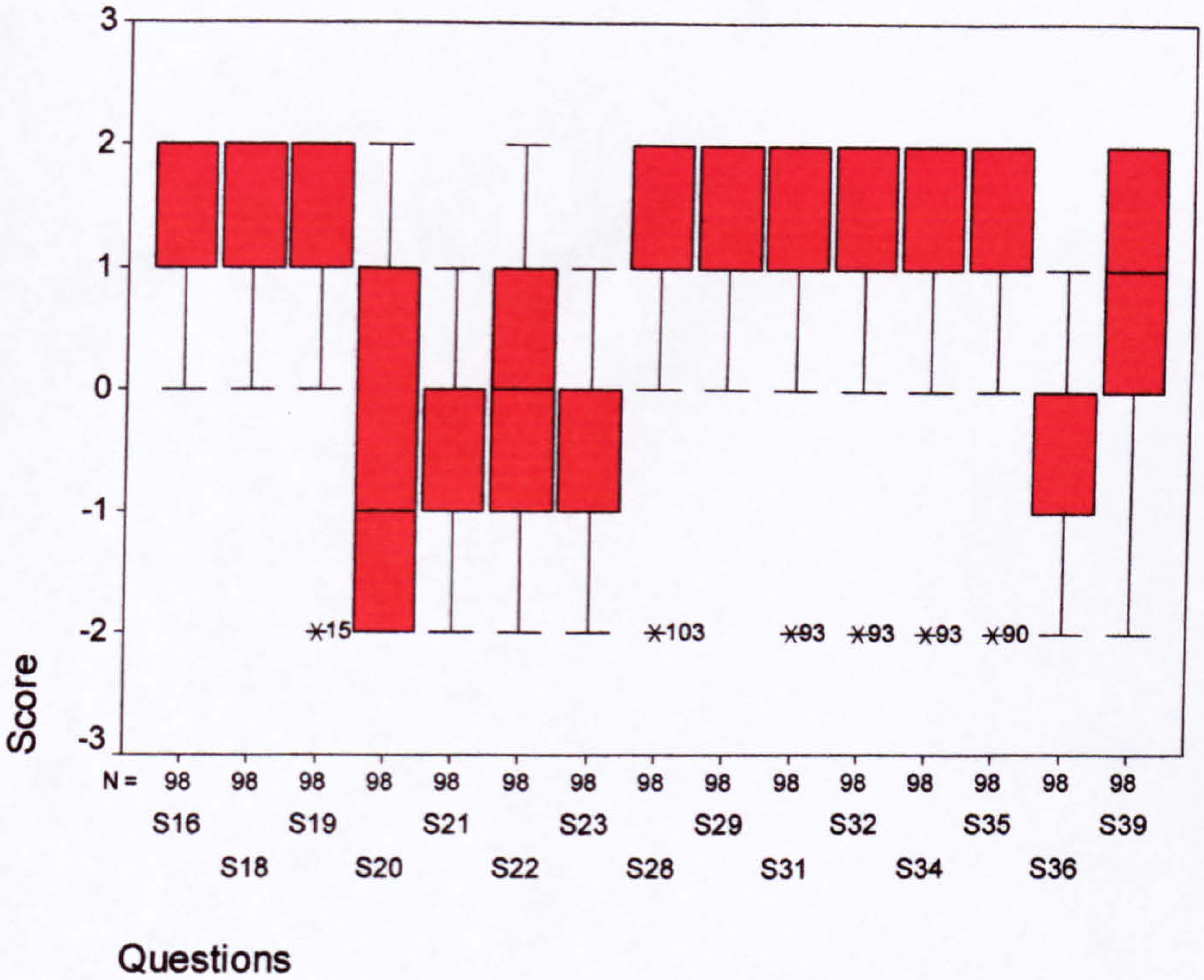

Figure 8.20 Students' preference for teaching of Environmental Design issues

S16: Understand better if lectures combine practice with theories S19: Prefer lecturers who explain how things relate to the outside world S20: Tend to accept what I am told S21: Don't put effort into learning because I can consult later S22: Concentrate more on philosophical aspects of Design S23: Extra effort on technical aspects S28: More time dedicated to Design than to any other subject	S29: Visits and looking at buildings improve understanding S31: Understand if participating in an environmental project S32: I understand better if I am in a small group S34: I understand better if there is variety in class S35: I feel motivated by guest architects who are practising the profession S36: Not interested, as nothing is done in practice S39: Adventurous design regardless of technical difficulties * Numbers 15, 103, 93 and 90 describe extremes

Furthermore, 92% of the students believe they can learn better when lectures are combining practice and theory (S16, Figure 8.20). Ninety-three per cent also agreed that they prefer it when lecturers and tutors explain the subjects by taking examples from the real world and relating them to the information (S19). This is supported by 84% of students who affirm that, in order to understand Environmental Design better, they need to visit and look at the building examples (S29), which is something that some Schools are continuing to do when the finances permit.

	Students understand through visits and looking at building examples	Students understand better if they have examples from daily life	Students understand Environmental Design if they participate in a project
Mann-Whitney U	1532.500	541.000	2005.500
Asymptotic Significance (2-tailed)	.000 **	.000 **	.084

Figure 8.21 Test of independence of variables 6

** Highly significantly different

Many of the students are discouraged from understanding Environmental Design and Sustainability, as there are not many things done practically in the design process (Section 6.1.2). Nevertheless, 41% disagreed with this statement ('in order for me to understand environmental design better, I need to visit and look at the building examples') and 33% are neutral about this subject. What is interesting is that 59% of students would like to try an adventurous design regardless of the technical difficulties and alternative technologies (S39). However, as mentioned in Chapter 6, time constraints and extra work tend to counteract this.

Summary

Students and teachers believe that experimenting is one of the best ways to learn Environmental Design and Sustainability; however, they seem to disagree in how strongly they believe this.

8.3 Summary

There are some differences between the data obtained through interviews and through questionnaires. Some of the findings acquired from the online questionnaire prove to be highly relevant and there is an overwhelming degree of statistical support for differences in perception of students and teachers in a number of areas:

1- Sustainability is a design generator that starts to be present in the design from the first idea.

2- Students believe Environment is as important as any other design factor.

3- While designing, students think about the environment and Sustainability.

4- Students would not like to increase the weight on environmental issues in their designs.

5- Students do not understand Environmental Design because it has too many calculations and mathematics.

6- Students find lectures boring and try skipping them.

7- Students understand through visits and looking at building examples.

8- Students understand better if they have examples from daily life.

This disagreement can lead to a communication problem between teachers and students because when they talk or interact the reference points are not the same. One way to solve this problem is setting clear rules and objectives, at the beginning of courses and projects; also defining the elements of the teaching method and students' learning contract during the first meeting, revising and negotiating them regularly.

It is important to remember that the answers from the questionnaire are used just to support or contrast some of the ideas collected during the interviews. Moreover, explanations of the possible biases of the research are explained in Chapter 5. The information is useful, nevertheless, for indicating the percentage of responses and the agreement between teachers and students on different learning and teaching issues.

Students and teachers have a high interest in Sustainability, and both understand what Environmental Design means and relates to, in one way or another. However, students are not applying their environmental knowledge in the design. Teachers blame this on a predisposition of students against scientific matters. Nevertheless, there is not enough support for the statement that students dislike studying calculations and science. It can be said, however, that although students seem to like technology and scientific issues, they seem not to understand Environmental Design and Sustainability calculations.

Teachers are trying to reduce students' dislike of calculations through different methods, the most favoured being the introduction of simple principles in class and gradually moving to more complicated scientific matters. Nevertheless, an overwhelming number of students preferred to have more of a practical approach to Environmental Design and Sustainability through projects, participatory design, site visits and practical elements introduced in theoretical lectures.

Many teachers agree with teaching Environmental Design and Sustainability through case studies and design projects, also that students need more attention and that the contact time should increase to improve students' learning experiences. Students would also agree with these statements, as they are interested in applying the information in the Design studio where they spend most of their time. Nevertheless, the majority of the courses are given through lectures and students are not convinced that this is the best way to learn these issues, preferring participation through class visits, real examples and Design projects.

Some of the conclusions drawn so far from the findings (in Chapters 6 and 7) and from the comparison with findings in this chapter are as follows:

There is a need:

- for teacher training, multidisciplinary work and collaboration;
- for agreement on teaching objectives;
- for communication among teachers and with students, also to increase the contact time between teachers and students;
- to improve teaching and increase students' motivation, and to help students to learn the way they prefer to learn;
- for real projects, and for teaching and learning to be closer to reality and more experiential;
- for a gradual approach to learning; and
- to integrate ideas with the design project.

In the following chapter some strategies and ideas derived from the results in this and previous chapters will be outlined. These strategies will evolve in to the final conclusions and recommendations in Chapter 10.

Many teachers agree with teaching Environmental Design and Sustainability through case studies and design projects, also that students need more attention and that the contact time should increase to improve students' learning experiences. Students would also agree with these statements, as they are interested in applying the information in the Design studio where they spend most of their time. Nevertheless, the majority of the courses are given through lectures and students are not convinced that this is the best way to learn these issues, preferring participation through class visits, real examples and Design projects.

In the following Chapter some strategies and ideas derived from the results will be explained.

[1]

[1] **Lewis, R. K. (1998).** *Architect? A candid guide to the profession.* **Cambridge, Massachusetts, The MIT press.**

Chapter 9.Research Discussion

Chapter 9

9 Strategies for Teaching and Learning

In this chapter some of the ideas resulting from the interviews and questionnaires will be used to make suggestions about how to teach and learn Environmental Design and Sustainability in Architecture courses.

9.1 Improving the Teaching of Environmental Design and Sustainability in Architecture

There are many suggestions from teachers and students of Architecture about how to teach and learn Environmental Design and Sustainability. Many refer to practical things, such as which subjects to introduce and which material to teach, but others are more concerned with the dynamics of education in Architecture.

De Jonge has described four key attributes of teaching, all of which can be applied to the teaching of Environmental Design and Sustainability today. According to De Jonge (De Jonge 1999), teaching must be enabling, challenging, supporting and advising. Teaching should be democratic and meet the needs of learners who must take their place in society; and teaching is and should be an aid to learning and not the purpose of education.

For architectural education to be effective, life inside university should start to have real contact with society (section 3.2.5). The exchange of knowledge must not be limited to the university campuses. Moreover, the sectarian focus that has always characterised Architecture is preventing a bigger range of cultural perspectives from being included in the education of the architect.

In order to implement some of the elements that will move Architecture away from departmentalisation and miscommunication, some understanding of the causes of this separation and a greater focus on the actual needs of Architecture should be achieved. The role of the architect has to move towards one of a collaborator and member of a multidisciplinary career, which is concerned with the global environment and its inhabitants (Section 3.2.3). Teachers have the responsibility to embrace this role, because the next generation of architects is in their hands.

Educational institutions should remember that the student body comes from a wide range of backgrounds, that the public demand of architecture varies with time and the culture of the place, and that there are many aspects of architectural education. The scope of architectural education is not only the training of architects but also the development of conscious citizens and future promoters of the ideas learnt in the Schools (section 3.2.5). Architecture has to become more sustainable in the sense of being local, flexible and adaptable to the situations it encounters, in teaching and practice.

To achieve these aims, some suggestions and strategies are outlined below.

9.1.1 Motivate Students to Learn

The main reason students are not learning Environmental Design and Sustainability is the lack of motivation (section 2.1.3.1). It has been demonstrated through interviews and questionnaires that students find these issues interesting. However, it is one thing to find something interesting; another to develop the motivation lo learn more about it.

One of the ways teachers have tried to motivate students to learn more is to involve them in community projects and to give them the opportunity to interact as consultants with clients during the development of projects, with teachers sometimes assuming the role of clients and expert consultants. Another way to motivate students is to increase their awareness of the damage humans are causing to the environment, through lectures and examples. Also, some Schools use simple campaigns of recycling waste and re-using materials, which are very attractive to students and are easy to implement (section 6.1.2.4). These campaigns are not only beneficial in the way they help the use and re-use of waste, but also in the way they involve students in Sustainability, make them aware of other issues related to the global environment and motivate them to apply Sustainability in their designs.

Therefore, to increase students' motivation to learn about environmental issues and the consequent application in their designs, teachers should make the projects more relevant through extra contact with the community, or by increasing the reality of the projects through the inclusion of the role of clients, users and costs (section

6.1.3.2). They should also promote students' awareness of and involvement in environmental issues through small conservation campaigns and recycling.

9.1.2 Use a Gradual Approach to Knowledge

Learning about environmental issues has always been related to numbers and calculations and, as explained in previous chapters, students are not very attracted to the idea of Mathematics in Architecture. This could be because of a predisposition against this subject or because it is more difficult for students to understand the knowledge in numerical as opposed to visual terms (section 6.1.2.2).

A gradual approach to learning is a good way to approach issues that will require calculations, equations and mathematical knowledge. This does not mean less information, but a gradual increment of complexity in the teaching approach. Students may not be really interested in doing extra work and putting in extra effort, but they lose interest in subjects that do not challenge their intelligence and make them think. Teaching ideas will be a means to understanding what is behind a calculation and why it is or will be useful for architects to learn.

9.1.3 Integrate Knowledge

Students and teachers believe in the integration of all aspects of design into their projects. However, they also favour integration in the way architectural discourse occurs. Schools of Architecture tend to separate areas of knowledge and although they are linked in many ways, the discourse continues as if they were separate issues from separate disciplines.

Part of the separation of Environmental Design and Sustainability from Design is due to the definitions Schools and staff give them and the nomenclature used to label the different administrative sections and staff groups in the Schools. For administrative purposes, it is useful to have several academic areas and names, to organise the Schools and especially the finances and funding. Nevertheless, the ethos of the Schools should be focused on integration.

Design projects should all include Sustainability and an environmental focus, include reference to Construction Techniques and Structural Design, have some historical background, and also some perspectives from the population and clients. All aspects are part of the Design project and have to be assessed as such (section 6.1.3.2.1). This does not mean that students will have extra amounts of work, as they need to have the basis of these subjects in the first place, but that all the subjects have to be considered equally in the Design project and its assessment.

The mistake is to think that giving equal importance to all the areas will mean less developed projects and less artistic freedom. Students are given the variables they will need to work with, and as individuals or as small groups, they will have to consider the best solution, according to the environment, the clients, the users, the resources available for the projects, etc. Not all the projects have to be 100% environmentally friendly; the idea is rather that all include some degree of commitment to the ideas of Sustainability and respect for the local and global environment and inhabitants.

9.1.4 Experience the Work Environment

Students learn the things they think interesting, important and relevant for their lives. As previously mentioned, students of Architecture realise the relevance of environmental issues when they understand them. For students the best way to understand something is through experiences that reflect their living realities (section 3.2.6). To add some realism to the architecture studio, it has been proposed to introduce real clients into the Architecture curriculum. However, there are several reasons why universities have avoided real projects. First, is the amount of time that a real project will take. Second, the number of clients that are willing to work with students is not many. Consequently, the number of projects available for students is not enough to support a Professional Practice module.

Additionally, even when some projects can be used for educational purposes, they are simplified, which is not preparing students for real life situations. People's lives, costs and the impact on the environment will not depend directly on the work of the student. Regrettably, the fact that, as architects, students will have the responsibility of designing and constructing buildings which will influence people's lives and which can modify their health and behaviour, is usually ignored.

Adding more reality will help students learn, about Sustainability and other areas, and is also the best way during training to have a direct retro-feed from professional practice. Nevertheless, education is reticent about implementing real projects. As a solution to this reticence, small-scale projects and a student-led consultancy office could be included in the curriculum as part of the Professional Practice module. The idea of the practice is to prepare students for their working experience and not to substitute the year out. Schools of Architecture can open the office to the local public. Students, with the guidance of a professional architect, will carry out small projects at competitive prices. Ideally all students will work in the office, however this will depend on the size of the office and the goals of the Schools. A re-structuring of the curriculum will be useful to include more practice time and real projects, and the role of tutors will need to change for them to act more like consultants and facilitators of students goals. Similar practices have been implemented in the US from the 1960s as they prove to help students to have a real link with the community and learn about the working environment and its complications (Rüedi 2000).

The university can benefit from this office by creating a real relation with the world outside academia. Students will be better prepared for a real work environment and the university can charge clients a basic fee. Students can also act as consultants to other students on environmental problems, as they would have experienced them in the practice, and can include this knowledge as part of the Schools' educational discourse.

9.1.5 Bring Architectural Education Closer to Reality

As previously mentioned, one way to improve learning of environmental issues is through practice and experience; another is through narrowing the distance between academia and the real world (section 3.2.5). Architecture teaching and professional practice must narrow their differences and start moving in the same direction. Working in the same space, practitioners, consultants and academics will ameliorate the quality of architectural education and will narrow the existing breach between colleagues. Some experiments like the Work-Based Learning in Hull University can be use as examples of linking architecture and its practice, where students work as part of their learning and big emphasis is given to students' individual learning contracts (Earl 2002).

The students should learn in which context they live, should question their position in society, should become observers of their surroundings and be observed at the same time. A student who does not know his/her immediate environment and how to respond to it will not be able to design a building that responds to it, less will he/she be able to transpose that knowledge to other places and environments. That is why experimenting and being involved in what is happening in the social environment is so important. Students in Strathclyde University have proved the value of community projects and having contact with clients and users for their learning experiences in a community project in recent years (University of Strathclyde 2001).

Students learn from their own experiences and by working with real cases or imitating real situations with a proper verification of process and content from a practitioner. Students benefit from experiencing problems that will reflect situations in reality and the way they will be solved in reality. This can take place in collaboration with other disciplines and, when in continuous contact with clients and users, a more accurate learning of what to expect after graduation will occur. Moreover, having a deeper knowledge and experience of real projects in a tangible context will help students realise how the design process responds to a place and its inhabitants, and how the place affects the design process.

9.1.6 Induce Collaborative Work

One of the main complaints of students regarding the integration of many areas of knowledge into the design (environmental issues for example) is the fact that they have no time to deal with everything before the submission date (section 6.1.3.2). This can be solved through group working and collaborative design; nevertheless there are always problems of integration and collaboration between groups, both within departments of Architecture and with other careers (section 6.1.3.4).

Multidisciplinary integration among Architecture-related subjects, like Engineering, Construction, Landscaping, and Planning, among others, is very important for the development of good practice in the construction industry. As mentioned previously, architects need to face reality and start being open to collaboration and team working in a multidisciplinary environment.

Students like experiencing and practising with environmental projects. Nevertheless, it seems that the only way to help them understand that teamwork is necessary is by convincing them that experience and deliberation are the way we work and live, and that through collaboration we can benefit from other experiences. Experiences with dual courses and combined learning between careers have been used to narrow the gap between students and industry and also to narrow the separation between professional areas in the building industry (surveying, architecture, IT Managers, engineers and contractors). These experiences proved that students improve their self-confidence, understanding and communication skills, and also learn how to respect the work of other disciplines and understand the collaborative character of Architecture (Howes 2000).

Collaboration and integration of big classes is introduced through group work. However, lecturers often poorly manage group work, an approach which admittedly has many risks but also lots of benefits (Holcombe 1999). Students find a way to divide the work and not see each other again until submission time. That is the case where the group has a good relationship and the individuals within it trust in each other's expertise in the subject.

In many other cases, the person with the most concern about the group's success will do all the work for the rest. Usually, teachers find it difficult to help students understand the benefits of group work, because often they also do not understand it and sometimes have problems relating to other members of staff, especially from different areas of expertise (section 6.1.2.4.1).

Although from examples of collaboration projects, only a few have worked effectively (University of West England with planning students and Strathclyde University with engineering students, among others, Marley and Claydon 2000, Howieson 2000), teachers have to put aside their professional differences about teaching and set the example of collaboration in projects with other members of staff and other faculties. Schools of Architecture should also experiment with the possibilities of multidisciplinary projects where students will face not only Design projects, but also integration and communication challenges. Students will benefit, as projects can reach a better level of completion, and students can gain a better sense of environmental issues and how design can reduce the impact of a building on its surroundings.

9.1.7 Promote Communication and Interaction

One of the things that affects student learning is the fact that academia seems to be separated from the real world. As already mentioned, there are various ideas about how to link practising architects with teaching, such as creating an architectural office within Schools. Nevertheless, communication seems to be a problem not only between practitioners and academics, but also between practitioners and clients (section 3.2.5).

The profession must be oriented towards a global environment and be client oriented (Worthington 1999). Architects need to work with the client, trying to design according to the client's needs, rather than according to what they want to design. This lack of communication seems to stem from how Architecture is taught in the Schools of Architecture, where communication skills, client management, and collaborative work are not considered essential in the curriculum. As concluded by the Construction Industry Council (CIC) in 1998 the lack of collaboration and communication is also a reflection of the professional area where adversarial attitudes are inculcated by single discipline staff (Howes 2000).

Communication skills, and the whole area of interpersonal relations, are not on the top of the list of subjects in Schools of Architecture. Nevertheless, architects with good interpersonal skills will be more flexible in dealing with the changes that Architecture as a profession might experience, and adapt more easily to new situations, working environments, clients and users (section 3.2.4). The answer to communication in the Architectural profession comes back to student learning and interaction with other students, staff and real clients (Torrington 2000).

Architects need to communicate with the public and users, as they are an important source of information about the living environment. And it has to be made clear that Environmental Design is not only concerned with the global environment, but also with local surroundings and their inhabitants. Schools of Architecture should promote a sense of group from the beginning, a feeling that students are part of an entity and not only an entity by themselves. In addition, schools should provide opportunities for students to relate to real clients and users in real projects, seeing that exercises in communication have shown that through interaction with real clients and exposure of students to multidisciplinary environments, they improve their communication skills and increase the level of debate in Schools' reviews (Torrington 2000, Chiles 2000). In this way, Schools can promote interaction between students during their university training. Besides, schools can include workshops for teachers and students to develop skills, become self-learners and maintain good working relationships between staff, clients and future colleagues (Fisher 2000). Developing students communication skills and interaction with other members of staff and clients will help them learn how to deal with and listen to others later in life.

Through example and practice, teachers should stress the importance of communication in orientating people towards common goals. Rotation of students' groups during studio exercises, "vertical" studios where students from different years work together; and teachers sometimes participating in a student group (as a student or as a consultant), will all help to develop interaction and narrow hierarchical separation and communication problems.

9.1.8 Change Attitudes Towards Teaching Architects

According to H. Barrows (Barrows 1988) the tutor's success in any educational method depends on his/her training and ability to maintain the quality of education in line with the following aims:

1) Developing students' thinking or reasoning skills (problem-solving, metacognition, critical thinking) as they learn; and

2) Helping them to become independent, self-directed learners (learning to learn, learning management).

Students are in need of tutoring which helps them refine their ideas through a problem, not by presenting an image to imitate (section 2.1.3). Tutors in Architecture have to become more facilitators of students' learning than teachers. To do this, more training and workshops are necessary to develop the teacher's awareness of students' learning and to evaluate and generate teaching ideas and a team sense (Fisher 2000).

Creating an environment of collaboration and teamwork in Schools of Architecture between teaching staff is also necessary, because over the last few decades, the number of students has increased significantly and consequently the student-teacher ratio has increased considerably. All teachers in Architecture have less time to deal with particular problems. Lecturers have to count on Design tutors to support the teaching in several subjects, such as Environmental Design, which will need extra practical experience and critical thinking outside lecture hours. Therefore, it is necessary for all teachers, including the Design tutors, to know about the principles of Sustainability and be engaged with them at some level. Design tutors have to be involved in and be aware of different areas of architecture to be able to advise and help students' thinking in all areas of architectural design.

Tutors have to remember that learning is the important part of architectural education and not teaching. The role of the teacher is that of an advisor, an experienced person who can increase the learning capabilities of the students (section 2.3.1). Teachers' aim is to make students learn how to make decisions, be self-motivated to learn and be critical about all problems and their solutions.

The essence of Architecture teaching/learning is solving problems and the way students learn in the studio is perfect ground for a problem-based learning approach (PBL). When a real project is not possible, unstructured information and vague explanations are the ways tutors can challenge students' intelligence and thought processes to solve design projects. In addition students enjoy the challenges this type of project presents. The obstacle is the lack of ground rules and teacher training, as teachers will need to learn how to deal with unstructured problems and students' different levels of development, both of which can lead to time constraint issues.

Sometimes students will grasp the basics of an environmental problem and its solution, and be able to apply this solution in their designs. And this will have repercussions on the way the projects are assessed. That is why teachers have to agree the learning objectives and methods of assessment before each project and make them clear to students and other members of staff.

Teachers will also improve the way they teach environmental issues in the studio when they are motivated by the subject and change the way they approach student learning. The main error is to believe that the teacher is the one that takes the active part in education, and students are passive, the ones that receive. Teachers are in a constant learning process and the system should work both ways. Teachers learn from students on an everyday basis; that is why teaching enables the teacher to teach in a more effective way. Students should be helped to develop their learning skills and not be taught knowledge. Tutors should experience the learning process to make it work and they should review their attitudes towards other architectural areas and the way students approach learning.

9.1.9 Teach Teachers to Teach

Many, if not all, students are interested in learning when they enter a School of Architecture. Nevertheless, they are also interested in obtaining a degree in Architecture. For the latter however, it is not always necessary to have "deep" learning in the subject. It is more difficult to get away with surface learning in Design projects, as students have to ponder many things and think about solutions and impacts, among other things. Nevertheless, it is possible to learn how to make designs look good despite deficiencies in many other aspects.

Teachers of Architecture have to learn how to motivate students for a deeper learning, for finding solutions, discussing and thinking. This is applicable not only to Environmental Education but also to all areas of Architecture. Each student learns in an individual way and that is the way they have to be treated. Teachers in Architecture should have a teacher's training before starting as a member of the teaching staff, so they can manage different teaching techniques and problems of students' motivation, class integration, etc. This training should be repeated regularly, so teachers can increase their knowledge in a particular area, learn new strategies, pedagogical methods, and developments in educational psychology, and especially develop interaction and collaboration techniques between staff. The University of East London has also started a training course directed to part time teachers and practitioners with interest in teaching (Weaver et al 2000). This initiative can be expanded to other universities, in order to train teachers, not only part timers, in pedagogy through gradual involvement in the classroom and reflection on their teaching.

Ideally, all teachers in architecture are motivated to learn more about teaching methodologies. Nevertheless, some motivation to participate in this training might be necessary, an increase in teachers' status and salary, depending on their training, or teachers' training counting as research or teaching 'points' for the universities.

Continuing professional development will consume part of teachers' time. Nevertheless, it would be helpful to increase confidence when dealing with the integration of architectural technologies, Sustainability, and environmental issues into the design, or as support to it. Moreover it will promote teachers' motivation and understanding in their role as facilitators and not providers.

9.1.10 Reduce Teachers' Administrative Tasks

Some members of staff enter academia because they enjoy teaching, while others like research. However, not many like administrative work. In UK universities, teaching staff are both research staff and administrative staff.

The problem with administrative work is that it contributes to a decrease in contact time with students. Members of the teaching staff have to deal with administrative duties and other tasks that could probably be done by administrative or secretarial staff. Many teachers complained about the fact that student-teacher contact time was reduced by meetings and administrative duties (section 6.1.2.4.1). This is detrimental to teaching and learning, as students have less time to discuss individual problems and doubts, and teachers have less time for each particular project and idea.

Many Schools resort to part-time teachers, who are valuable as they contribute with extra teaching hours and contact with students, and also because they often input important knowledge from professional practice. Nevertheless, this teaching aid is not enough. Ideally, there would be more support staff (administrators and secretaries) to carry out these tasks or more full-time teaching staff. However, it seems that the problem stems more from the lack of financial resources in the Schools.

It is understandable that Schools' resources are limited; however some strategies to generate resources could be created in order to pay for extra staff and other resources for the benefit of the departments. As mentioned previously, a connection with industry could be beneficial: research projects at postgraduate level and from academic staff could be applicable and of interest to industrial markets. This contact with industry has been tried at Middlesex University and the University of Lincolnshire and Humberside. They concluded that there is an interest from industry, commerce and students to have a close relation between work and learning (Earl 2002), and also proved that these experiences are viable.

As already mentioned, another way to generate funds for the Schools is through an architectural office in the Schools that can provide advice and work on small projects at competitive prices. A departmental office will also have the benefit of providing professional practice to some of the students and have a better link with real projects, expertise and a relation with other areas of construction.

Teachers need extra time to dedicate to students and to improve and prepare their pedagogical strategies. Support staff would be helpful to reduce the number of the extra tasks that teachers have to do. If money is an issue, Schools of Architecture should create a strategy that would provide funds and at the same time maintain their educational objectives. Therefore, a close link with industry and the creation of an architectural office within the Schools would be ideal.

9.1.11 Share Teaching Experiences

There is no ideal method of teaching Environmental Design and Sustainability in Schools of Architecture. Despite the fact that all students prefer more practical approaches to learning these subjects (experiential design projects, visits, etc), these are not always available due to costs and project availability. Probably a change in the structure of education will be needed in order to accommodate this preferred learning method. Nevertheless in the current educational structure, Environmental Design and Sustainability are usually taught separately from the Design studio through lectures, seminars and special assignments.

Many teachers think that the best way to teach Environmental Design and Sustainability is through the Design project (section 8.2.2). Nevertheless, the problem begins when members of staff define these issues: Is Environmental Design just Design or is it part of something else? There are many definitions and approaches to Sustainability and Environmental Design in Schools of Architecture (section 6.1.2.1). There have also been many teaching approaches and experiences in the past or which are currently being implemented, and all these are experiences that could be exchanged between Schools of Architecture. Conferences and teaching fora that have been happening in the UK in the past four years are a good way to develop this exchange. Moreover, the centre for Education in the Built Environment (established in January 2000) has also promoted the exchange of case studies and information through an Internet platform. Nevertheless, the amount of information on Environmental Design and Sustainability teaching in conferences and in many of the exchange exercises has not been enough.

It is good to exchange ideas and experiences, however, it is important to remember that some teaching strategies can work in some places and not in others. It is also important to open up a wider range of teaching possibilities, as students welcome variety and experimentation. If prescribing a teaching strategy for the improvement of Environmental Design and Sustainability were needed, the strategy would include a variety of teaching methods and experiments in education. That way, all students would experience different teaching and learning approaches. And teachers could ponder which strategy works best for different problems, projects, and for the understanding of Environmental Design and Sustainability issues in Architecture.

9.2 Summary

There are many ideas derived from teachers' and students' interviews and questionnaires. Some refer to improving the way Environmental Design and Sustainability are taught, others to increasing students' and teachers' motivation and narrowing students' and teachers' disagreement especially through communication.

The strategies suggested are:

1- Motivate students to learn.

2- Use gradual approaches to knowledge.

3- Integrate knowledge.

4- Experience the work environment.

5- Bring Architecture closer to reality.

6- Induce collaborative work.

7- Promote communication and interaction.

8- Change attitudes toward teaching architects.

9- Teach teachers to teach.

10- Reduce teachers' administrative tasks.

11- Share teaching experiences.

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Chapter 10.Conclusions

Chapter 10

10 Conclusions and Further Research

10.1 Summary of the Study

Many of the factors that shaped today's architecture and architects can be traced to the origins of Architecture as a profession and to the transition from apprenticeship to institutionalisation. Architecture has also changed with time and has been redefined accordingly.

Historically the professional architect passed skills to his pupils who copied and followed his and others' work and learnt from his experience. This educational system worked while there were few pupils and fair work conditions. However, architects increasingly pushed for architectural education to become more formal, just, and controlled, resulting in, 1470, in the creation of the first academy in Italy.

It was only around the 18th century, however, when the first British Schools of Architecture started to appear as a support for the work in the offices, culminating in the 1940s with the adoption of university teaching as the best way to learn Architecture. Yet the essence of architectural education remained, and still does, in learning through practice and experience in the working environment.

The introduction of new technologies and issues such as Environmental Design and Sustainability are just some of the many changes Schools of Architecture have faced during the 20th century. They will continue to be some of the central issues in the educational agenda for the next century due to the fact that architects and, indeed, all members of the construction industry bear a big responsibility for the production of polluting gases and waste and, therefore, can play a big role in their reduction. Consequently, making Architecture students aware of the impact architecture can have on the environment is essential.

Over the last few decades, Schools of Architecture have introduced many new subjects and materials in an effort to increase awareness of environmental issues among students. Nevertheless, it seems that these concerns have not been effectively and extensively represented in constructed buildings. Why is this? This study has searched for an explanation by studying the way architectural education, and more specifically environmental education, is carried out in Schools of Architecture.

Having no previous data to compare students and teachers of architecture opinions, the study started exploring, through literature review and observation, current methods of delivering Environmental Design and Sustainability in 10 of the 37 Schools of Architecture in the United Kingdom. It also investigated the efficacy of different Environmental Design courses using students and teachers' opinions and satisfaction with the courses, the methods used to teach and study these courses, and with teachers and students' attitudes. This investigation was carried out through personal interviews, focus groups and discussions.

1- First of all, primary research was carried out, through a pilot study of teaching methods and teacher satisfaction. The pilot study pointed out different teaching methods used to teach Environmental Design and Sustainability. It also showed teachers' low satisfaction with their performance with teaching using only one method rather than a combination of strategies.

2- The opinion of first year students was then explored. Focus groups and discussions were organised to find out students' opinions about the teachers and teaching methods and also their preference for different learning strategies. Part of this exploration of teaching led to a comparison of commonly used teaching methods – lectures and workshops – through a semi-experimental setting. A feedback session followed the comparison of teaching methods to review what students thought about some subjects and the way they should be taught. Concluding, students prefer methods that are interesting.

3- Following the preliminary research, qualitative research was conducted using personal and group interviews, to find out students' and teachers' learning and teaching preferences in Environmental Design and Sustainability. The interviews were also used to find out students' and teachers' understanding of the subjects and their motivation for and engagement with them. After the observation a great amount of data was obtained from different Schools. The results were organised in categories and used to design a survey questionnaire. This was used in order to corroborate the information obtained in the qualitative research in a more quantifiable way.

The data were compared, between qualitative and quantitative sets of data, and especially between teachers and students. The research identified discrepancies between teachers and students in the following aspects:

1- Sustainability is a design generator that starts to be present in the design from the first idea.
2- Students believe Environment is as important as any other design factor.
3- While designing, students think about the environment and Sustainability.
4- Students would not like to increase the weight on environmental issues in their designs.
5- Students not understanding Environmental Design because it has too many calculations and mathematics.
6- Students find lectures boring and try skipping them.
7- Students understand through visits and looking at building examples.
8- Students understand better if they have examples from daily life.

The research also identified some of the teaching methods and learning approaches that help understanding of Environmental Design and Sustainability in Architecture and their integration with the Design projects.

The results were analysed and conclusions and recommendations were drawn.

10.2 Main Findings and Recommendations

Motivate Students to Learn

There are many ways teachers and students define Environmental Design and Sustainability, many opinions on what they involve, and many levels of commitment to these subjects. Nevertheless, teachers and students generally agree that Environmental Design and Sustainability are important issues in Architecture.

The main element that determines whether Sustainability and Environmental Design are considered important and interesting is whether or not students see them as relevant to their lives and future careers. This relevance is also determined by the attitudes teachers have towards the subjects and how students perceive the grading system.

Although interested in the subject, students do not always apply environmental concerns in their Design projects. This seems to be partly because attention to environmental issues is not strictly necessary for obtaining a pass or satisfactory grade. In addition, students think adding environmental issues in their designs limits their aesthetic freedom, and involves extra work and complicated calculations.

Use a Gradual Approach to Knowledge

Teachers agree that students do not produce complete designs that involve all areas of Architecture (Construction, Structures, Services, History, Aesthetics, etc.). Teachers also agree that not applying environmental elements in the design is partly due to the fact that students do not understand calculations or Mathematics. Therefore their approach is to teach the principles and ideas of Sustainability and Environmental Design before progressing to more complicated mathematical and physical examples. This way, students will be able to understand the ideas and then be able to use them in their design process. Students prefer this approach to learning, as they learn better if they understand the principles behind the knowledge. Moreover, they welcome discussion if it occurs at a high, conceptual level and not superficially.

Experience the Work Environment

Students also like learning through experimentation, practice, and through visiting examples, so they can understand the mechanics of the buildings through "doing" and experiencing them. Students who have obtained an awareness of the role of the architect in Environmental Design are more ready to approach Design projects with more environmental considerations.

Change Attitudes Towards Teaching Architects

Teachers agree with teaching through Design projects, but also with the inclusion of a variety of teaching methods, because different projects require different emphasis and ideas, and can be approached in different ways. Moreover, the author considers that introducing a more "sustainable" concept into Schools of Architecture will not diminish the aesthetic qualities of design, since all designs are unique and are exposed to unique characteristics. Teachers should see students as individuals and their learning also as different from other learning. Moreover, teachers should keep in mind that their role is to facilitate students' learning and not simply to teach them.

Increase contact time

Teachers of Architecture would like to have more time to dedicate to students and teaching activities so they can improve the learning of the subject. However, there are many extra activities in the Schools that make this unlikely. Design tutors and part-time teachers also need to get involved in the teaching of environmental issues and Sustainability in Architecture in order to be able to bring about some integration in the design, and in the discourse of Schools of Architecture.

There is an interest from the staff in improving the profile of Sustainability in architectural discourse. That is why most of the strategies proposed for the improvement of learning Environmental Design and Sustainability in Architecture are targeted at teachers, as it is they who can effect change, both in their teaching and in students' learning.

Bring Architectural Education Closer to Reality and Induce Collaborative Work

Teachers of Architecture can help to motivate students to learn and to experience the work environment through live projects or by involving students in projects that are closer to reality. Although there are few clients willing to give a big or medium-size project to students, they may be more willing when it comes to smaller projects. On the other hand, wider use of architectural offices led by students with some professional assistance would link practice and academia, and provide students with much-needed practical experience.

Teachers can induce collaborative work through multidisciplinary group projects and by narrowing the gap between Architecture students and students in other professions to help them become more comfortable in communicating and sharing with others. Involving students in some environmental campaigns would also help engender the feeling that all students are aiming for the same goals.

Share Teaching Experiences and Learn how to Teach

Teachers can also share their teaching experiences with other colleagues. In other words, teachers are the ones who can more readily change the way they teach and open a dialogue in Schools for more teacher-student contact time.

Integrate Knowledge

The main difficulty in attempting to make Environmental Design and Sustainability a more integral part of students' discourse in Schools of Architecture is the lack of motivation from students to do so, and the consequent superficial approach to understanding Architecture in environmental terms. The best solution is to open a dialogue in Schools of Architecture to synchronise efforts and ideas, and to teach students with a variety of methods. This will motivate them to learn more deeply about Environmental Design and Sustainability.

The current research has improved understanding of the teaching and learning of Environmental Design and Sustainability. Through analysis of the topic, it is possible to envisage ways of improving teaching and learning in Schools of Architecture and to apply them in the design process.

10.3 Directions for Further Research

The teaching and learning of Environmental Design and Sustainability can also be improved through additional study in:

- **The way architectural education occurs in other countries**

  How cultural and historical differences have shaped the way the teaching and learning of Architecture happens. What are the differences in the way teachers and students conceive Architecture and how it is practised?

- **How experiential projects have affected students' learning and awareness of environmental issues**

  Studying the differences in students' awareness of and engagement with environmental issues and Sustainability, before and after experiencing a practical project or a project with a real client. Study how this experience will affect the way they design projects and how interested or not they become.

- **The dynamic of each School and its particular problems**

  How different problems in each School of Architecture can affect the way Environmental Design and Sustainability is learnt. Some Schools will have financial or political problems; others less motivated students or fewer teaching staff. All will have different learning priorities and different answers as to how to teach Environmental Design and Sustainability. Their experiences could be helpful for other Schools with similar challenges.

- **The development of a theory of architectural education;**

  What is Architecture? How should Architecture be taught? What are the ideas all architects should judge? There are as many ways to answer these questions as people interested in answering them. The development of ideas and philosophies of architectural education is needed to open a debate and provide themes for research into educational studies in Architecture. This research, in turn, could generate guidelines for the formation of architects.

- **How successful teaching experiences from other faculties can be useful to architectural teaching.**

  An exploration of the experiences of other Schools that are not usually linked with Architectural studies – Medicine, Agriculture, Politics, among others – could contribute to architectural teaching and learning. Relevant areas of study might be how they teach, how they integrate big groups, how they teach small ones, and how they make teaching more experiential without excessive risk.

  Developing a deeper understanding of what Architecture is and what it involves in terms of teaching and practice would be beneficial for Schools of Architecture and for the professional environment. Students, teachers and architects should be clear about what Architecture comprises, and consequently what is needed for the formation of the architect. Looking at unfamiliar teaching experiences, in other countries or in different professional areas, could help to deepen this understanding.

In addition, a philosophical guideline for architects and educationalists is needed in Architecture. There are many educational theories; however there is no theory of architectural education that can be used this way. More research and understanding is needed in the development of Architecture, in how education and learning is being taught (including all aspects of Architecture), and in how they are linked.

Appendices

Appendix A

Introduction

These are the transcripts from the environmental discussion and focus group. Most of the students' words and phrases are left unedited, although some author additions and corrections were made to help the understanding of some ideas.

Interviews With First Years

Students' opinions about learning sustainability in a workshop

"It was very interesting."

"I think that it wasn't the same, he [the workshop leader] gave us a topic and he tried to describe it. I was not sure what I was looking for. They gave us some magazines and I was not sure what we were looking for, but that was the idea; to make us think about Sustainability, economic and social and environmental issues."

"Yes I think it was pretty good, because it was focusing more on making you think than just facts, in comparison to the lectures we had in the past about Environment. I suppose they are right at the beginning of the lecture course, so they are more interested in solar radiation and things like that and it is harder to get a feel of what is important."

"I've come from a background which is pretty much environmental, so my views on anything that we talk about are going to be influenced by that. Other students have other views, but I am very much aware that people have no idea of the truth. Especially in terms of environment, it becomes more subjective, there are more crossovers, also people are "buying" advertisements. I think yesterday's workshop is beginning to ask people to look beyond advertisement, to what you actually see. I think that's really important to make you think. I think the most important thing is to make people think, think about change, think about what they do, get their own answers."

"I think the workshops are pretty good, because they take a totally different approach and they are not being taught. You need the workshops before any information comes in, so your interest is stimulated, and you actually want it [the information]. I think that will be the best way you have to build interest, and think the workshops are very effective for that."

"What I found quite interesting about the workshop was that it was a good workshop in the sense that he didn't control it. It was not too much taking from one person and, 'You just have to sit down and listen all the way through'. What he did was talk a bit and then he gave us all these magazines to look through and try to find out how they linked to Sustainability, and find an article. That was really good and then we had to stand up and present and stuff, but what I like was the fact he was quite quick to the point, some people just kind of say one point and keep going on and on. You just need to say this is how it happened, this is and this is this. What really helped was also him using the board to kind of draw stuff and diagrams to show, to try to explain stuff, that was quite good. I really enjoyed that."

Student's perception of their learning during and after the workshop

"We said many things, things we haven't thought before, but mainly things that were more environmentally suitable, socially and economically as well. It can make you realise how the three interact and how one fact can affect all three."

"Not necessarily [I have not learnt anything new], actually, it is something in the air!"

"I am quite interested in the course, actually. I thought it was more environmentally based, not as social or economic. [Before going to the workshop] you thought more like [it was going to be] a green exercise. I don't know, I thought like green, I know it set a basic scenario of sort green things mostly, economic [elements of Sustainability], the use of the land, technology, it set that out more carefully, but I think [the workshop] introduces us to generalities. I think people are scared, scared of teaching. I think at this stage they are more general [issues to take care of, priorities]. I think they [the lecturers] are very cautious of that. They are scared of really going into depth about any particular issue."

"I learnt a lot more, and also, you are talking about one thing and, also, diagrams really do help to clarify what you are trying to put across."

"I still think I need a long way to go. I think I haven't really grasped about the environment that much. I think I would like to know more about the environment, maybe because we haven't had a lot of like field trips. I think that'll be quite nice to do that, and probably giving us a questionnaire to fill in as we were doing so it won't feel like an actual exercise and make us learn a bit more. And maybe have some activities like collecting many leaves, I don't know, something...No just talking, that will be good."

Teaching methods

Comparing lectures, studio and workshops

"[Lectures are] an hour and a half [to] two hours with a break in between. [Our concentration length is] about two hours... One hour, yes one hour, [the lecturer usually] puts some slides at the end, which is quite good. As for the workshops, the first one was very strong, an introduction."

"I think a combination [of methods is needed]. You will get a lot of information and then you can go practise that information for yourself. In the lectures you just sit there at a table, especially in the after-lunch hours. They [the lecturers] are there in the afternoon showing you knowledge. Lectures tell [you] of things that they know and then you put them into practice."

"Yes, [a combination of lectures and workshops], something not too profound, a few slides, just keep it interesting. One thing that really worked in the workshop was the case study. It was more interesting because it brought some issues that you can start discussing in groups, that particular issue it was quite good."

"[Doing different things] works to surprise people in a way, creates more attention. Like that lecture, maybe it makes it interesting because you are interested in the subject, like in Architecture where the subjects are all fascinating."

"There are people enjoying different parts of the Architecture course so far, depending on their 'A levels', people that've done Maths and Physics 'A levels'. If you have to do more immediately, there is a moment when you say, 'No more'. I did Physics."

"I did pretty artistic A levels and I am quite enjoying construction, where drawing ... it is not like maths, just sit there and draw and stress out to reach deadlines."

"I don't know, I did very artistic 'A levels' and sometimes it is very nice and sometimes it is very annoying. Lectures are sometimes good, sometimes not. Sometimes you feel like, 'Wow, everything is good'. Sometimes you are, 'No, I am bored'."

"It is good to have a lecture to fresh up the weekend. When you wake up, first thing in the morning, you think, 'Oh I have a lecture today'. Thursdays, 9 o'clock in the morning lectures are not good."

Previous experiences in learning

"It was crap in college. Dull sitting, boring, you just keep talking with your friends, just sitting watching people coming through the door. Lectures were better, you are just sitting there watching some slides, sitting down and trying not to sleep, talking..."

"To get back to your question about the teaching in school, I think the main reason is that you understand poorly. People watching over you, if you didn't go to class, they'll phone up. Here you have a lecture, if you don't want to go, you just don't. You have to be very self-disciplined, self-motivated."

"In Maths... what was good about the teacher, he was very fast. Sometimes it could be too fast, but most of the time, it was good that he was quite fast, because you always have to keep up with him, because then you know and you didn't have time to lay back and daydream. It was really fast, got to the point, straight to point, he did the work very quickly, and I think that's important to keep the energy going in the room."

"Arts was basically relaxed. What did I find really enjoyable about that? I guess being left to your own devices, and at times that's really good, and theatre, that was just a nice learning experience. That's all."

"You see, the way of teaching in here is slightly more formal for me than it was before. For me, it was a completely different kind of style of teaching, in the sense that, students and teachers didn't have this sort of bridge between them, we were more or less humans working on the same level entirely. The only difference is that you are listening to someone and they are giving you some information and then you responding to that. I prefer school a lot more, the fact that we were just people placed in the room and learning from each other, and the teachers may not necessarily know everything sometimes they are learning things from students and that's kind of the feeling there. That's what I like from there. Here it is sort of getting there. It is just, I guess it is early days, so what we do, sometimes is probably not such a wonderful standard. They are probably not learning anything from us right now."

"I worked as a volunteer for an environmental organisation... I found it really difficult, extremely, not rewarding much of the time. I think a lot of people who work there [in environmental organisations], in the green movement in the area, are self-supported, so [they] aren't willing to help all the time. For a start they are busy, but they wouldn't give time or any part of the work away, even though it was obvious if they came together so much more would be achieved. I found that deeply frustrating. It's a wonderful indulgence to take time out [and study]."

"I am trying to work in university, it is amazing that students are in fifth/sixth years and they have more or less the same views as the first years, because they didn't have any environmental education like the first years are having now. They are in these issues, more or less the same. I found people's awareness and other students' less than when I was a first- time student. I think, because I lived in the countryside and I've always being quite interested in environmental issues, I was quite surprised because I'd thought that environmental education was much more important in schools."

"I think it has probably done badly in schools. Maybe it's being enforced, because it is coming all the time, that it is like a negative reinforcement. If you want to condition somebody to be interested in something, you don't give it to them all the time, the first thing they do is get bored. It is like giving them porridge every day! If you give porridge to people once a month it might get attractive, a different flavour, at the moment nothing like that has happened."

Motivation for environmental education

"We are all interested in environmental issues, at least curious..."

"I suppose people come to become interested and that's a task. Because, I think people are more interested in their development, in Britain, the society is more geared towards individuals, it's geared towards people's well-being, what we have is every image you ever see is of happiness through gain, and that is not the whole picture as far as I am concerned and the environment has much more to do with it. Probably the satisfaction of giving away, it is a much deeper sort of thought not to get, to work on the environment. Because, it is not very rewarding, it is not financial, and I guess we have to change people's ways of thinking and that's tough. That's the point to start, people have brains and there is no way that if they think one thing, that other ideas can come out of that."

How students teach sustainability and environmental design if they were teachers

"I guess if I have to teach myself, I guess I have to be very self-disciplined, probably, it depends on people, some people pick up from [other people] some people from [other people or things] and again think about the subjects and discuss with people, interact with your classmates, you get more ideas through discussion. In the lectures, they tell you about a few things and then with the presentation you can't get the ideas straight away. Sometimes things you never thought about."

"[Create] a more motivated [teaching] environment."

"I am not very good at teaching. I will be worried about getting it wrong. Don't get too much into discussion unless you know that people are happy about what they are discussing. If you don't know anything about it, then you get frustrated or depressed. I think one good thing about school was that you did three subjects for 'A levels' and you could have two which were going well, and the other they could make alright to be on the level. Whereas in here, you are doing just one subject, and sometimes it is going alright and sometimes it is not, but there is no balance, that's why I started my modules in architecture.

"I am doing town planning and sitting in architecture it has been quite hard, studio work, which however, is quite easy to compare with the lectures. It is just the way they draw [your attention], they should do more...There is so much more there, they just concentrate on Greek and Roman, there is so much more instead, learning more about the pyramids, which have been there 10,000 years and they concentrate on things from 3,000 years ago, things that are interesting as well, but..."

"I have no idea. I am already interested, so I can't think of things that would make me more interested. I can't think of anything more important than this. I'm so interested in efficiency. I don't know how I would do it. I will ask them [students] to think, because they have to think about it, they don't have to become interested."

"If I have to compare what we had when we made our model, we had this sort of overview, how we all did and how we have to learn. What I like about the actual workshop is that we had to do something in it, we had to participate, not just have someone telling you, which I already said a million times. But I really think you always have to get people involved, you can't just keep talking for a long time, so that was good [in the workshop]."

"Probably the best thing that gets me learning is, like, some teachers what they do is basically give you all the information, pass it on to you and then go. And you just think: 'That's ok'! It is nicer to keep interacting with each other, if you don't understand something, you can always speak with your tutors for the right direction. I also like a teacher who is kind of... I don't know more or less... [like this] tutor, he is such a 'joky' character and sometimes you just drift off from the actual subjects, and that is quite good at times but sometimes you just want to really get in there. I need someone, a teacher who has so much energy and enthusiasm for what they are going to give you so that you feel this is really good, I kind of need that."

"You go out. Like I say, just giving me information. That makes you disconnect. Let's go out!"

"I guess, doing what you are doing right now [just talking about the environment]."

"I think, getting them actively participating a lot will be my main motive basically, so it is not just the case of me teaching them the facts about the environment, just them actually going out to learn about it themselves, actively, a lot of field trips and things. And also I think once in a while you kind of need an interval, so you can sort of reflect on what you've learnt, and that kind of thing. So in between all the teaching that's going on, you just have a moment of recapping what's going on, what happened, what they've found. It is interesting that you have three courses, meaning you have set topics going on, but in between them students sometimes pick up something different that links into another subject. You know, during those intervals I'd like hear things like that, like you associate this with this and then go to the class and let others hear about it."

"[Like a discussion] sometimes it brings the ideas together."

"I'd also like quizzes. Not really tests, as such, they're too serious. They kind of always keep you on what's going on; something that is not being reflected in your grades, but like a review. That will be good."

Appendix B

Introduction

Some of the guiding questions and information raised with teachers and students of Architecture were outlined in Chapter 5.

The following are the actual questionnaire statements organised by topic of interest. The students' questionnaire was used in full; the teachers' questionnaire was reduced (from 50 questions to 38). The final version of both questionnaires can be found in Appendix D.

Questionnaire Design for Students

Criteria used in the questionnaire to extract information on learning methods used by students:

Self-Evaluation

How students grade their understanding and competence in Environmental Design and Sustainability:

> I rate my overall understanding in Environmental Design and Sustainability as high.

Integration of Environment and Sustainability in the Design Process:

> While designing, I always think about environment and sustainability.
>
> I frequently relate lecture information to the design project, as it's easy to see the relevance of Environmental Design this way.
>
> I always consider environmental factors in my design because I understand Environmental Design very well and can easily relate it to any project.
>
> Design studio is the main thing; the other subjects are more like secondary subjects.
>
> I like to try an adventurous design regardless of the technical difficulties.
>
> I will discard a possibly flamboyant design if I consider it is not environmentally friendly.
>
> I don't apply much environmental design in my projects because I really haven't been into it in class.

Environmental issues are becoming more amalgamated into design.

Importance of Environmental Design and Sustainability

I always consider environmental design and sustainability in my projects because I believe they can be a design generator.

I always design environmentally because I believe it is as important as other factors in design.

I concentrate more on the philosophical aspect of design than on the technical issues.

When designing I put extra effort into technical aspects (e.g. Environment, services, construction, structures, etc.).

Methods of Studying

The questions cover learning behaviour or method practised by students to learn:

I have to do some extra research to understand what Environmental Design is about.

I always discuss with friends or seniors to better understand Environment and Sustainability.

I always discuss problems regarding Environmental Design with lecturers and in this way I can understand better.

I can learn Environmental Design by just listening to lectures.

I can learn Environmental Design by just reading books and magazines.

I better learn Environmental Design when lectures combine practice with theories.

The questions cover students' attitudes towards learning, memorising or understanding:

When I learn something I try to see in my mind how things fit together with other subjects.

I generally prefer the lecturers/tutors who explain to me how what we learn relates to the outside world.

I tend to accept what I am told by the teacher without thinking whether I agree or not.

Preferred Learning Methods

The questions were intended to find out the various methods or media of learning preferred by students:

In order for me to understand Environmental Design better, I need to visit and look at the building examples.

I can understand environmental issues better if there are slides showing the buildings.

I can understand Environmental Design if I can participate in an environmental project.

I can understand environmental issues better if I am in a small group, so I can ask.

I understand better if we do different things in class, (lectures, visits, projects, etc.). It's good to change!

Time Management

I divide my time equally between all my subjects.

I expend more time on the design projects than on the assignments.

Learning Motivation

These questions were intended to find out the overall motivation of the students for learning to design environmentally:

I feel more influence and motivation from guest architects that are actually doing environmental designs.

I am not really interested. As in class, we talk a lot about environmental issues but nothing is done about it in practice.

In my opinion, Environmental Design is a very interesting subject.

I always enjoy learning Environmental Design.

Understanding Environmental Design is secondary. I mostly go to lectures because I need the credits from them.

I find lectures difficult and quite boring.

How tutoring and teaching affects students' perception of Sustainability and Environmental Design:

Sustainability should be an important area as there is a 'big chunk of people' recognising Sustainability in architecture.

Sustainability is not that important; even if I am asked to do some work in Sustainability, tutors won't look at it in detail.

Tutors are much more interested in working out how good your building is in terms of structure, functioning, expression and things like that.

I put less effort into environmental issues in my design project because I can always consult my lecturers later.

Lectures didn't make anyone think: I must design 'sustainable'!

To identify students' opinions on learning Environmental Design and Sustainability:

I really enjoy environmental architecture because it tends to get a bit more theoretical than any other kind of architecture.

I always dislike the fact that Environmental Design has too many calculations.

It took me quite a lot to understand the terminology.

Environmental architecture is very technical and they don't slow down so we can go back and review the physics.

The difficulty in understanding Environmental Design results from lecturers dealing mainly with calculations.

Questionnaire Design for Lecturers

Criteria used in the questionnaire to extract information on teaching methods used and opinions on students' learning:

Teaching Approaches

To identify teaching methods frequently used by teachers of Environmental Design and related subjects:

My most frequent method of teaching Environment and Sustainability issues is giving lectures.

I use the OHP very frequently to illustrate.

I frequently show videos of environmentally friendly and sustainable design examples.

I frequently take students on site visits to learn and see environmental designs.

I frequently show slides of Environmental Design examples to show the techniques used.

I frequently refer to students' design briefs.

I believe technology issues should be dealt with separately so students can make the connections while designing.

I use design projects as the vehicle to deliver the environmental material, so I tie the teaching with the design.

To identify the teaching methods preferred by the lecturers or thought of as the best way to teach:

I believe in teaching Environmental Design through slide shows.

I believe in teaching Environmental Design through case studies, by analysing existing buildings.

The best way to learn technology is making a model from the drawings.

I believe in teaching Environmental Design through lab/experiment sessions.

I believe in teaching Environmental Design through hands-on-experience/real projects.

I believe studio design is the best way to teach Sustainability in architecture.

I believe in teaching Environmental Design through tutorials.

I believe in teaching Environmental Design through integrated projects.

I believe in teaching Environmental Design through seminars.

I believe in teaching Environmental Design through small group sessions and seminars.

Student learning

To identify the overall perception of effective teaching methods of Environmental Design and its effects on student learning:

I believe examinations are very important in making students learn Environmental Design.

I believe giving the students the principles of Environmental Design and Sustainability will be more effective than giving them calculations of environmental factors.

I believe more contact with students at tutorials improves their learning experience.

Delivering simultaneously the design project and the building engineering helps students to get the idea that Environmental Design and architecture is actually the same thing.

I believe that knowing what students are doing in other modules will help improve teaching Environmental Design.

I don't believe in numerical modelling because I don't think it is the best way to tell what is happening in a building.

To identify students' difficulty in understanding Environmental Design from the teacher's point of view:

I can see that my students are facing difficulties in understanding Environmental Design because they lack daily examples.

The students seem to have problems in understanding Sustainability and environment in terms of design.

There seems to be compartmentalisation of knowledge between environment and other related architectural subjects, which is reflected in students' learning.

I noticed students tend to skip lectures and only attend tutorials and lab sessions.

In students' projects there are few 'talking gestures' but not fundamental issues of Environmental Design and Sustainability.

Students tend to avoid any subject that looks more like science.

Students don't understand if something looks like it has anything to do with mathematics.

To understand how teachers perceive Environmental Design in architecture:

Environment and Sustainability are part of technology subjects in architecture.

Architecture is actually Environmental Design.

In my class we talk about scientific principles rather than the design aspect.

We are teaching how to design things; sustainable design has to start from the first idea, not added things at the end.

Environmental Design is part technology, part how to do things and a part the history of how people have done it.

I believe that we use the environment to create buildings.

Environmental Design classes are about how students interpret scientific facts into their designs.

Environmental Design is about a mixture of abstract philosophy and technology.

I find that big classes are problematic in teaching Environmental Design.

I think this is a design school and I think there is a reluctance for many of the design teachers to embrace technology, not only environmental sciences, but building technology, structures, etc...

Sustainability needs more experimentation, a place where students can take risks.

In general design tutors are environmentally disappointing.

They may use other techniques of exploring the application of the theory into the design, so they can take a section of the building and reveal it in terms of sustainability and environmental design.

We don't know the answer to Sustainability, so how can we teach it?

The structure of the school is an important element in teaching of Environmental Design.

Integration with the Design Process

I noticed that students ask questions based on their design problems.

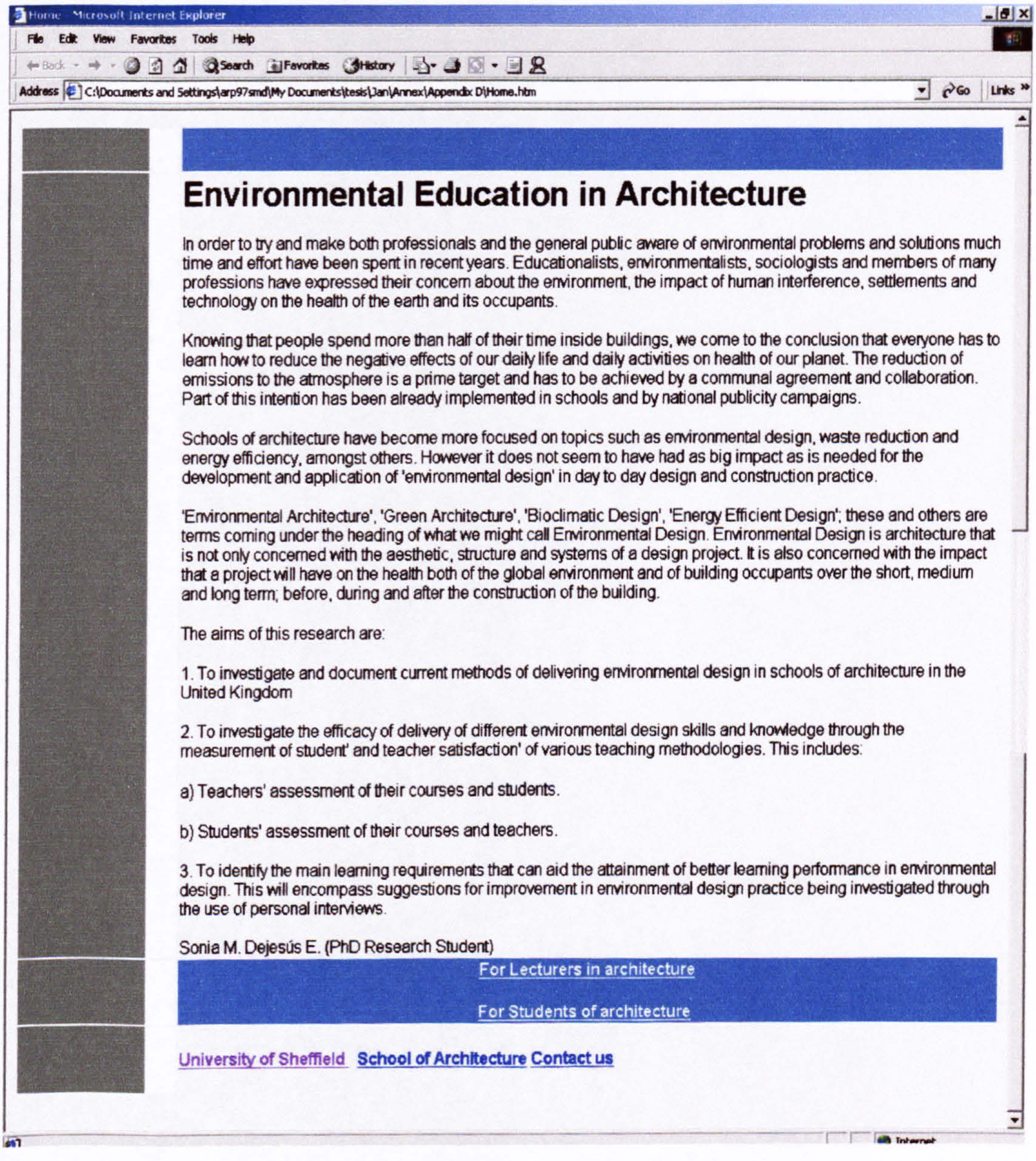
I really don't know what students are doing at other modules.

I think the assessment weight in the studio related to environmental issues should increase.

Environmental science is the same as Environmental Design.

Appendix C

The following are images from the World Wide Web to show how the on-line questionnaires were presented to students and teachers of Architecture.



Home - Microsoft Internet Explorer

File Edit View Favorites Tools Help

Address C:\Documents and Settings\arp97smd\My Documents\tesis\Jan\Annex\Appendix D\Home.htm

Environmental Education in Architecture

In order to try and make both professionals and the general public aware of environmental problems and solutions much time and effort have been spent in recent years. Educationalists, environmentalists, sociologists and members of many professions have expressed their concern about the environment, the impact of human interference, settlements and technology on the health of the earth and its occupants.

Knowing that people spend more than half of their time inside buildings, we come to the conclusion that everyone has to learn how to reduce the negative effects of our daily life and daily activities on health of our planet. The reduction of emissions to the atmosphere is a prime target and has to be achieved by a communal agreement and collaboration. Part of this intention has been already implemented in schools and by national publicity campaigns.

Schools of architecture have become more focused on topics such as environmental design, waste reduction and energy efficiency, amongst others. However it does not seem to have had as big impact as is needed for the development and application of 'environmental design' in day to day design and construction practice.

'Environmental Architecture', 'Green Architecture', 'Bioclimatic Design', 'Energy Efficient Design'; these and others are terms coming under the heading of what we might call Environmental Design. Environmental Design is architecture that is not only concerned with the aesthetic, structure and systems of a design project. It is also concerned with the impact that a project will have on the health both of the global environment and of building occupants over the short, medium and long term; before, during and after the construction of the building.

The aims of this research are:

1. To investigate and document current methods of delivering environmental design in schools of architecture in the United Kingdom

2. To investigate the efficacy of delivery of different environmental design skills and knowledge through the measurement of student' and teacher satisfaction' of various teaching methodologies. This includes:

a) Teachers' assessment of their courses and students.

b) Students' assessment of their courses and teachers.

3. To identify the main learning requirements that can aid the attainment of better learning performance in environmental design. This will encompass suggestions for improvement in environmental design practice being investigated through the use of personal interviews.

Sonia M. Dejesús E. (PhD Research Student)

For Lecturers in architecture

For Students of architecture

University of Sheffield School of Architecture Contact us

Figure C1 On-line Questionnaire Home Page

http://www.shef.ac.uk/uni/academic/A-C/archst/research/postcur/sdje/sdje.html

Figure C1 shows the Home page of the questionnaire as it was assessed through the Internet. A different welcome page was given to students and teachers contacted through the department E-mail, as a shortcut to the questionnaires (Figure C 2)

Students and teachers were given the option to read more about the questionnaire or make comments through E-mail.

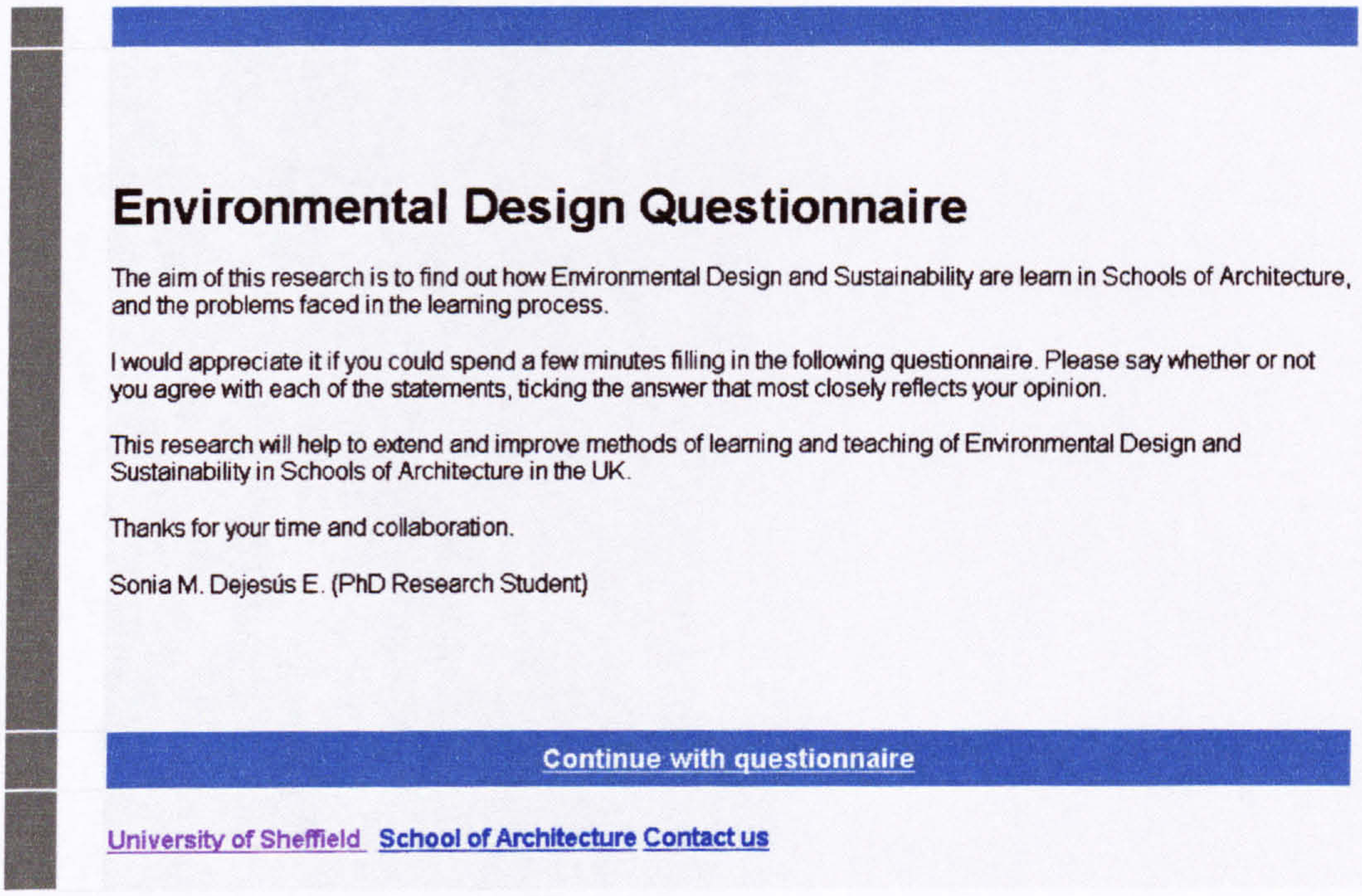


Figure C2 On-line Questionnaire Welcome page

The questions asked to students and teachers are at the end of the section. The way they were presented in the Internet can be seen on the following Figures (C3 and C4)

Questions for teachers

Environmental design questionnaire

How do you teach environmental design?

1 - My most frequent method of teaching environment and sustainability issues is giving lectures

Strongly disagree	Slightly disagree	Neutral	Slightly agree	Strongly agree

2 - I frequently take students to site visits to learn about and see environmental designs

Strongly disagree	Slightly disagree	Neutral	Slightly agree	Strongly agree

3 - I believe technology issues should be dealt separately so students should make the connections while designing

Strongly disagree	Slightly disagree	Neutral	Slightly agree	Strongly agree

4 - I use design projects as the vehicle to deliver the environmental material, so I tie the teaching with the design

Strongly disagree	Slightly disagree	Neutral	Slightly agree	Strongly agree

5 - I believe in teaching environmental design through case studies, by analysing existing buildings

Strongly disagree	Slightly disagree	Neutral	Slightly agree	Strongly agree

6 - I believe in teaching environmental design through lab/experiment sessions

Strongly disagree	Slightly disagree	Neutral	Slightly agree	Strongly agree

7 - I believe in teaching environmental design through hand-on-experience/real projects

Strongly disagree	Slightly disagree	Neutral	Slightly agree	Strongly agree

8 - I believe studio design is the best way to teach sustainability in architecture

Strongly disagree	Slightly disagree	Neutral	Slightly agree	Strongly agree

9 - I believe in teaching environmental design through integrated projects

Strongly disagree	Slightly disagree	Neutral	Slightly agree	Strongly agree

10 - I believe in teaching environmental design through small group sessions and seminars

Strongly disagree	Slightly disagree	Neutral	Slightly agree	Strongly agree

Figure C3 Teachers' On-line Questionnaire

		Strongly disagree	Slightly disagree	Neutral	Slightly agree	Strongly agree
1	My most frequent method of teaching environment and sustainability issues is giving lectures					
2	I frequently take students to site visits to learn about and see environmental designs					
3	I believe technology issues should be dealt separately so students should make the connections while designing					
4	I use design projects as the vehicle to deliver the environmental material, so I tie the teaching with the design					
5	I believe in teaching environmental design through case studies, by analysing existing buildings					
6	I believe in teaching environmental design through lab/experiment sessions					
7	I believe in teaching environmental design through hands-on-experience/real projects					
8	I believe studio design is the best way to teach sustainability in architecture					
9	I believe in teaching environmental design through integrated projects					
10	I believe in teaching environmental design through small group sessions and seminars					
11	I believe examinations are very important in making students learn environmental design					
12	I believe giving the students the principles of environmental design and sustainability will be more effective than giving them calculations of environmental factors					
13	I believe more contact with students at tutorials improves their learning experience					
14	Delivering simultaneously the design project and the building engineering help students to get the idea that environmental design and architecture are actually the same thing.					
15	I believe that knowing what students are doing in other modules will help improve teaching environmental design					
16	I can see that my students are facing difficulties in understanding environmental design because they lack daily examples					
17	The students seem to have problems in understanding sustainability and environment in terms of design					

	sustainability and environment in terms of design					
18	There seems to be compartmentalisation of knowledge between environment and other related architectural subjects, which is reflected into students learning					
19	I noticed during my course that students ask questions based on their design problems					
20	I noticed students tend to skip lectures and only attend tutorials and lab sessions					
21	In students' design projects there are few 'talking gestures' but not fundamental issues of environmental design and sustainability *					
22	Students tent to avoid any subject that looks more like science.					
23	Students don't try to understand if something looks like it has anything to do with mathematics.					
24	Environment and sustainability are part of technology subjects in architecture					
25	Architecture is actually Environmental design					
26	In my class we talk about scientific principles rather than the design aspect					
27	We are teaching how to design things; sustainable design has to start from the first idea, its not something added at the end.					
28	Environmental design is part technology, part how to do things and a part of the history of how people have done it					
29	I believe that we use the environment to create buildings					
30	Environmental design classes are more about how students interpret scientific facts into their designs.					
31	Environmental design is more about a mixture of abstract philosophy and technology.					
32	I think the assessment weight in the studio related to environmental issues should increase					
33	I find that big classes are problematic to teach environmental design					
34	I think this is a design school and I think there is a reluctance for many of the design teachers to embrace technology, not only environmental sciences, but building technology, structures, etc...					
35	Sustainability needs more experimentation, a place where students can take risks					
36	In general design tutors are environmentally disappointing					
37	We don't know the answer to sustainability, so how can we teach it?					

38	The structure of the school is an important element in teaching of environmental design					

* As some lecturers used this expression to mean talk and no substance, the expression was incorporated in a question. However, many respondents indicated that they did not understand the expression.

Questions for students

Environmental design questionnaire

What do you think about Environmenta Design?

1 - I rate my overall understanding in environmental design and sustainability as high

Strongly disagree | Slightly disagree | Neutral | Slightly agree | Strongly agree

2 - While designing, I always think about environment and sustainability

Strongly disagree | Slightly disagree | Neutral | Slightly agree | Strongly agree

3 - I frequently relate lecture's information to the design project as its easy to see the relevance of environmental design this way

Strongly disagree | Slightly disagree | Neutral | Slightly agree | Strongly agree

4 - I always consider environmental factors in my design because I understand environmental design very well and can relate it to any project easily

Strongly disagree | Slightly disagree | Neutral | Slightly agree | Strongly agree

5 - Design studio is the main thing, the other subjects are more like secondary subjects

Strongly disagree | Slightly disagree | Neutral | Slightly agree | Strongly agree

6 - I always consider environmental design and sustainability in my projects because I believe they can be a design generator

Strongly disagree | Slightly disagree | Neutral | Slightly agree | Strongly agree

7 - I always design environmentally because I believe it is as important as other factors in design

Strongly disagree | Slightly disagree | Neutral | Slightly agree | Strongly agree

8 - Sustainability should be an important area as there is a big group recognizing sustainability in architecture

Strongly disagree | Slightly disagree | Neutral | Slightly agree | Strongly agree

9 - Sustainability is not that important; even if I am asked to do some work in sustainability, tutors won't look at it in detail

Strongly disagree | Slightly disagree | Neutral | Slightly agree | Strongly agree

Figure C4 Students' On-line Questionnaire

		Strongly disagree	Slightly disagree	Neutral	Slightly agree	Strongly agree
1	I rate my overall understanding in environmental design and sustainability as high					
2	While designing, I always think about environment and sustainability					
3	I frequently relate lecture's information to the design project as its easy to see the relevance of environmental design this way					
4	I always consider environmental factors in my design because I understand environmental design very well and can relate it to any project easily					
5	Design studio is the main thing, the other subjects are more like secondary subjects					
6	I always consider environmental design and sustainability in my projects because I believe they can be a design generator					
7	I always design environmentally because I believe it is as important as other factors in design					
8	Sustainability should be an important area as there is a big group recognizing sustainability in architecture.					
9	Sustainability is not that important; even if I am asked to do some work in sustainability, tutors won't look at it in detail.					
10	Tutors are much more interested in working out how good your building is in terms of structure, function, expression and things like that.					
11	I have to do some extra research to understand what environmental design is about					
12	I always discuss with friends or seniors to better understand environment and sustainability					
13	I always discuss problems regarding environmental design with lecturers and in this way I can understand better					
14	I can learn environmental design by just listening to lectures					
15	I can learn environmental design by just reading books and magazines					
16	I better learn environmental design when lectures combine practice with theories					

17	Understanding environmental design is secondary; I mostly go to lectures because I need to pass the subject.					
18	When I learn something I try to see in my mind how things fit together with other subjects					
19	I generally prefer the lecturer/tutors who explain to me how what we learn relates to the outside world					
20	I tend to accept what I am told by the teacher without thinking whether I agree or not					
21	I put less effort into environmental issues in my design project because I can always consult my lecturers later					
22	I concentrate more in the philosophical aspect of design than on the technical issues.					
23	When designing I put extra effort in technical aspects (e.g. Environment, services, construction, structures, etc.)					
24	Environmental issues are becoming more amalgamated into design					
25	I don't apply environmental design much in my studio projects because I really haven't been interested in it in class					
26	Lectures didn't make anyone think: I mostly design sustainable anyway!					
27	I divide my time equally between all my subjects					
28	I expend more time in the design projects than in other work					
29	In order for me to understand environmental design better, I need to visit and look at the building examples					
30	I can understand environmental issues better if there are slides showing the buildings					
31	I can understand environmental design if I can participate in a environmental project					
32	I can understand environmental issues better if I am in a small group, so I can ask					
33	I find lectures difficult and quite boring					
34	I understand better if we do different things in class, (lectures, visits, projects; etc...) it's good to change!					
35	I feel more influence and motivation from guest architects that are actually doing environmental designs.					
36	I am not really interested; as in class we talk a lot about environmental issues but nothing is done about it in practice					
37	In my opinion environmental design is a very interesting subject					
38	I always enjoy learning environmental design					

39	I like to try an adventurous design regardless of the technical difficulties and alternative technologies						
40	I will discard a possibly flamboyant design if I consider it is not environmentally friendly						
41	I really enjoy environmental architecture because it tends to get a bit more theoretical than any other kind of architecture						
42	I always dislike the fact that environmental design has too many calculations						
43	It took me quite a lot of time to understand the terminology						
44	Environmental architecture is very technical and lecturers don't slow down so we can go back and review the physics and do few things with it.						
45	The difficulty in understanding environmental design results from lecturers dealing mainly with calculations						

D. Frequencies

Notes

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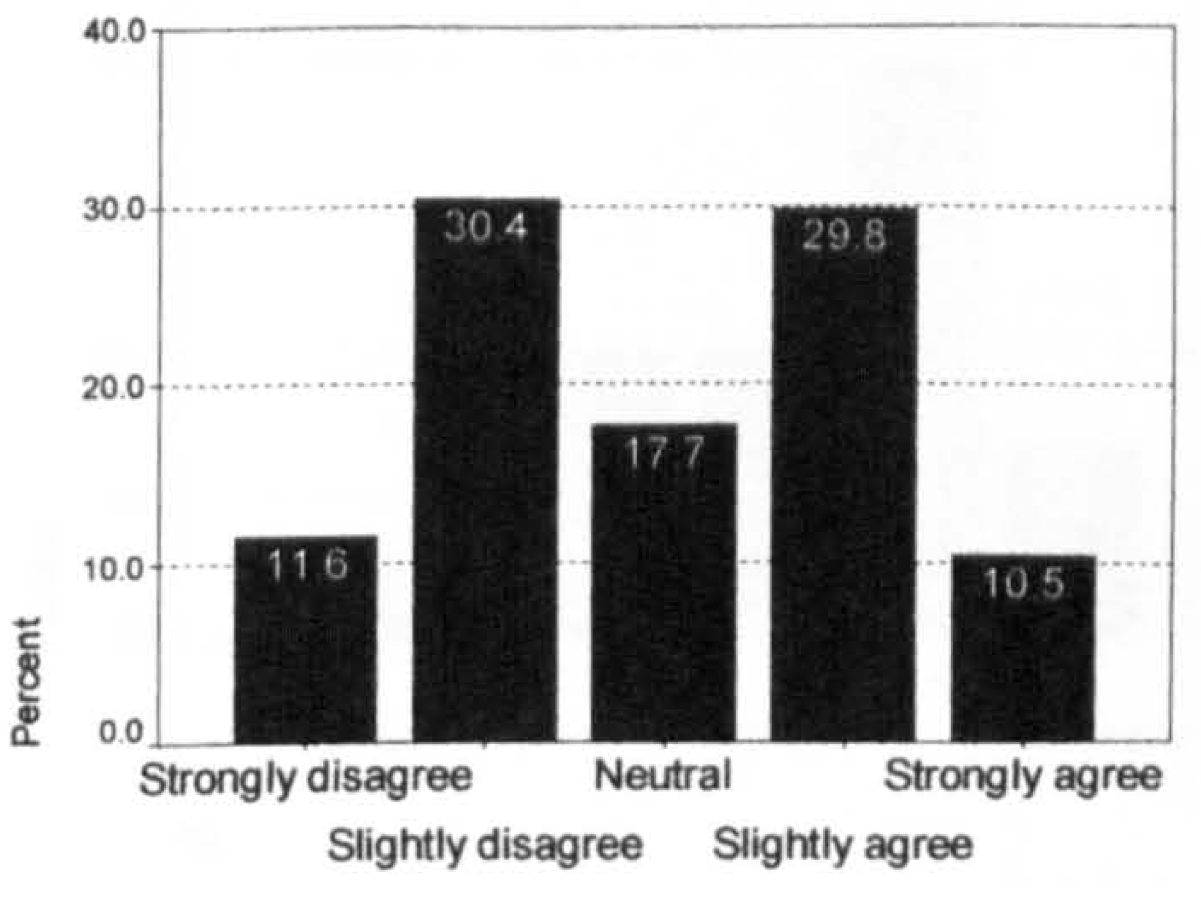
Frequency Table

S1:I rate my overall understanding in environmental design and sustainability as high					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly disagree	21	11.6	11.6	11.6
	Slightly disagree	55	30.4	30.4	42.0
	Neutral	32	17.7	17.7	59.7
	Slightly agree	54	29.8	29.8	89.5
	Strongly agree	19	10.5	10.5	100.0
	Total	181	100.0	100.0	



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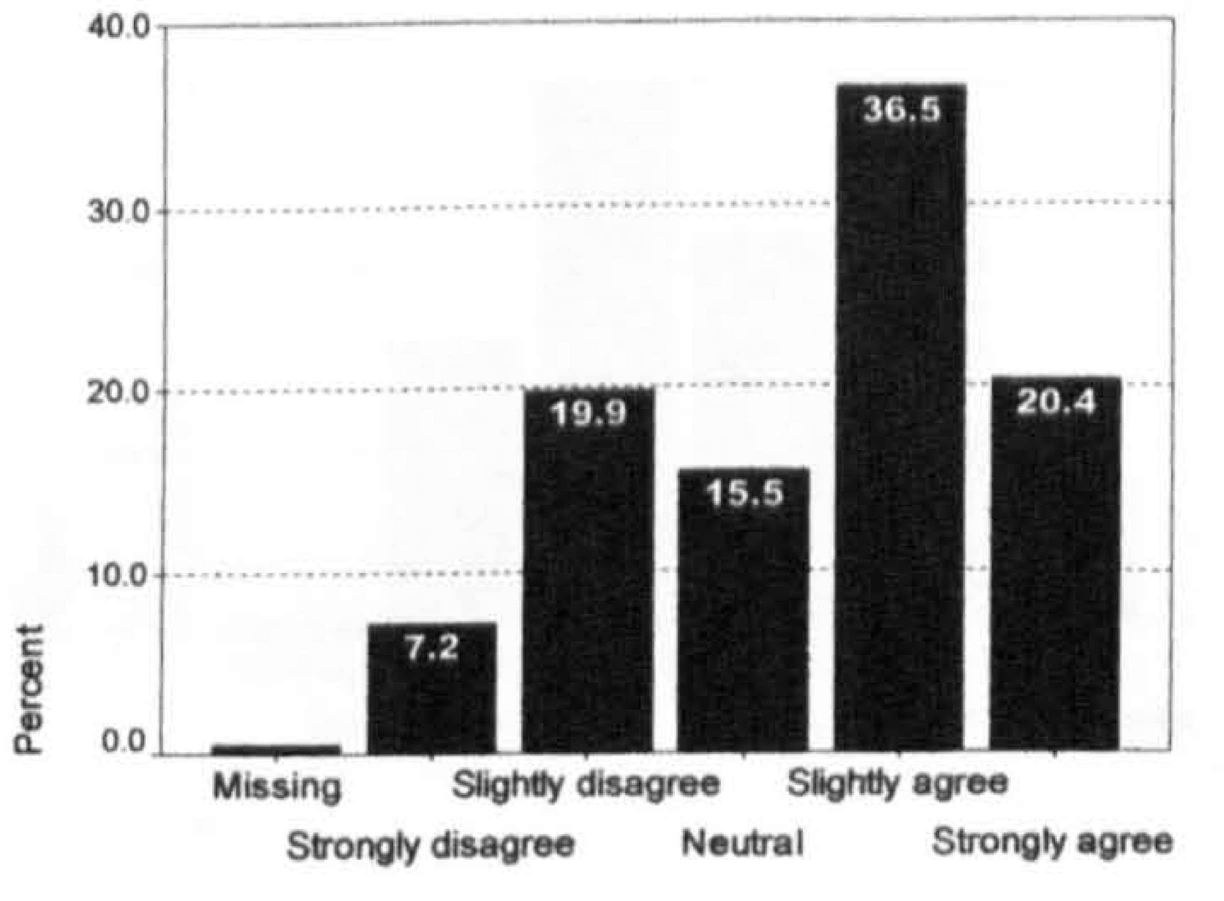
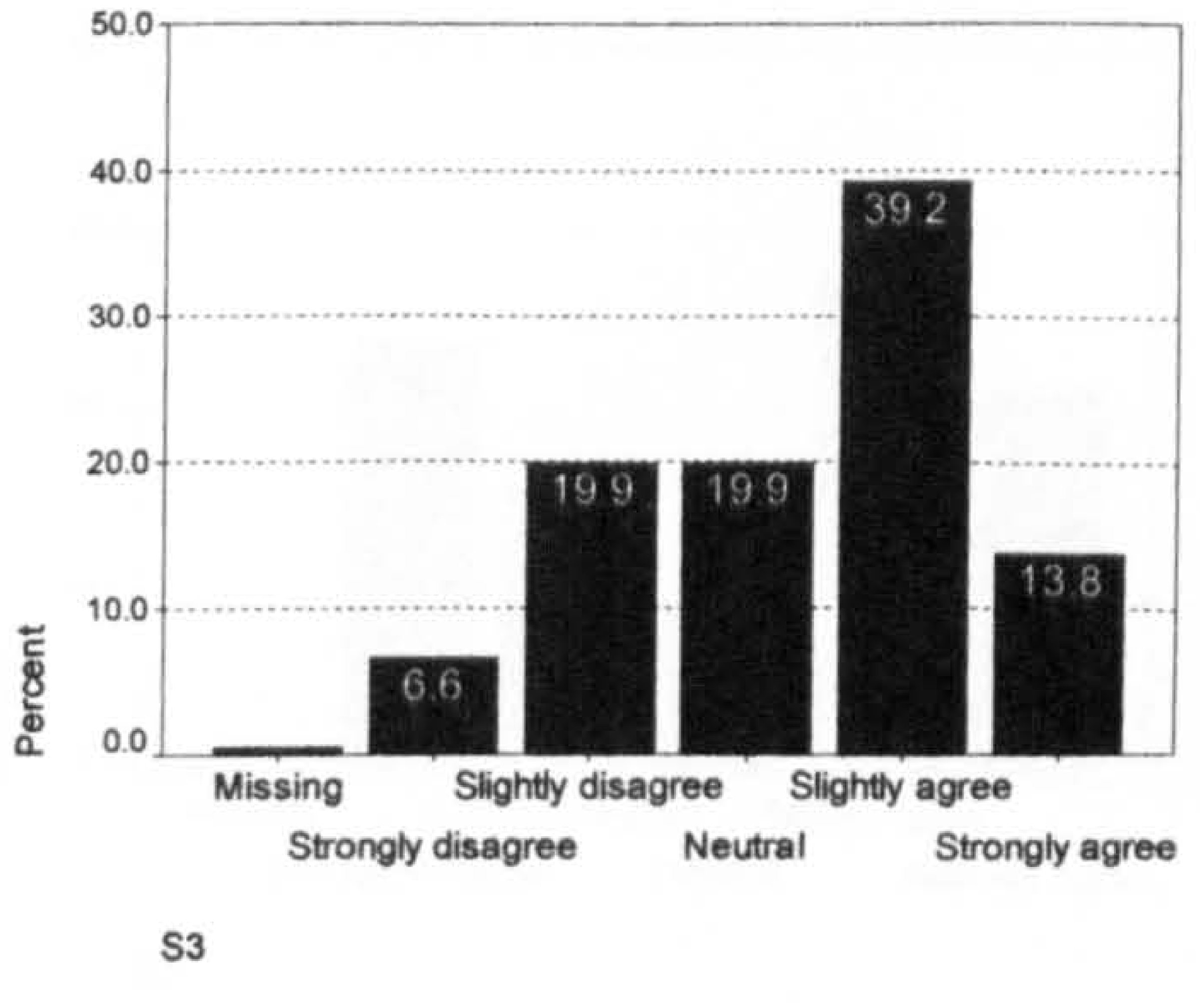
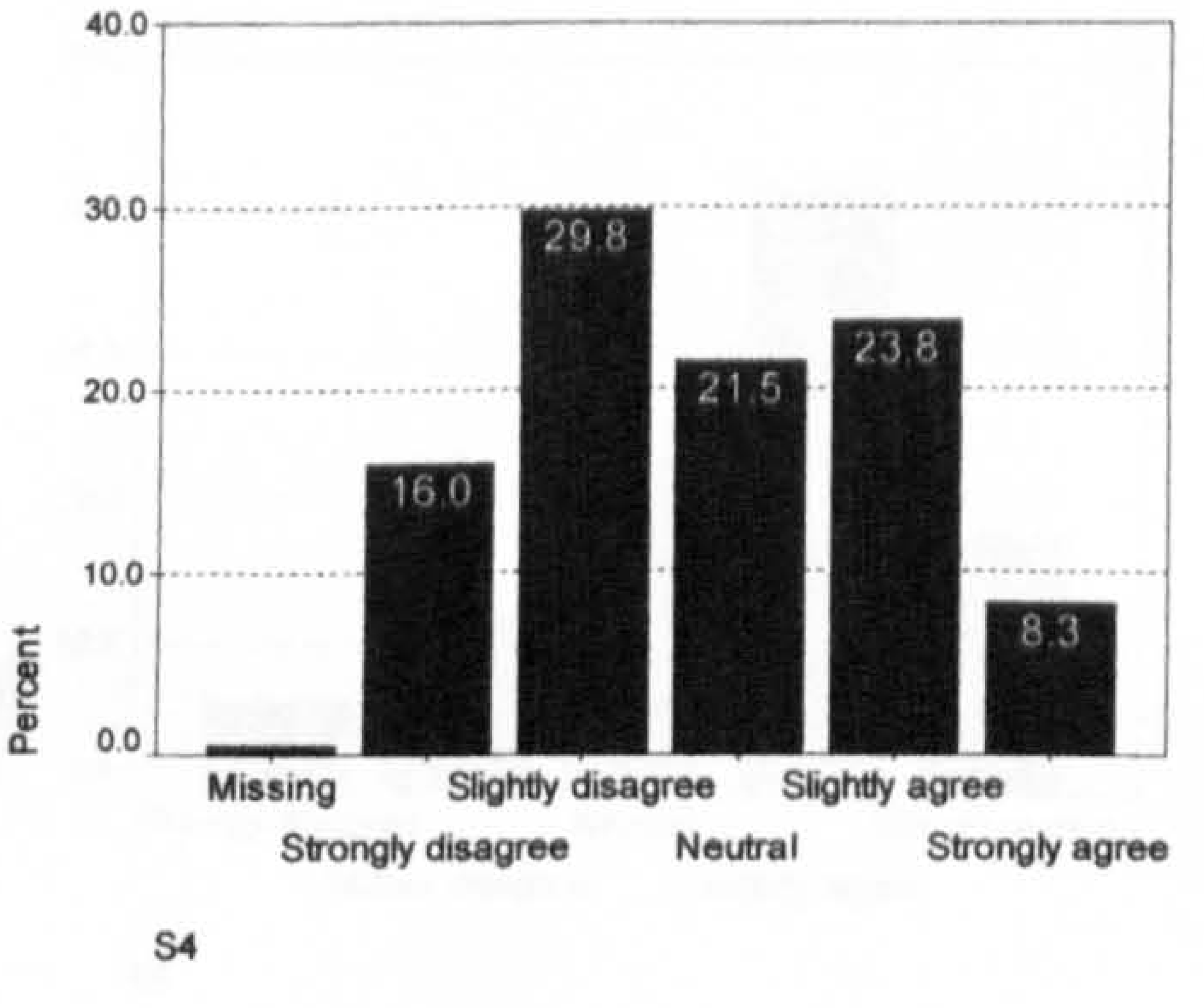


S2

S2: While designing, I always think about environment and sustainability					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly disagree	13	7.2	7.2	7.2
	Slightly disagree	36	19.9	20.0	27.2
	Neutral	28	15.5	15.6	42.8
	Slightly agree	66	36.5	36.7	79.4
	Strongly agree	37	20.4	20.6	100.0
	Total	180	99.4	100.0	
Missing	9	1	.6		
Total		181	100.0		

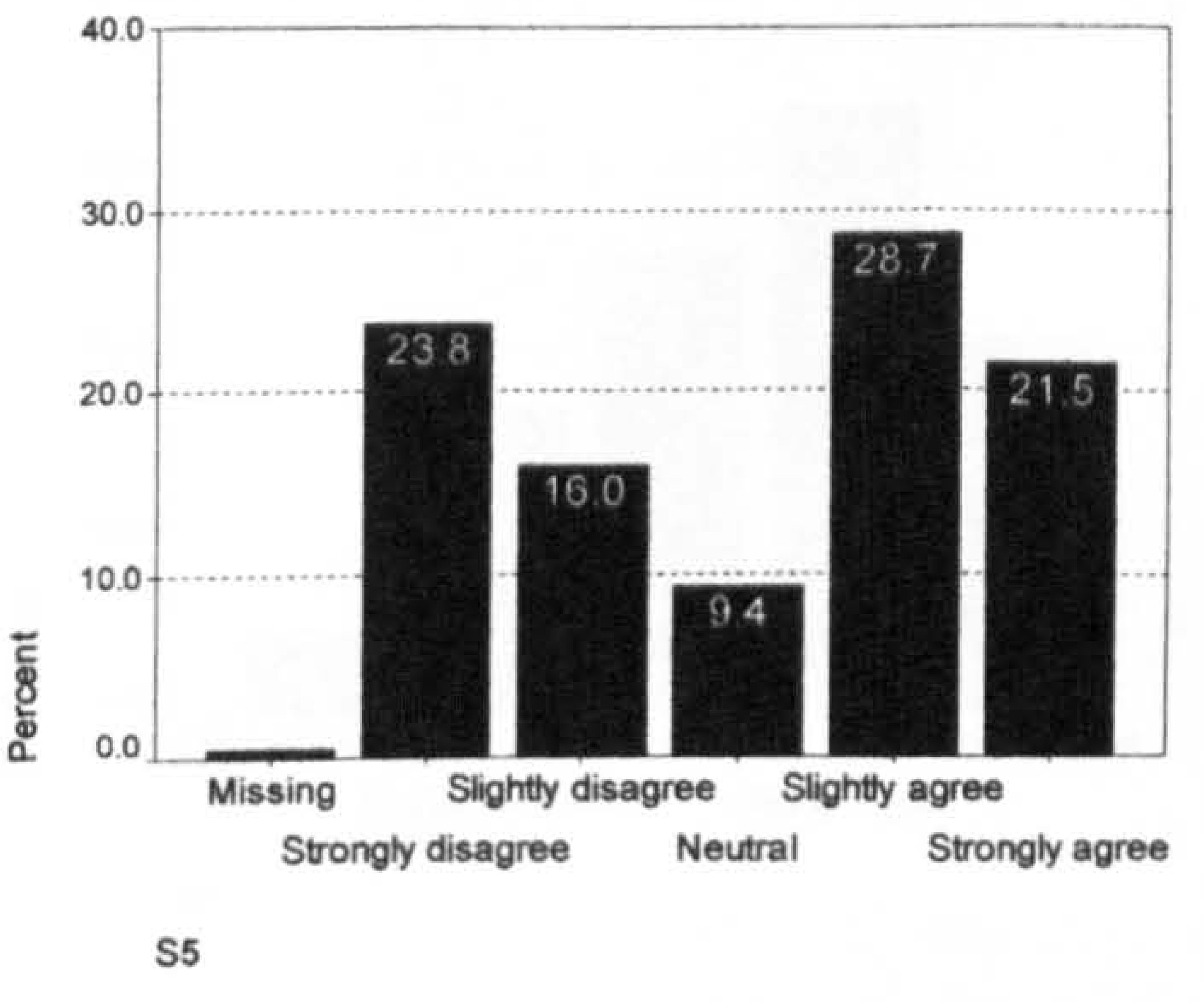
S3: I frequently relate lecture's information to the design project as its easy to see the relevance of environmental design this way					
		Frequency	**Percent**	**Valid Percent**	**Cumulative Percent**
Valid	**Strongly disagree**	12	6.6	6.7	6.7
	Slightly disagree	36	19.9	20.0	26.7
	Neutral	36	19.9	20.0	46.7
	Slightly agree	71	39.2	39.4	86.1
	Strongly agree	25	13.8	13.9	100.0
	Total	180	99.4	100.0	
Missing	**9**	1	.6		
Total		181	100.0		

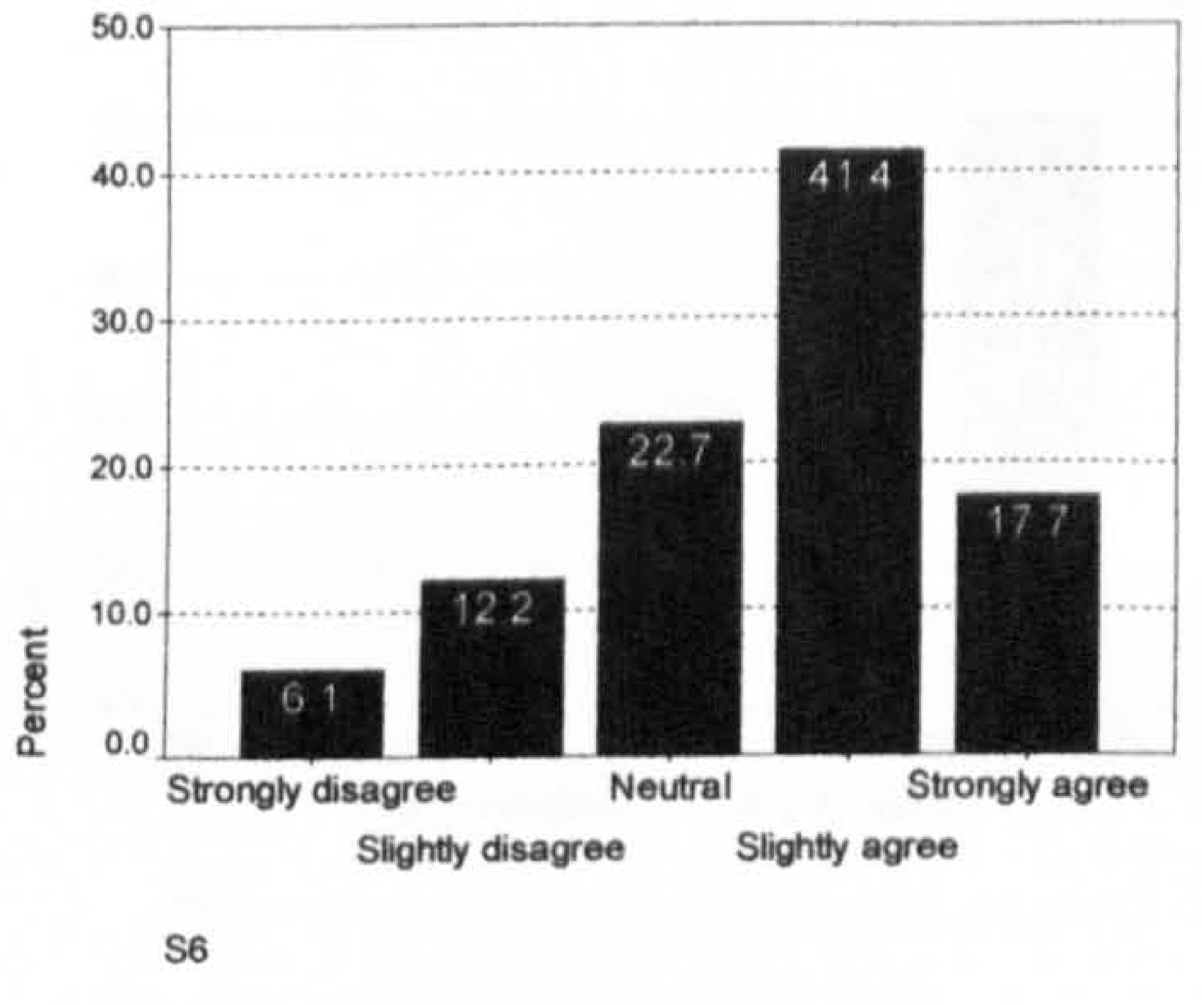




S4: I always consider environmental factors in my design because I understand environmental design very well and can relate it to any project easily					
		Frequency	**Percent**	**Valid Percent**	**Cumulative Percent**
Valid	**Strongly disagree**	29	16.0	16.1	16.1
	Slightly disagree	54	29.8	30.0	46.1
	Neutral	39	21.5	21.7	67.8
	Slightly agree	43	23.8	23.9	91.7
	Strongly agree	15	8.3	8.3	100.0
	Total	180	99.4	100.0	
Missing	**9**	1	.6		
Total		181	100.0		

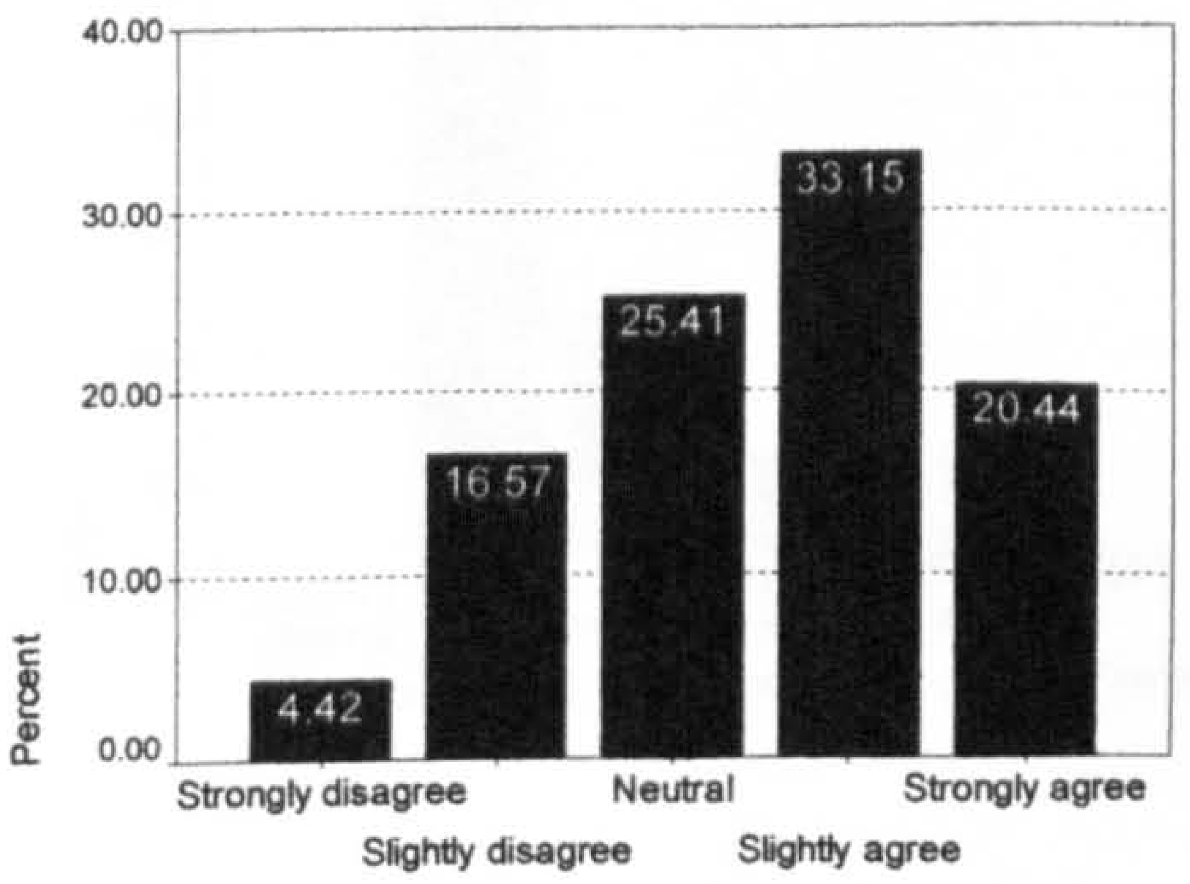
S5: Design studio is the main thing, the other subjects are more like secondary subjects					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly disagree	43	23.8	23.9	23.9
	Slightly disagree	29	16.0	16.1	40.0
	Neutral	17	9.4	9.4	49.4
	Slightly agree	52	28.7	28.9	78.3
	Strongly agree	39	21.5	21.7	100.0
	Total	180	99.4	100.0	
Missing	9	1	.6		
Total		181	100.0		





S6: I always consider environmental design and sustainability in my projects because I believe they can be a design generator					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly disagree	11	6.1	6.1	6.1
	Slightly disagree	22	12.2	12.2	18.2
	Neutral	41	22.7	22.7	40.9
	Slightly agree	75	41.4	41.4	82.3
	Strongly agree	32	17.7	17.7	100.0
	Total	181	100.0	100.0	

S7: I always design environmentally because I believe it is as important as other factors in design					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly disagree	8	4.4	4.4	4.4
	Slightly disagree	30	16.6	16.6	21.0
	Neutral	46	25.4	25.4	46.4
	Slightly agree	60	33.1	33.1	79.6
	Strongly agree	37	20.4	20.4	100.0
	Total	181	100.0	100.0	



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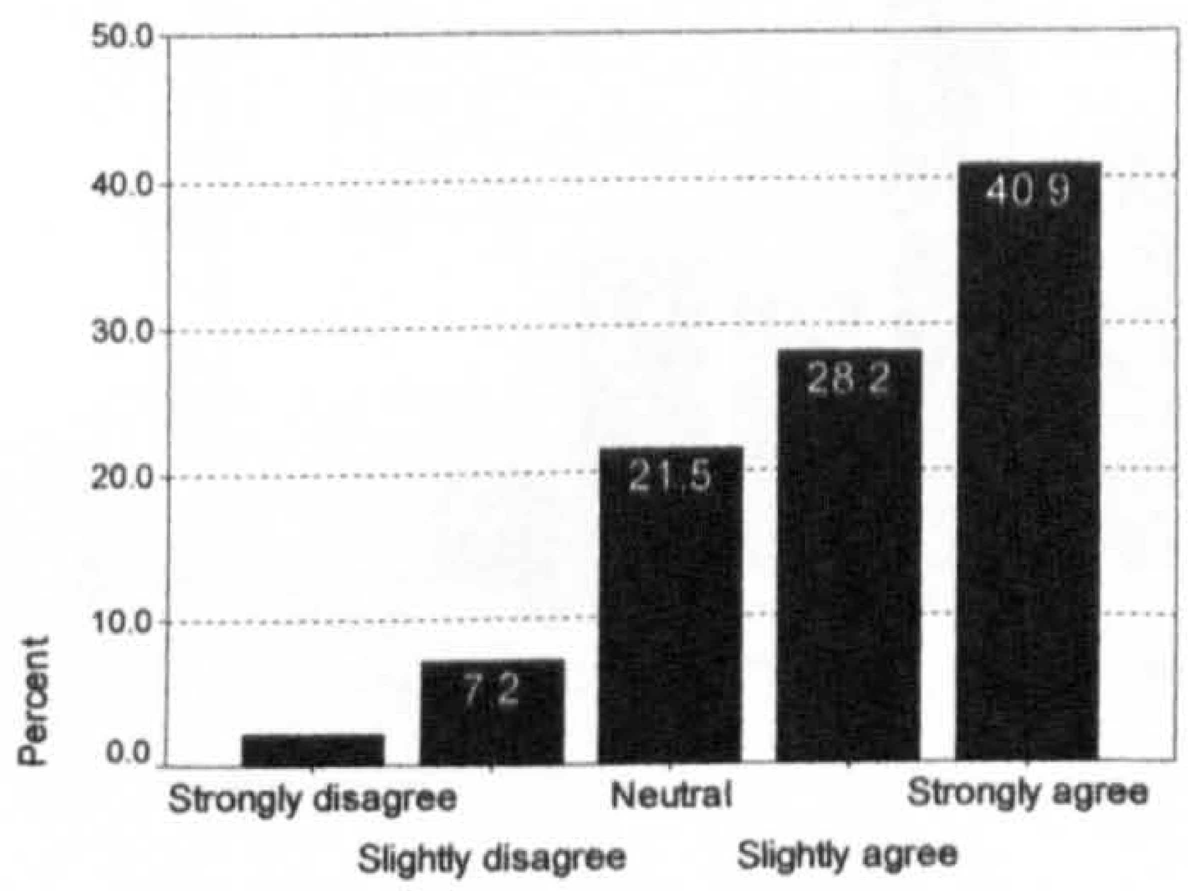
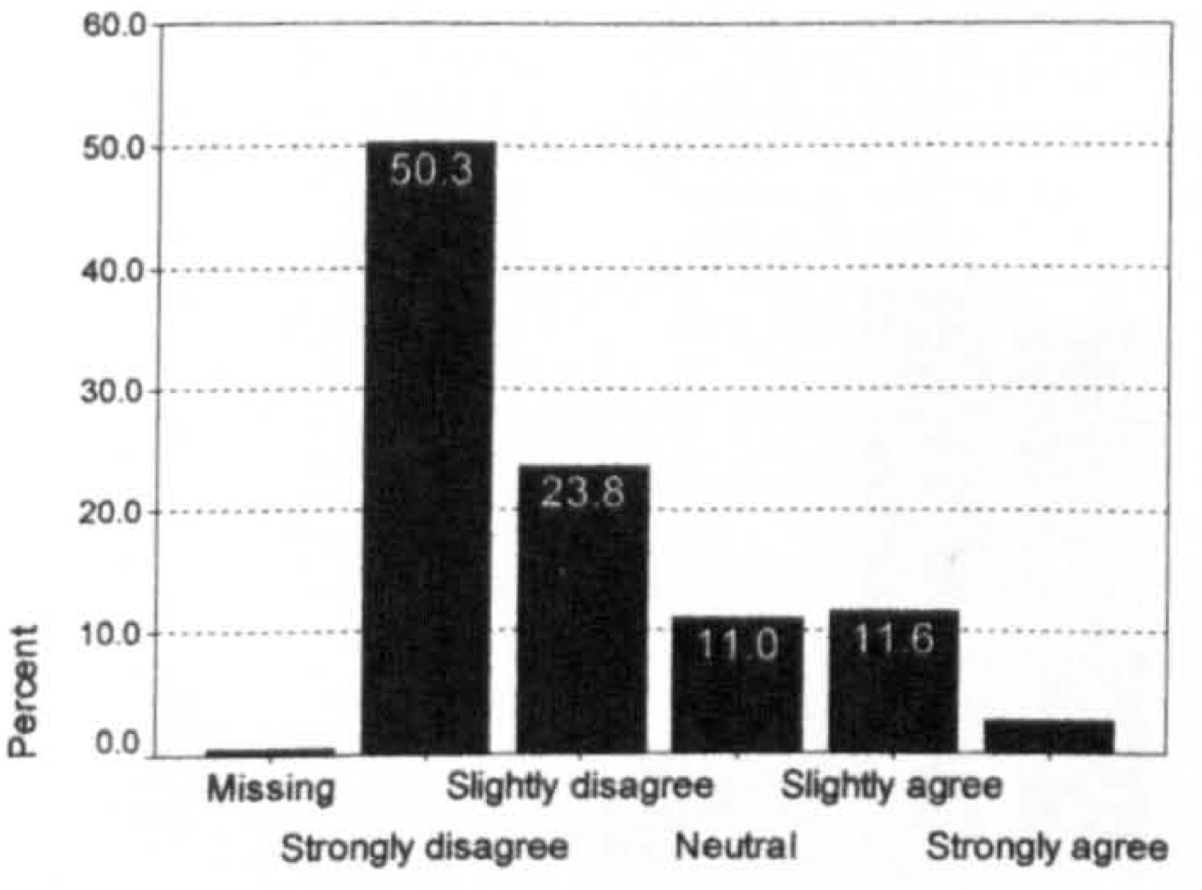


S8

S8: Sustainability should be an important area as there is a big group recognizing sustainability in architecture.					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly disagree	4	2.2	2.2	2.2
	Slightly disagree	13	7.2	7.2	9.4
	Neutral	39	21.5	21.5	30.9
	Slightly agree	51	28.2	28.2	59.1
	Strongly agree	74	40.9	40.9	100.0
	Total	181	100.0	100.0	

S9: Sustainability is not that important; even if I am asked to do some work in sustainability, tutors won't look at it in detail					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly disagree	91	50.3	50.6	50.6
	Slightly disagree	43	23.8	23.9	74.4
	Neutral	20	11.0	11.1	85.6
	Slightly agree	21	11.6	11.7	97.2
	Strongly agree	5	2.8	2.8	100.0
	Total	180	99.4	100.0	
Missing	9	1	.6		
Total		181	100.0		



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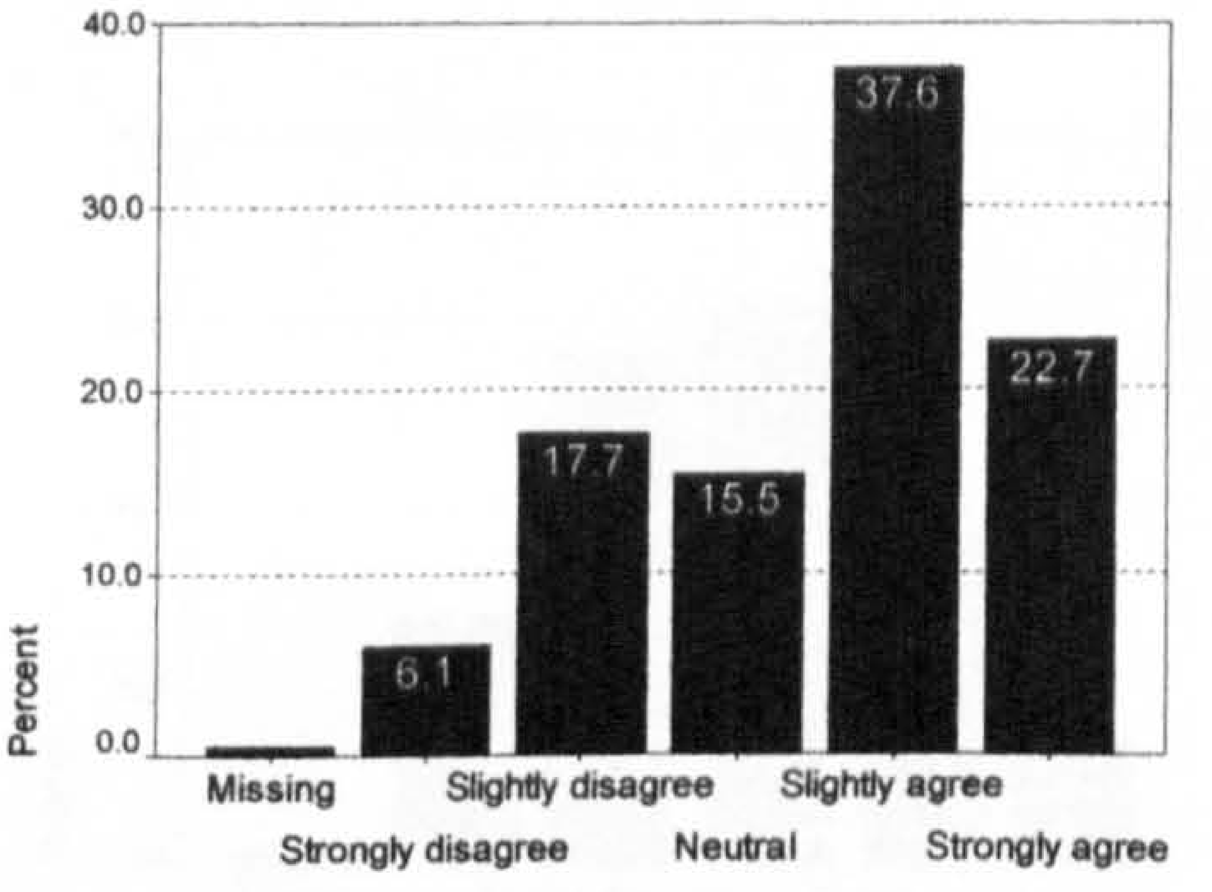
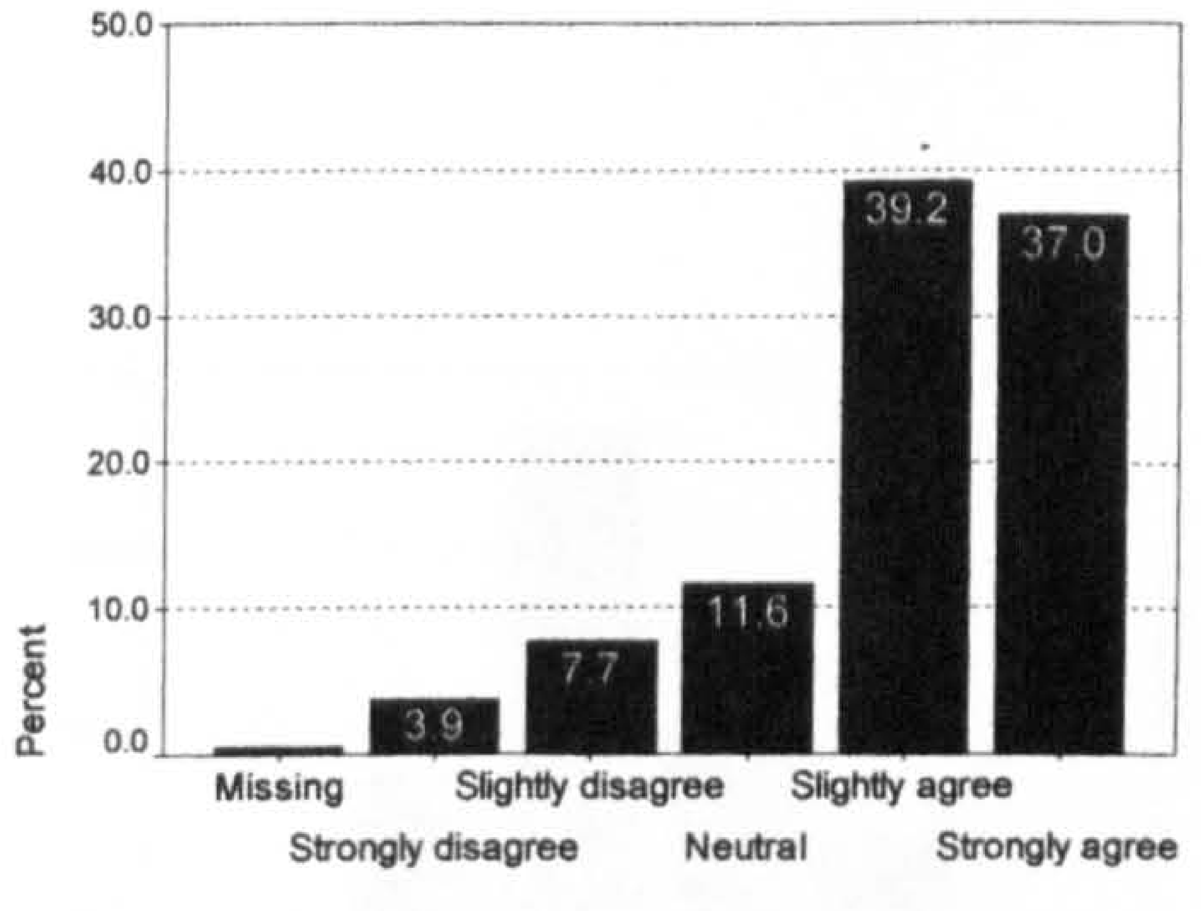


S10

S10: Tutors are much more interested in working out how good your building is in terms of structure, function, expression and things like that					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly disagree	11	6.1	6.1	6.1
	Slightly disagree	32	17.7	17.8	23.9
	Neutral	28	15.5	15.6	39.4
	Slightly agree	68	37.6	37.8	77.2
	Strongly agree	41	22.7	22.8	100.0
	Total	180	99.4	100.0	
Missing	9	1	.6		
Total		181	100.0		

S11: I have to do some extra research to understand what environmental design is about					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly disagree	7	3.9	3.9	3.9
	Slightly disagree	14	7.7	7.8	11.7
	Neutral	21	11.6	11.7	23.3
	Slightly agree	71	39.2	39.4	62.8
	Strongly agree	67	37.0	37.2	100.0
	Total	180	99.4	100.0	
Missing	9	1	.6		
Total		181	100.0		



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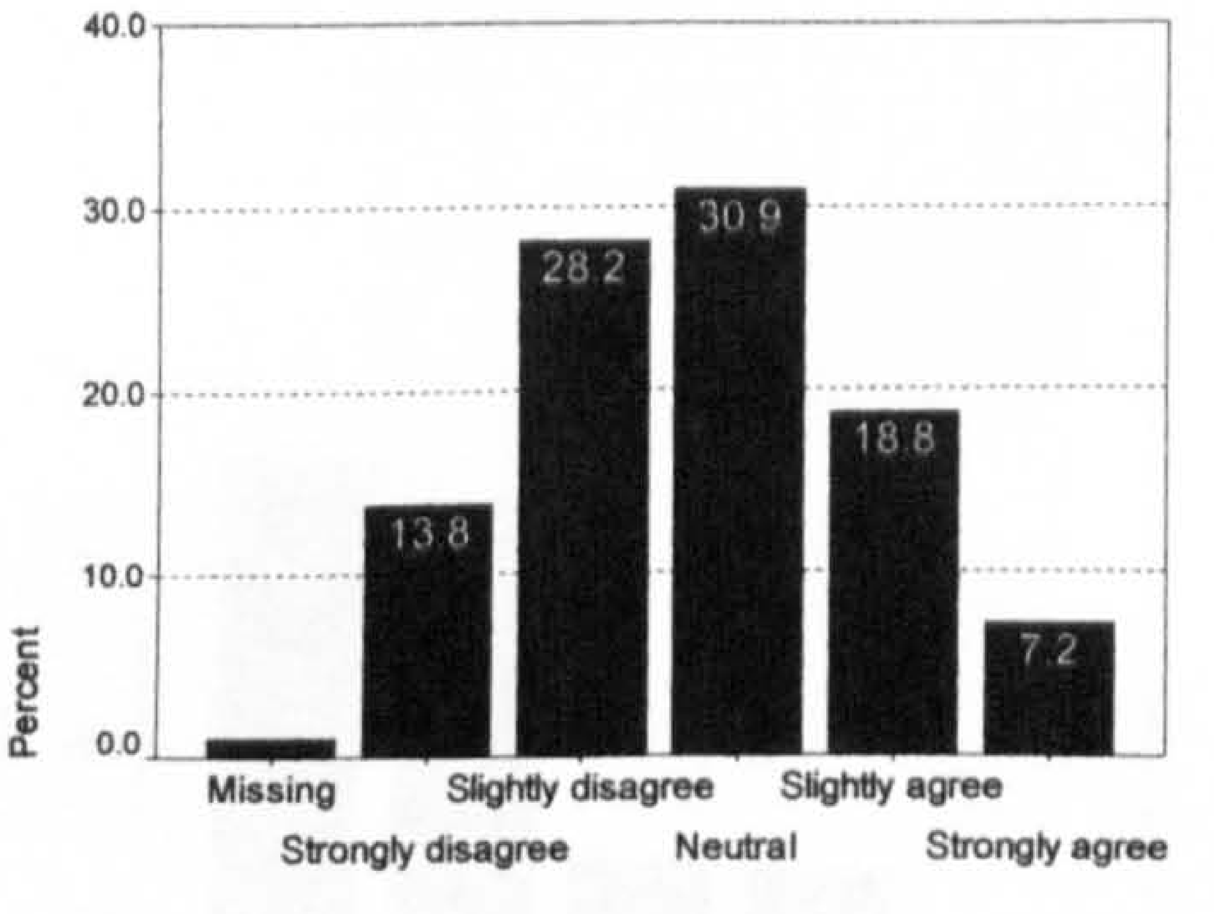
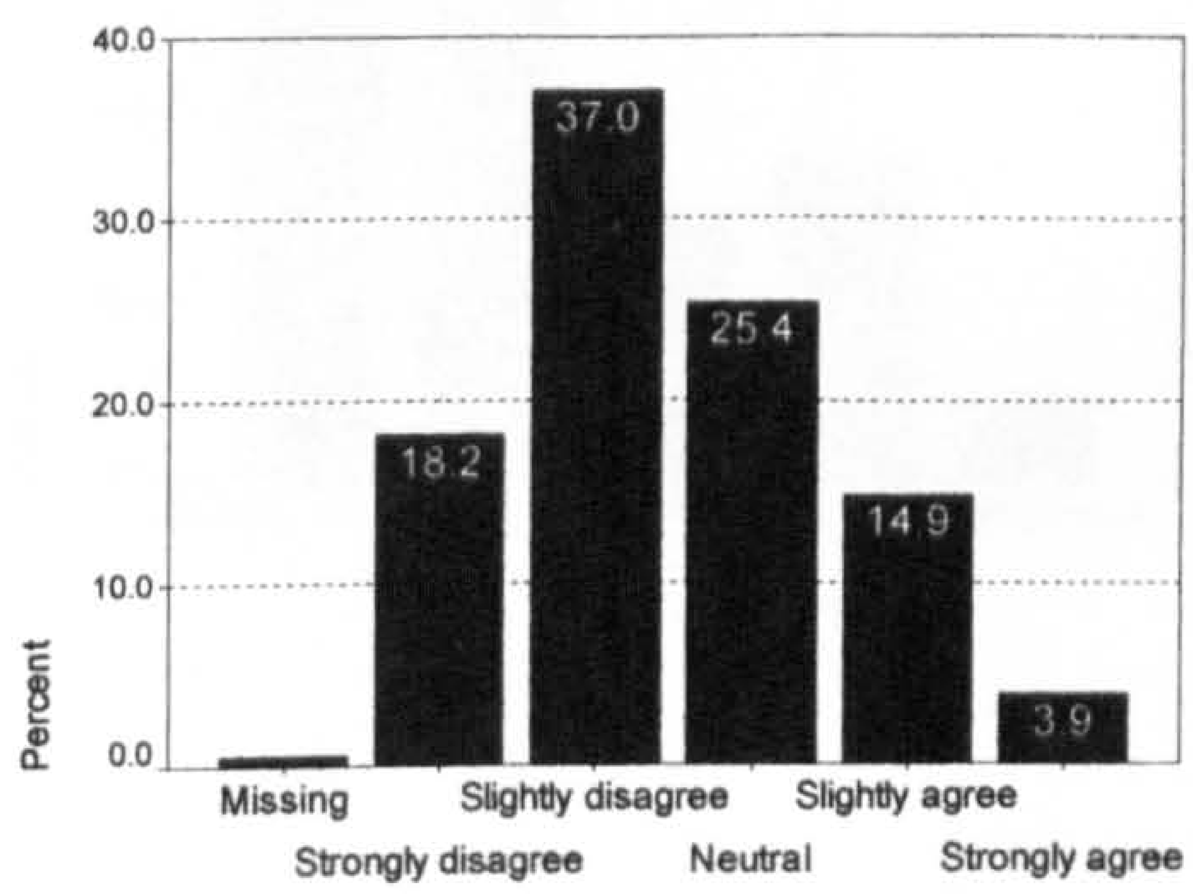


S12

S12: I always discuss with friends or seniors to better understand environment and sustainability					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly disagree	25	13.8	14.0	14.0
	Slightly disagree	51	28.2	28.5	42.5
	Neutral	56	30.9	31.3	73.7
	Slightly agree	34	18.8	19.0	92.7
	Strongly agree	13	7.2	7.3	100.0
	Total	179	98.9	100.0	
Missing	9	2	1.1		
Total		181	100.0		

S13: I always discuss problems regarding environmental design with lecturers and in this way I can understand better					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly disagree	33	18.2	18.3	18.3
	Slightly disagree	67	37.0	37.2	55.6
	Neutral	46	25.4	25.6	81.1
	Slightly agree	27	14.9	15.0	96.1
	Strongly agree	7	3.9	3.9	100.0
	Total	180	99.4	100.0	
Missing	9	1	.6		
Total		181	100.0		



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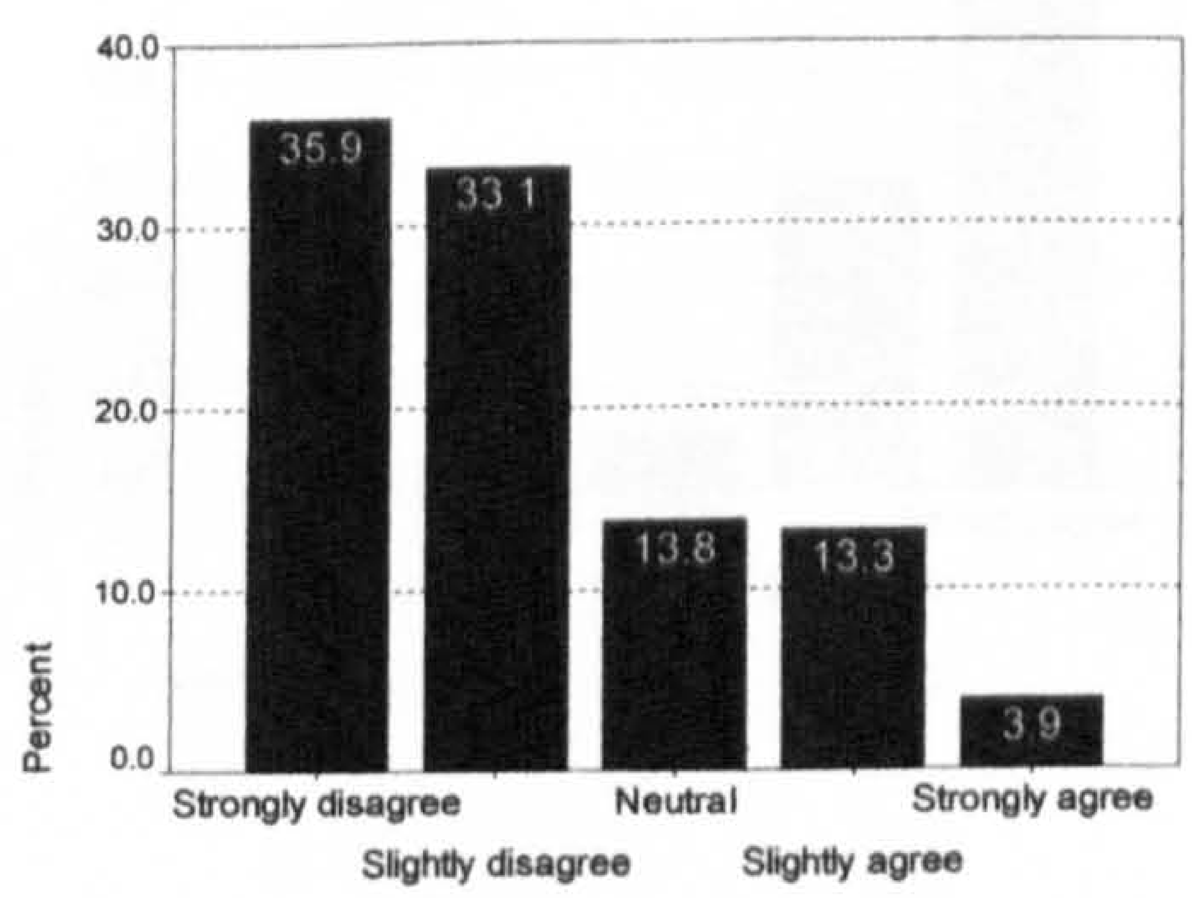
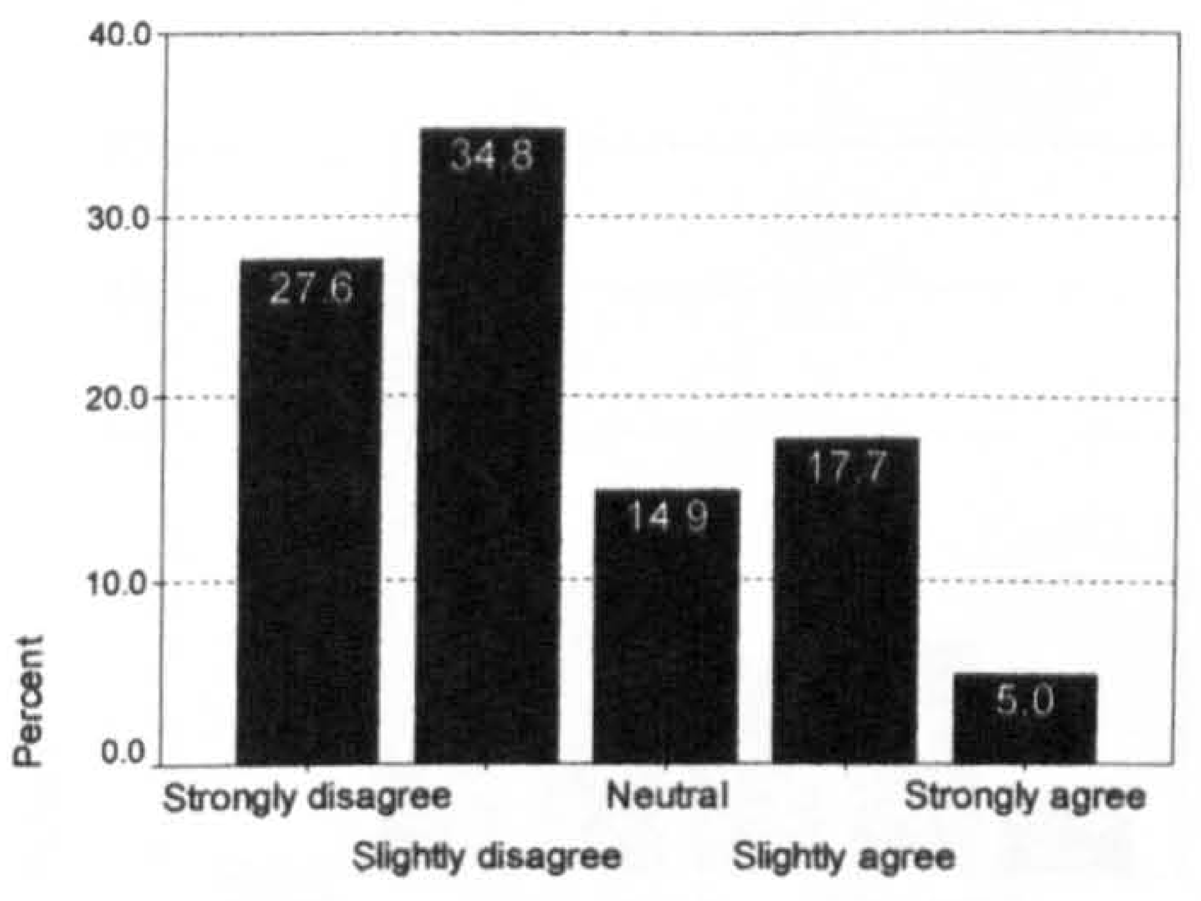


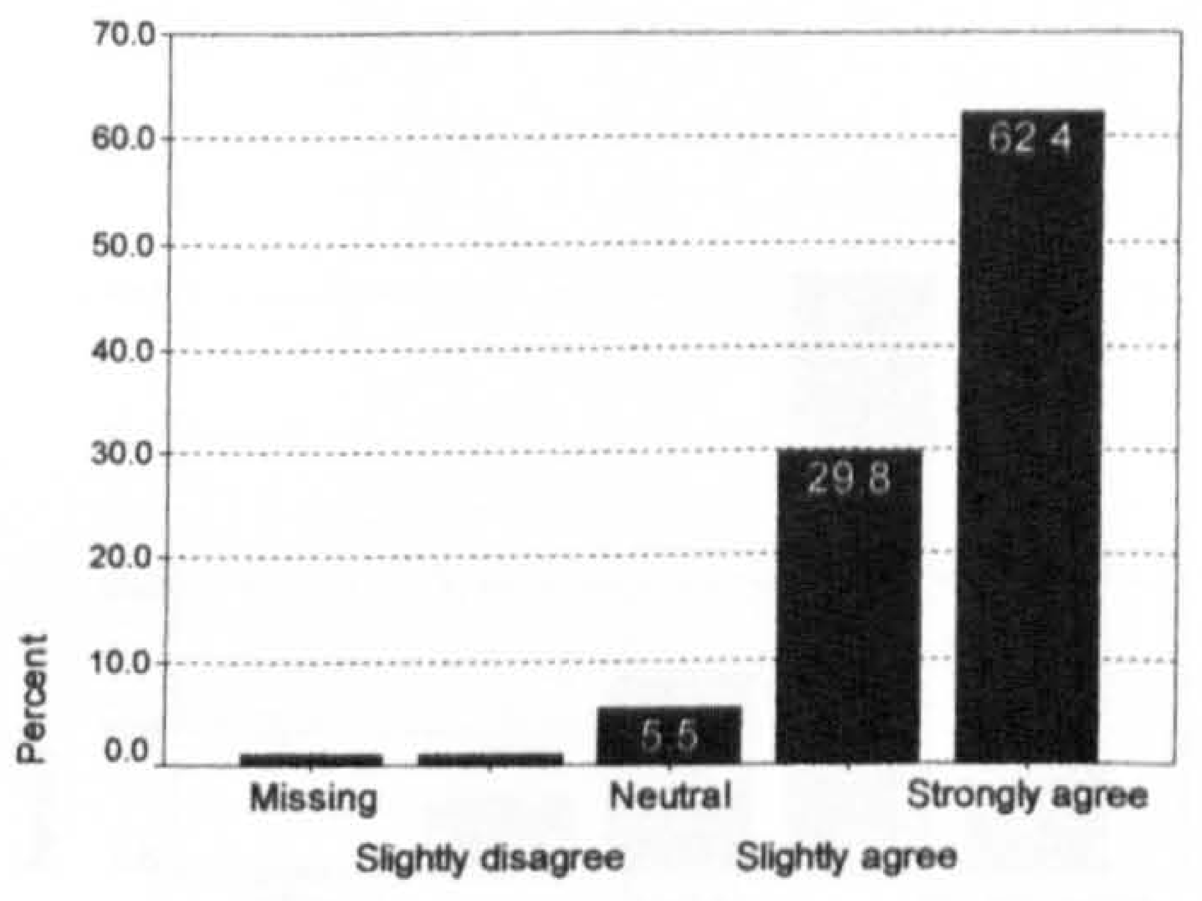
S14

S14: I can learn environmental design by just listening to lectures					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly disagree	65	35.9	35.9	35.9
	Slightly disagree	60	33.1	33.1	69.1
	Neutral	25	13.8	13.8	82.9
	Slightly agree	24	13.3	13.3	96.1
	Strongly agree	7	3.9	3.9	100.0
	Total	181	100.0	100.0	

S15: I can learn environmental design by just reading books and magazines					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly disagree	50	27.6	27.6	27.6
	Slightly disagree	63	34.8	34.8	62.4
	Neutral	27	14.9	14.9	77.3
	Slightly agree	32	17.7	17.7	95.0
	Strongly agree	9	5.0	5.0	100.0
	Total	181	100.0	100.0	



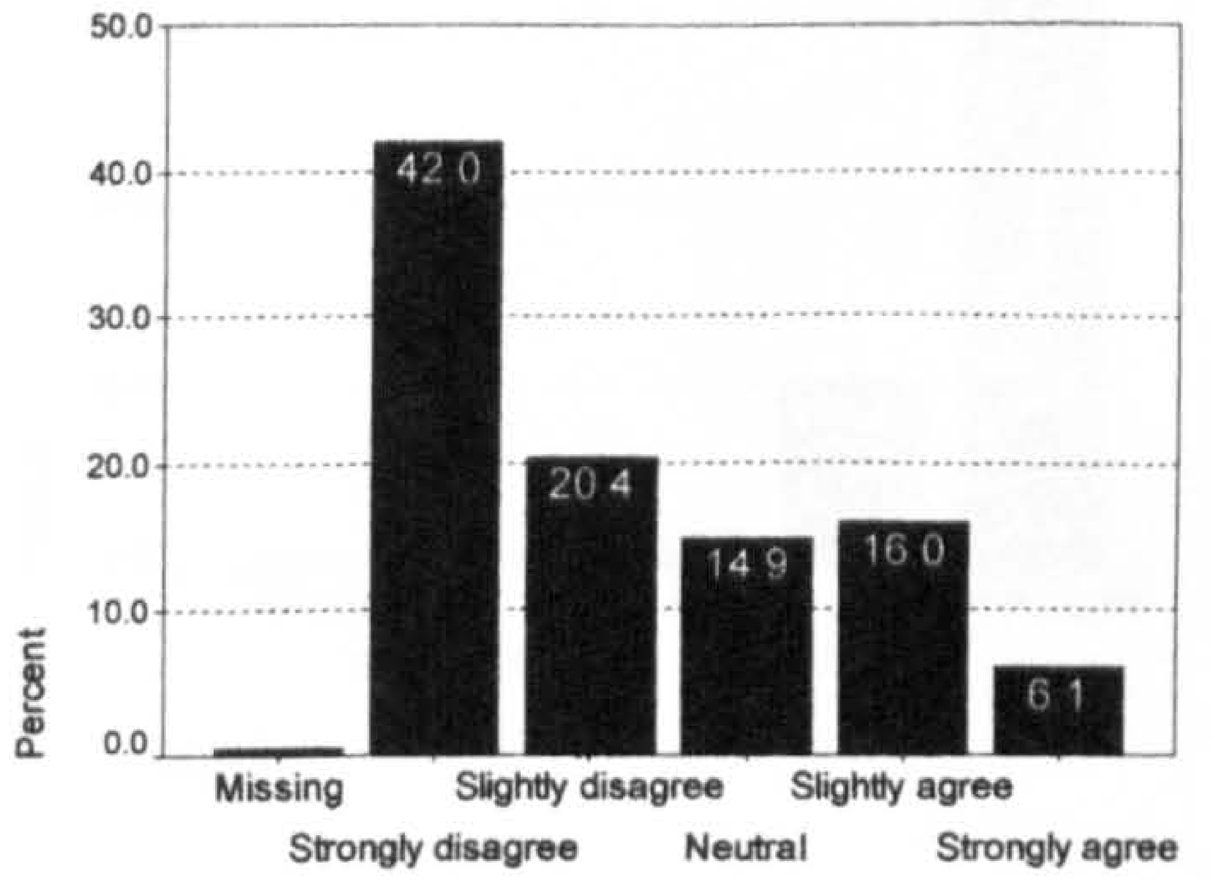
S15



S16

S16: I better learn environmental design when lectures combine practice with theories					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Slightly disagree	2	1.1	1.1	1.1
	Neutral	10	5.5	5.6	6.7
	Slightly agree	54	29.8	30.2	36.9
	Strongly agree	113	62.4	63.1	100.0
	Total	179	98.9	100.0	
Missing	9	2	1.1		
Total		181	100.0		

S17: Understanding environmental design is secondary; I mostly go to lectures because I need to pass the subject					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly disagree	76	42.0	42.2	42.2
	Slightly disagree	37	20.4	20.6	62.8
	Neutral	27	14.9	15.0	77.8
	Slightly agree	29	16.0	16.1	93.9
	Strongly agree	11	6.1	6.1	100.0
	Total	180	99.4	100.0	
Missing	9	1	.6		
Total		181	100.0		



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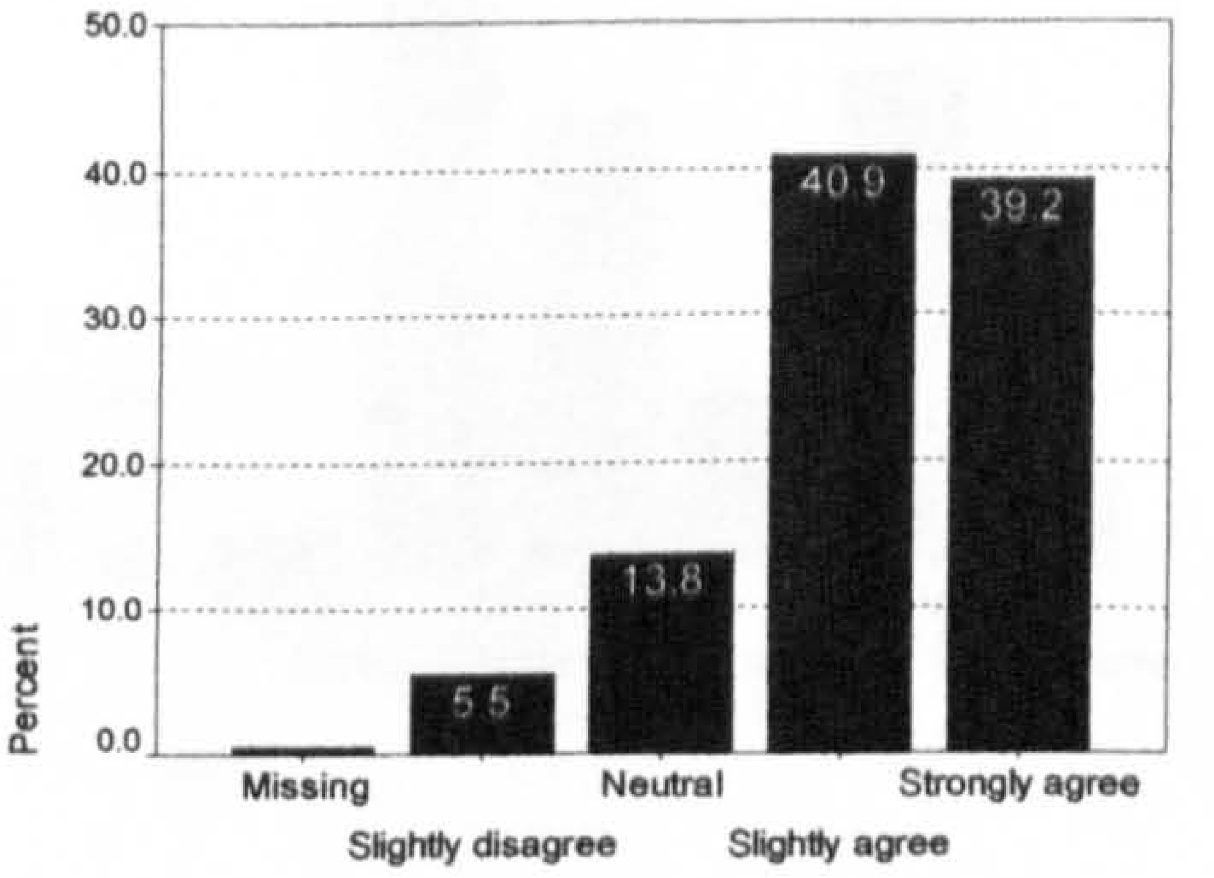
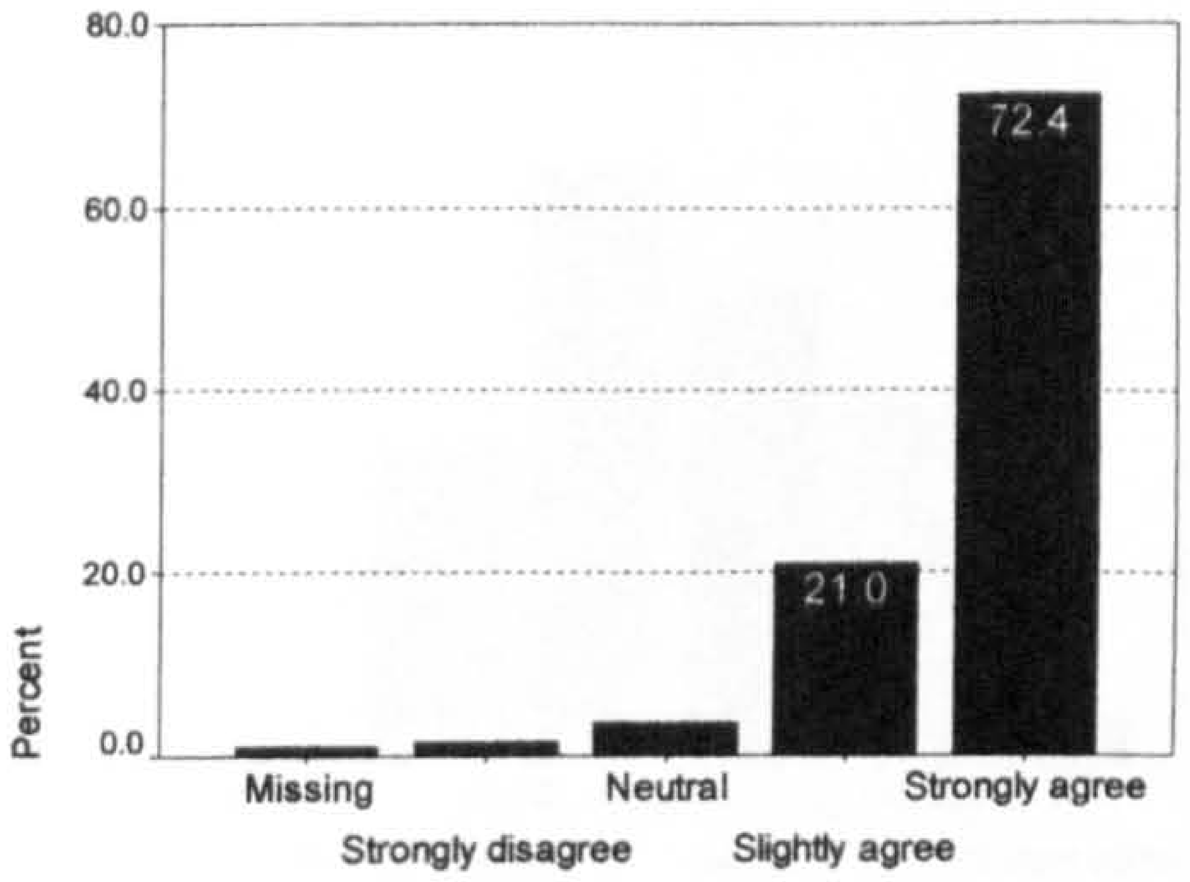


S18

S18: When I learn something I try to see in my mind how things fit together with other subjects					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Slightly disagree	10	5.5	5.6	5.6
	Neutral	25	13.8	13.9	19.4
	Slightly agree	74	40.9	41.1	60.6
	Strongly agree	71	39.2	39.4	100.0
	Total	180	99.4	100.0	
Missing	9	1	.6		
Total		181	100.0		

S19: I generally prefer the lecturer/tutors who explain to me how what we learn relates to the outside world					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly disagree	3	1.7	1.7	1.7
	Neutral	7	3.9	3.9	5.6
	Slightly agree	38	21.0	21.2	26.8
	Strongly agree	131	72.4	73.2	100.0
	Total	179	98.9	100.0	
Missing	9	2	1.1		
Total		181	100.0		



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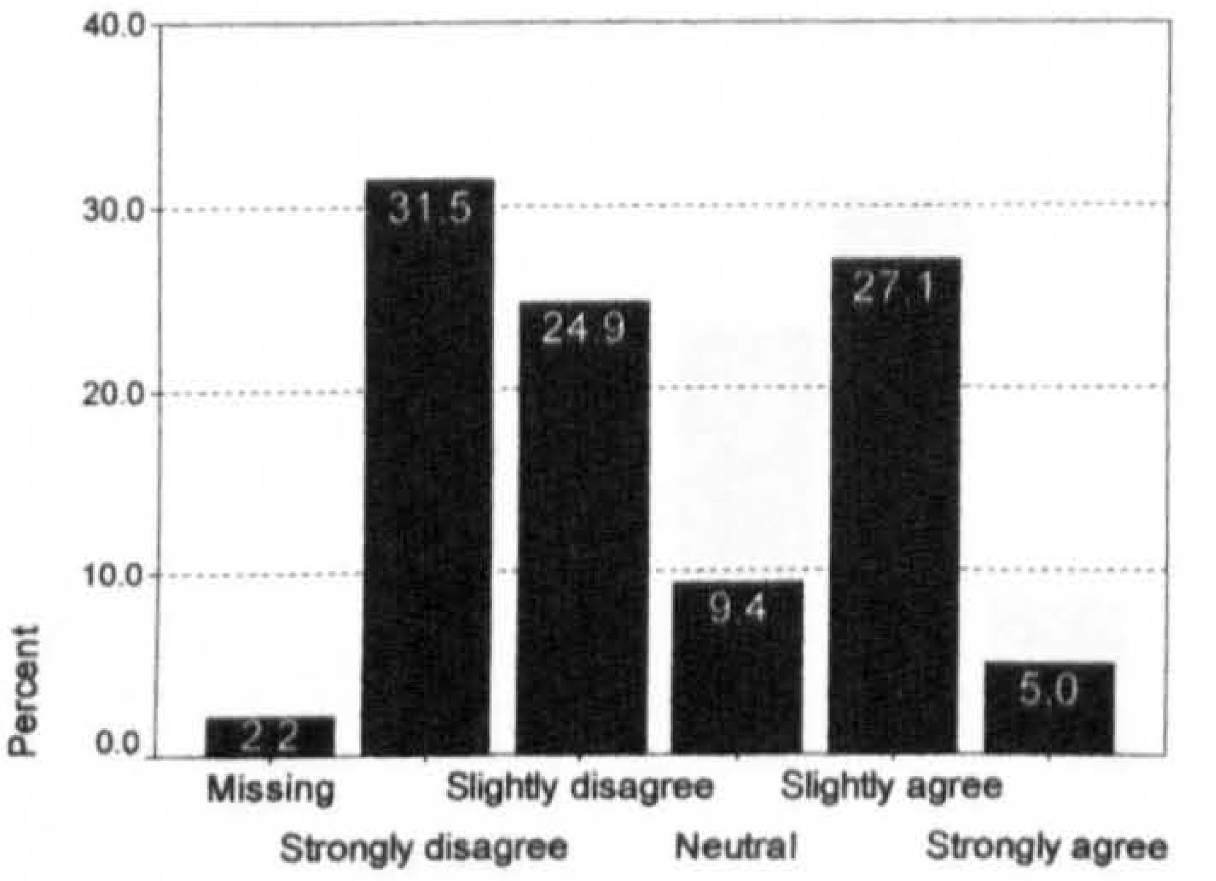
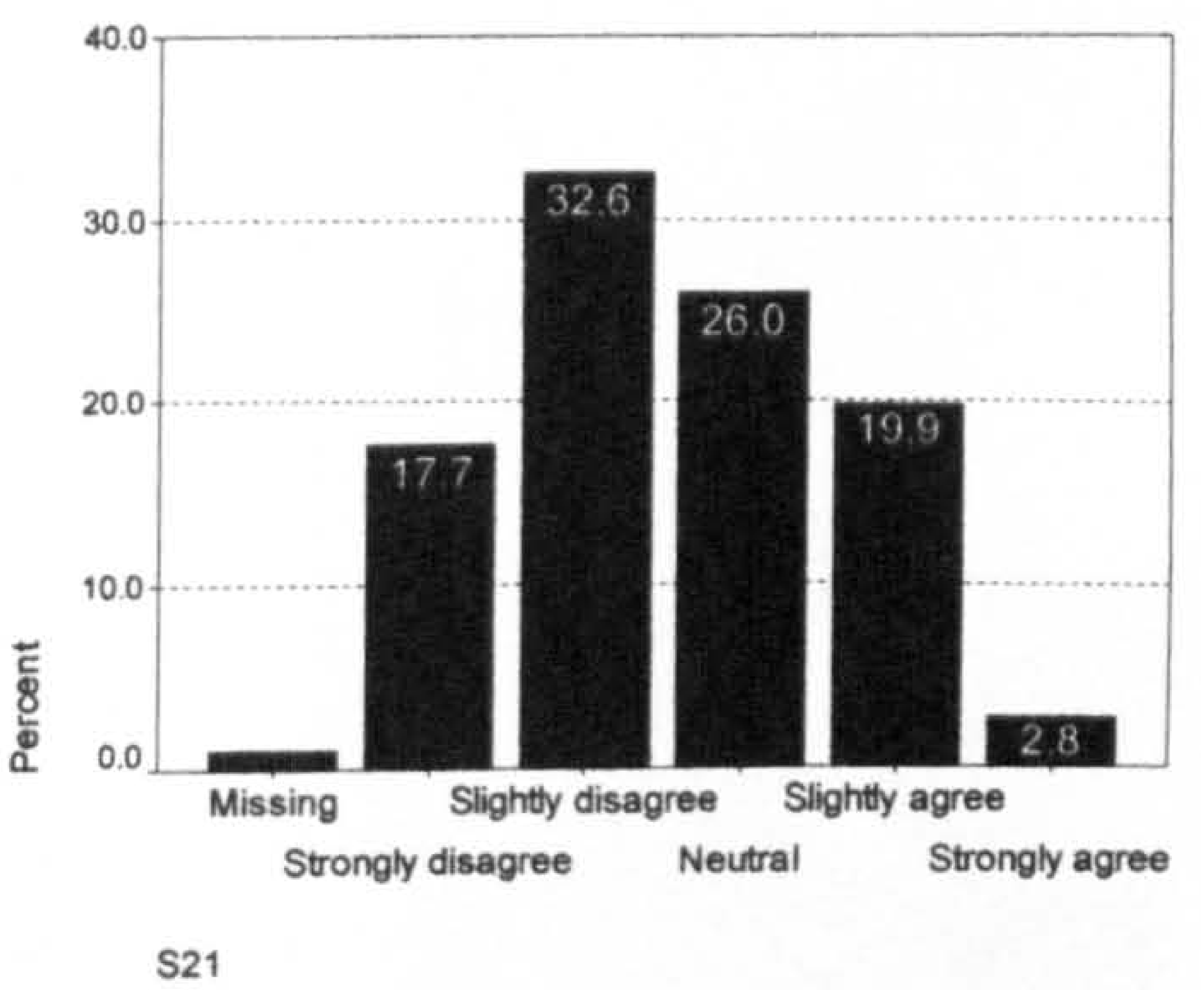
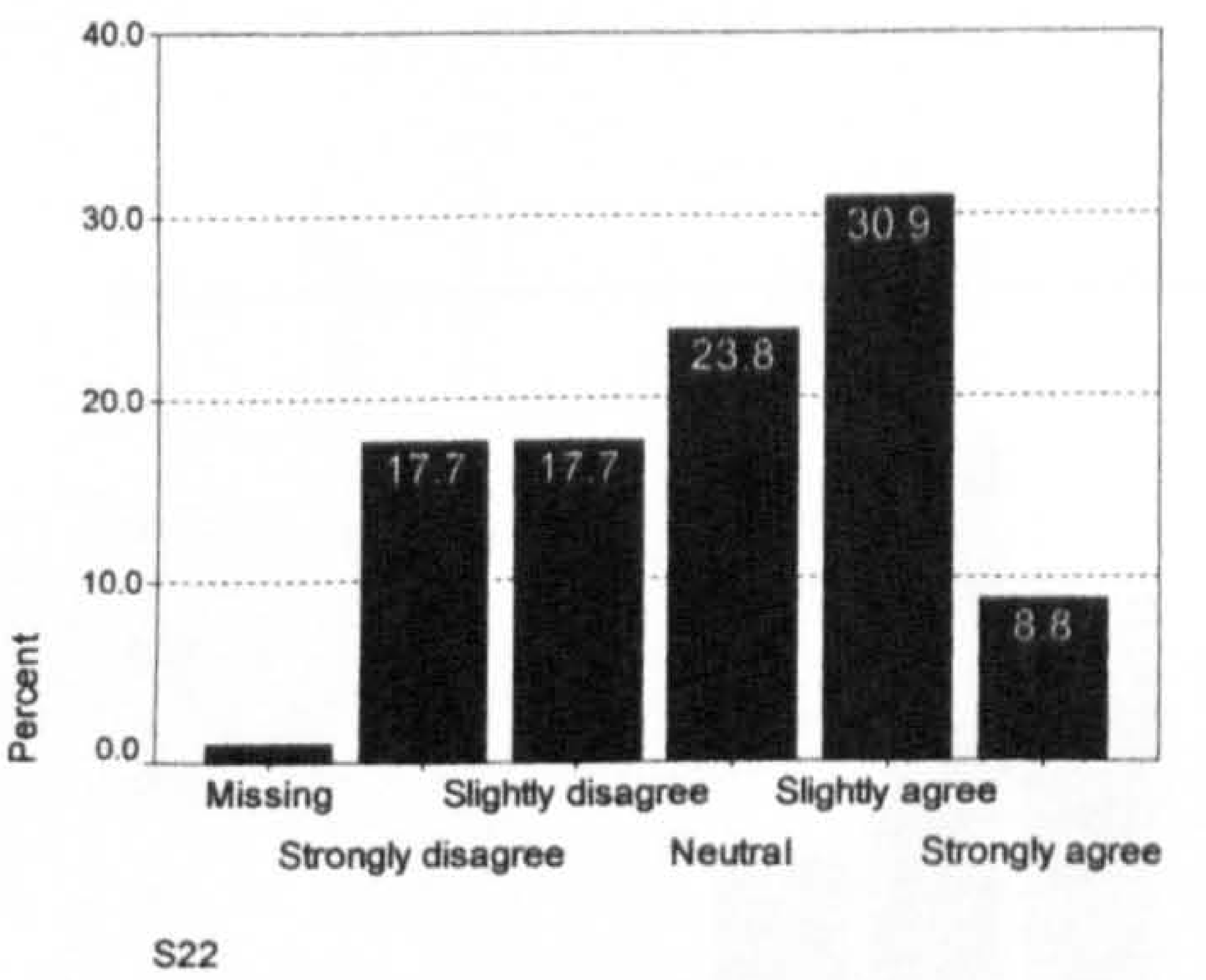


S20

S20: I tend to accept what I am told by the teacher without thinking whether I agree or not					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly disagree	57	31.5	32.2	32.2
	Slightly disagree	45	24.9	25.4	57.6
	Neutral	17	9.4	9.6	67.2
	Slightly agree	49	27.1	27.7	94.9
	Strongly agree	9	5.0	5.1	100.0
	Total	177	97.8	100.0	
Missing	9	4	2.2		
Total		181	100.0		

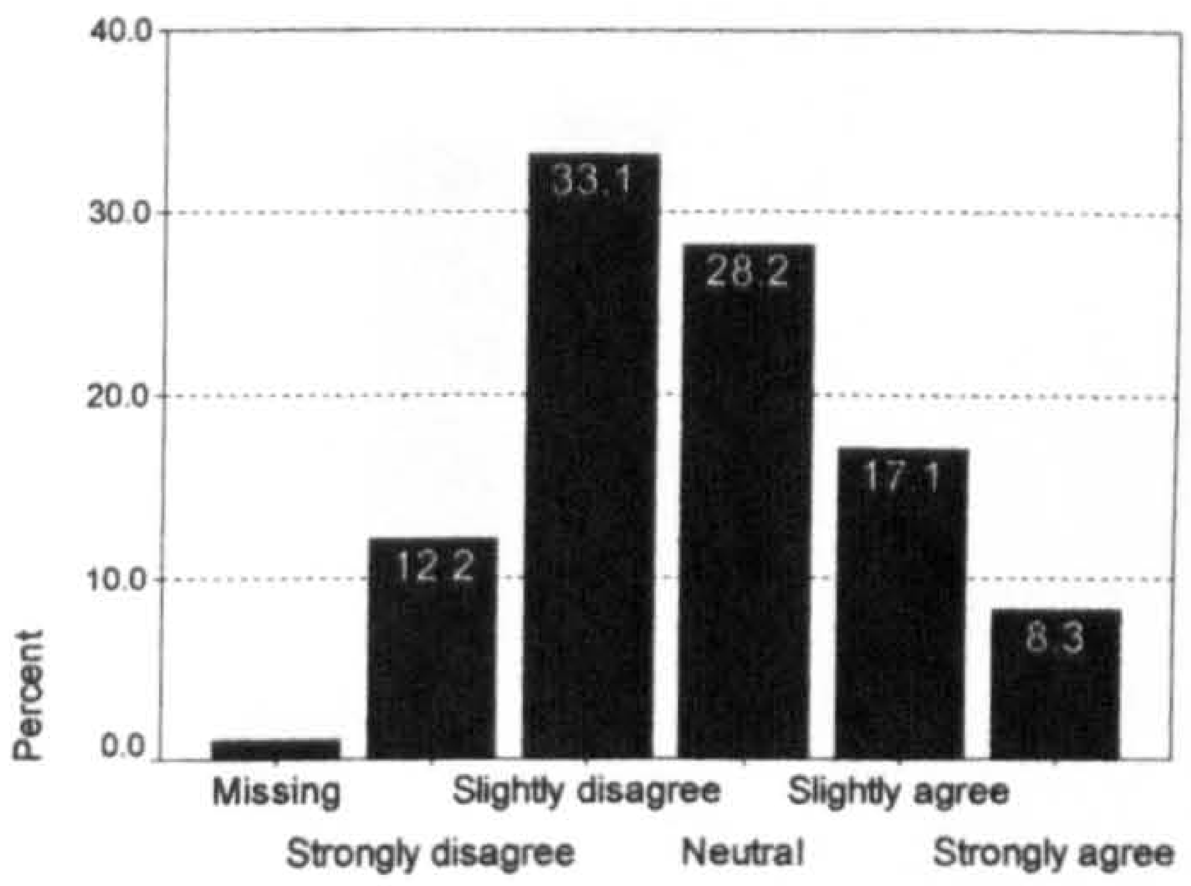
S21: I put less effort into environmental issues in my design project because I can always consult my lecturers later					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly disagree	32	17.7	17.9	17.9
	Slightly disagree	59	32.6	33.0	50.8
	Neutral	47	26.0	26.3	77.1
	Slightly agree	36	19.9	20.1	97.2
	Strongly agree	5	2.8	2.8	100.0
	Total	179	98.9	100.0	
Missing	9	2	1.1		
Total		181	100.0		





S22: I concentrate more in the philosophical aspect of design than on the technical issues					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly disagree	32	17.7	17.9	17.9
	Slightly disagree	32	17.7	17.9	35.8
	Neutral	43	23.8	24.0	59.8
	Slightly agree	56	30.9	31.3	91.1
	Strongly agree	16	8.8	8.9	100.0
	Total	179	98.9	100.0	
Missing	9	2	1.1		
Total		181	100.0		

S23: When designing I put extra effort in technical aspects (e.g. Environment, services, construction, structures, etc.)					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly disagree	22	12.2	12.3	12.3
	Slightly disagree	60	33.1	33.5	45.8
	Neutral	51	28.2	28.5	74.3
	Slightly agree	31	17.1	17.3	91.6
	Strongly agree	15	8.3	8.4	100.0
	Total	179	98.9	100.0	
Missing	9	2	1.1		
Total		181	100.0		



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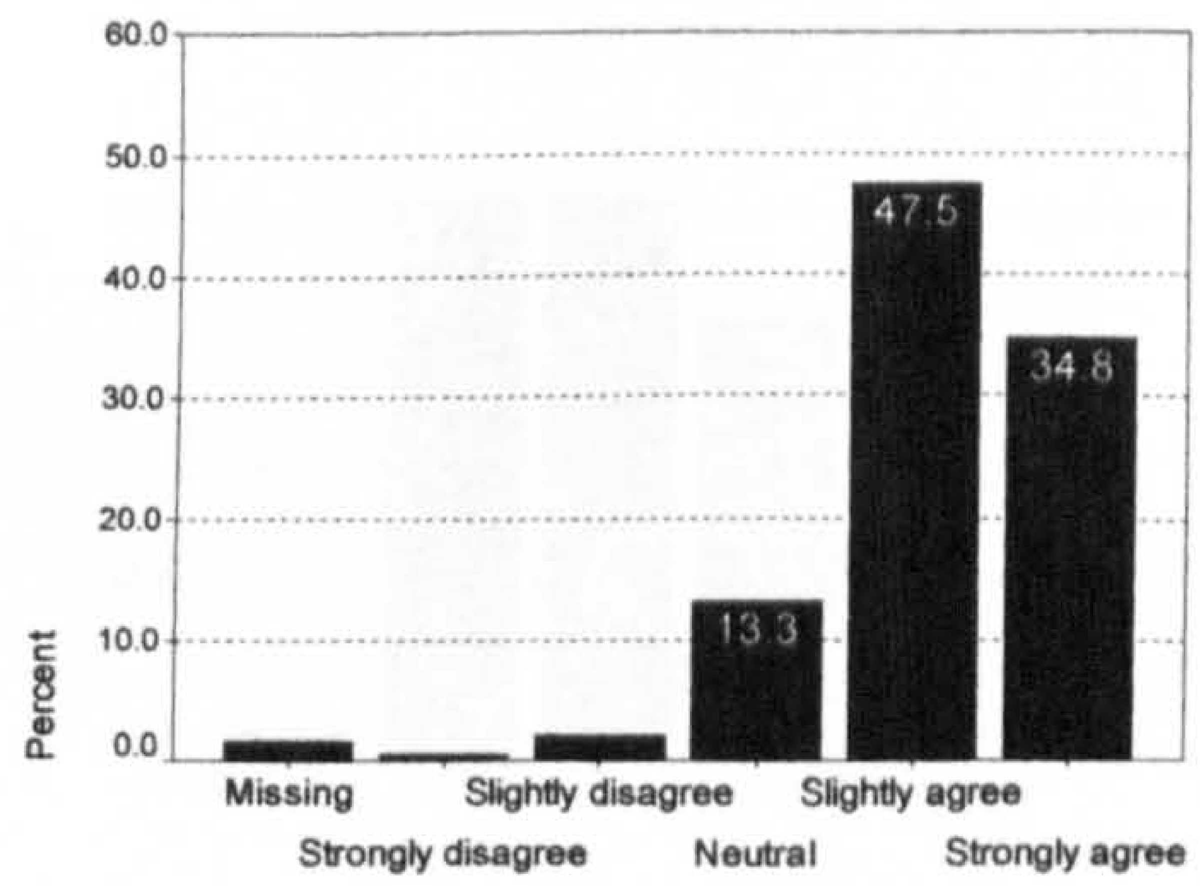
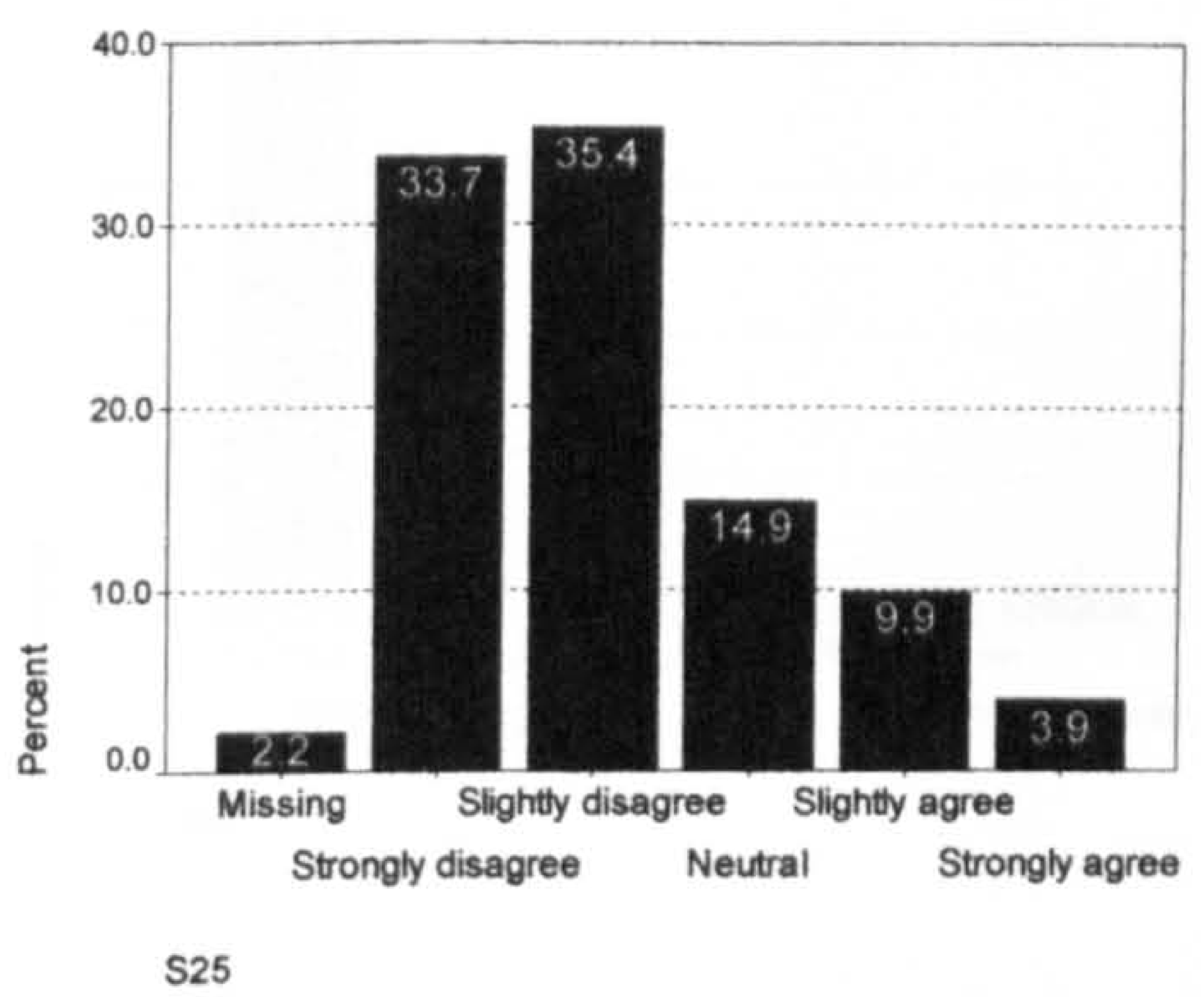
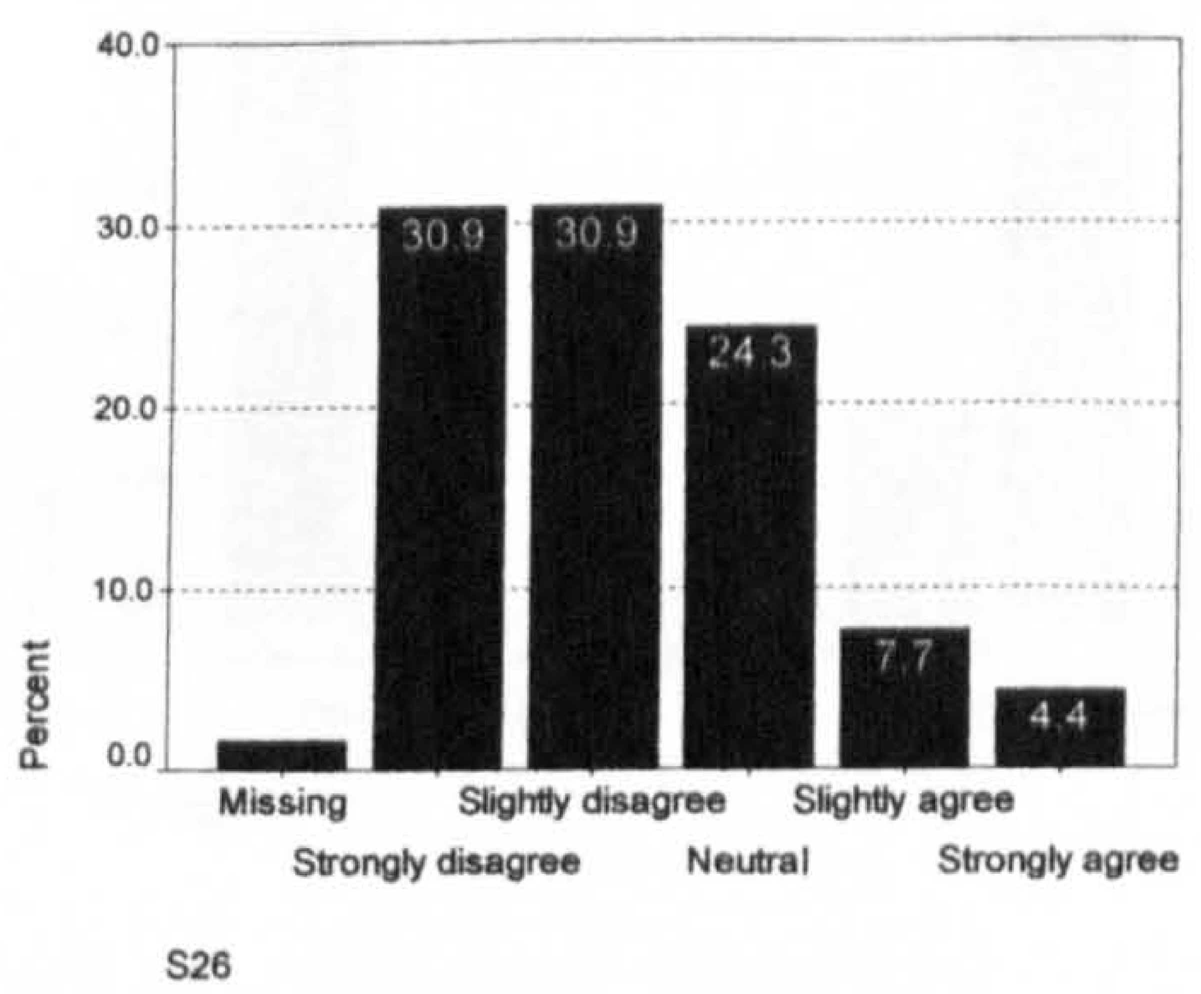


S24

S24: Environmental issues are becoming more amalgamated into design					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly disagree	1	.6	.6	.6
	Slightly disagree	4	2.2	2.2	2.8
	Neutral	24	13.3	13.5	16.3
	Slightly agree	86	47.5	48.3	64.6
	Strongly agree	63	34.8	35.4	100.0
	Total	178	98.3	100.0	
Missing	9	3	1.7		
Total		181	100.0		

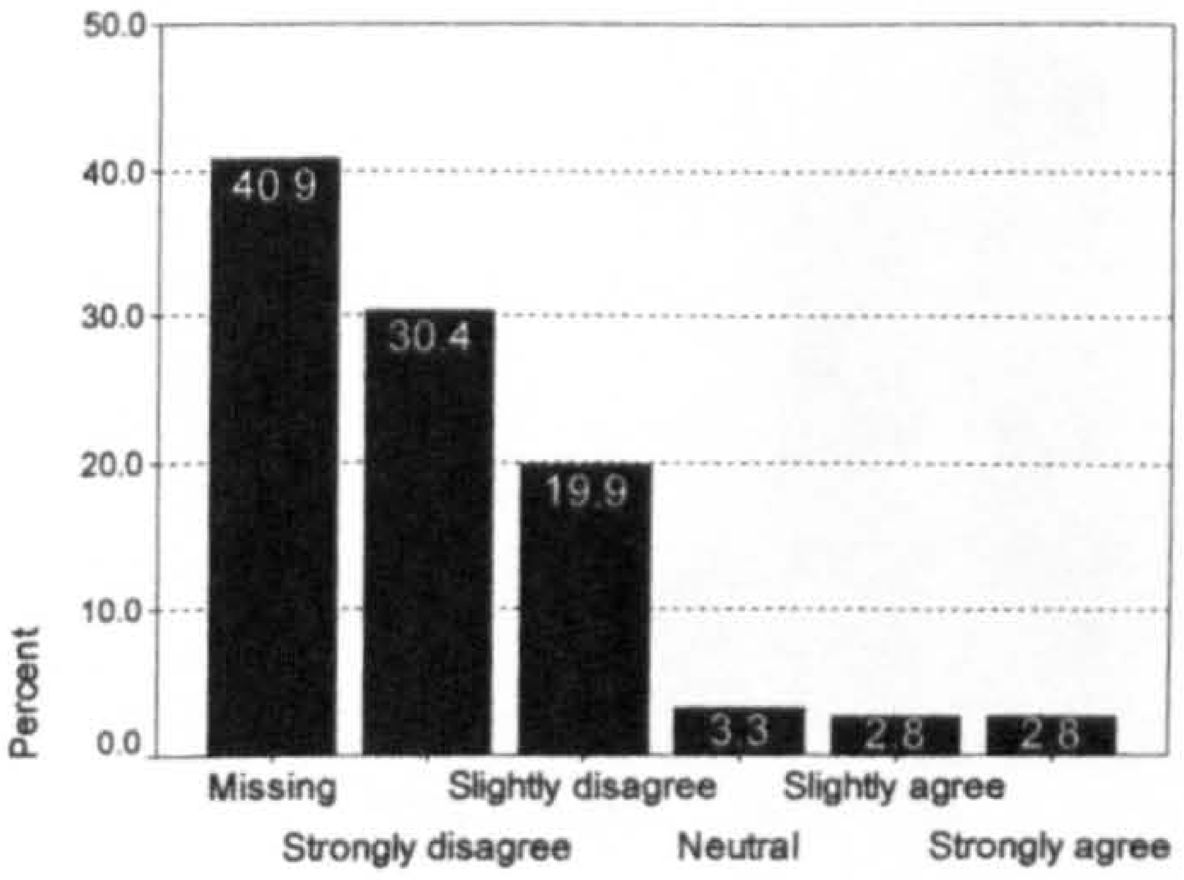
S25: I don't apply environmental design much in my studio projects because I really haven't been interested in it in class					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly disagree	61	33.7	34.5	34.5
	Slightly disagree	64	35.4	36.2	70.6
	Neutral	27	14.9	15.3	85.9
	Slightly agree	18	9.9	10.2	96.0
	Strongly agree	7	3.9	4.0	100.0
	Total	177	97.8	100.0	
Missing	9	4	2.2		
Total		181	100.0		



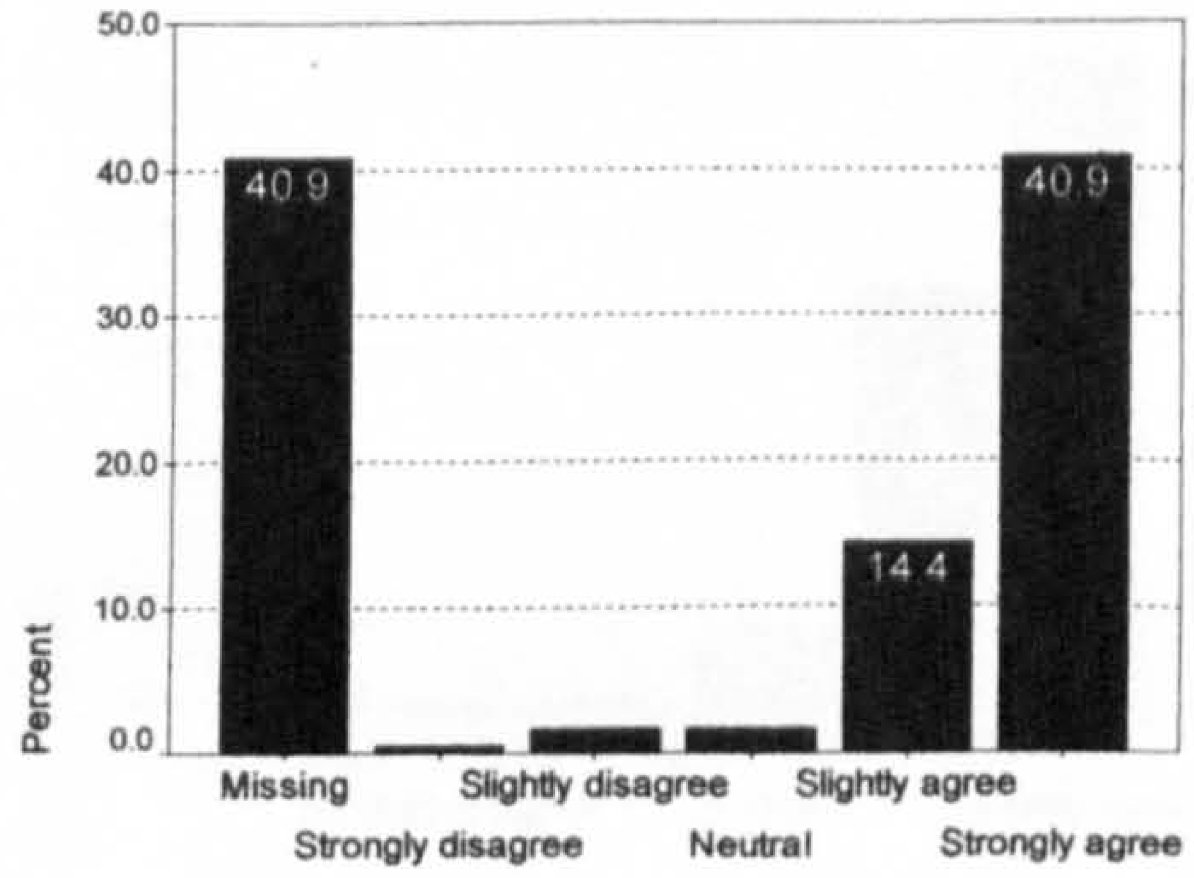


S26: Lectures didn't make anyone think: I mostly design sustainable anyway!					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly disagree	56	30.9	31.5	31.5
	Slightly disagree	56	30.9	31.5	62.9
	Neutral	44	24.3	24.7	87.6
	Slightly agree	14	7.7	7.9	95.5
	Strongly agree	8	4.4	4.5	100.0
	Total	178	98.3	100.0	
Missing	9	3	1.7		
Total		181	100.0		

S27: I divide my time equally between all my subjects[1]					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly disagree	55	30.4	51.4	51.4
	Slightly disagree	36	19.9	33.6	85.0
	Neutral	6	3.3	5.6	90.7
	Slightly agree	5	2.8	4.7	95.3
	Strongly agree	5	2.8	4.7	100.0
	Total	107	59.1	100.0	
Missing	9	74	40.9		
Total		181	100.0		



S27

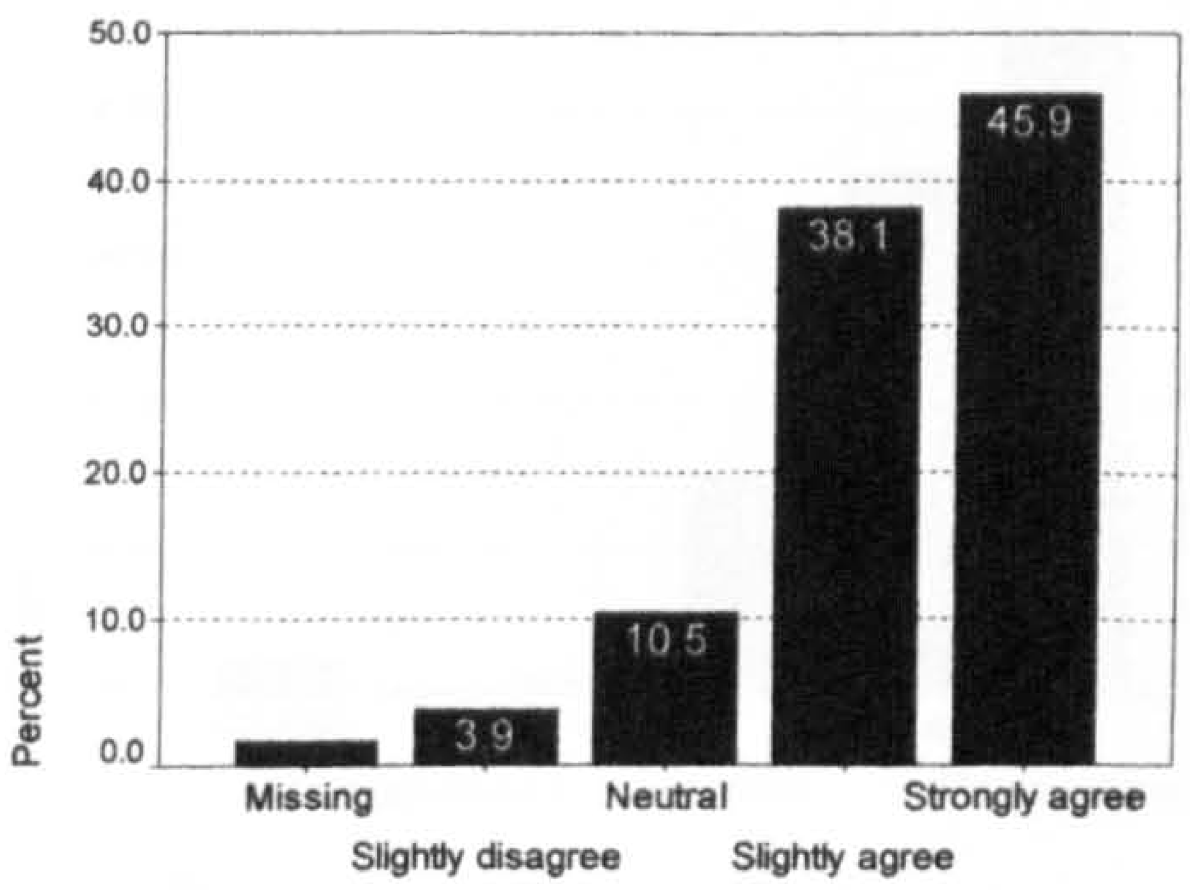


S28

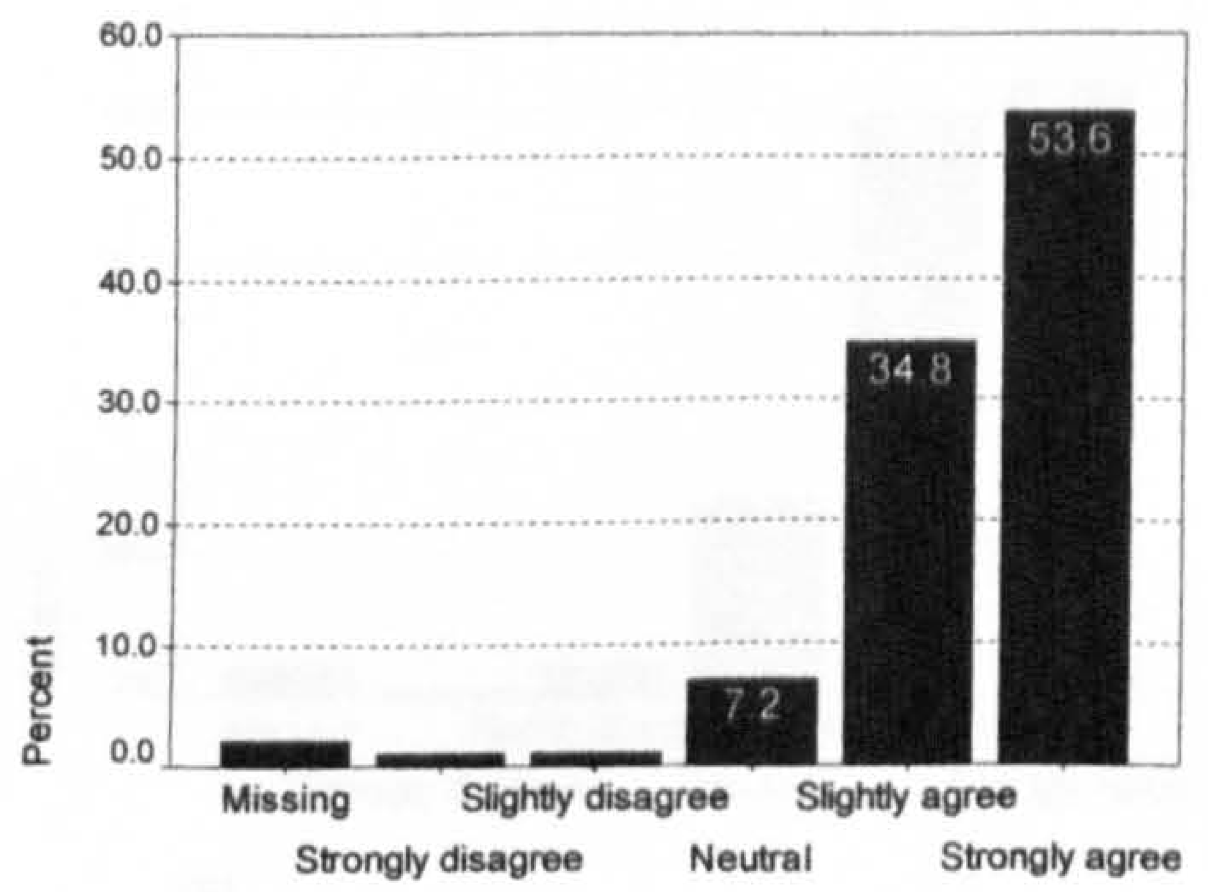
S28: I expend more time in the design projects than in other work					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly disagree	1	.6	.9	.9
	Slightly disagree	3	1.7	2.8	3.7
	Neutral	3	1.7	2.8	6.5
	Slightly agree	26	14.4	24.3	30.8
	Strongly agree	74	40.9	69.2	100.0
	Total	107	59.1	100.0	
Missing	9	74	40.9		
Total		181	100.0		

[1] It is interesting to note that on questions S27 and S28 there are 74 missing values. This is due to a typing mistake, which put together both questions. The responses received before the mistake was corrected were considered missing.

S29: In order for me to understand environmental design better, I need to visit and look at the building examples					
		Frequency	**Percent**	**Valid Percent**	**Cumulative Percent**
Valid	**Slightly disagree**	7	3.9	3.9	3.9
	Neutral	19	10.5	10.7	14.6
	Slightly agree	69	38.1	38.8	53.4
	Strongly agree	83	45.9	46.6	100.0
	Total	178	98.3	100.0	
Missing	**9**	3	1.7		
Total		181	100.0		



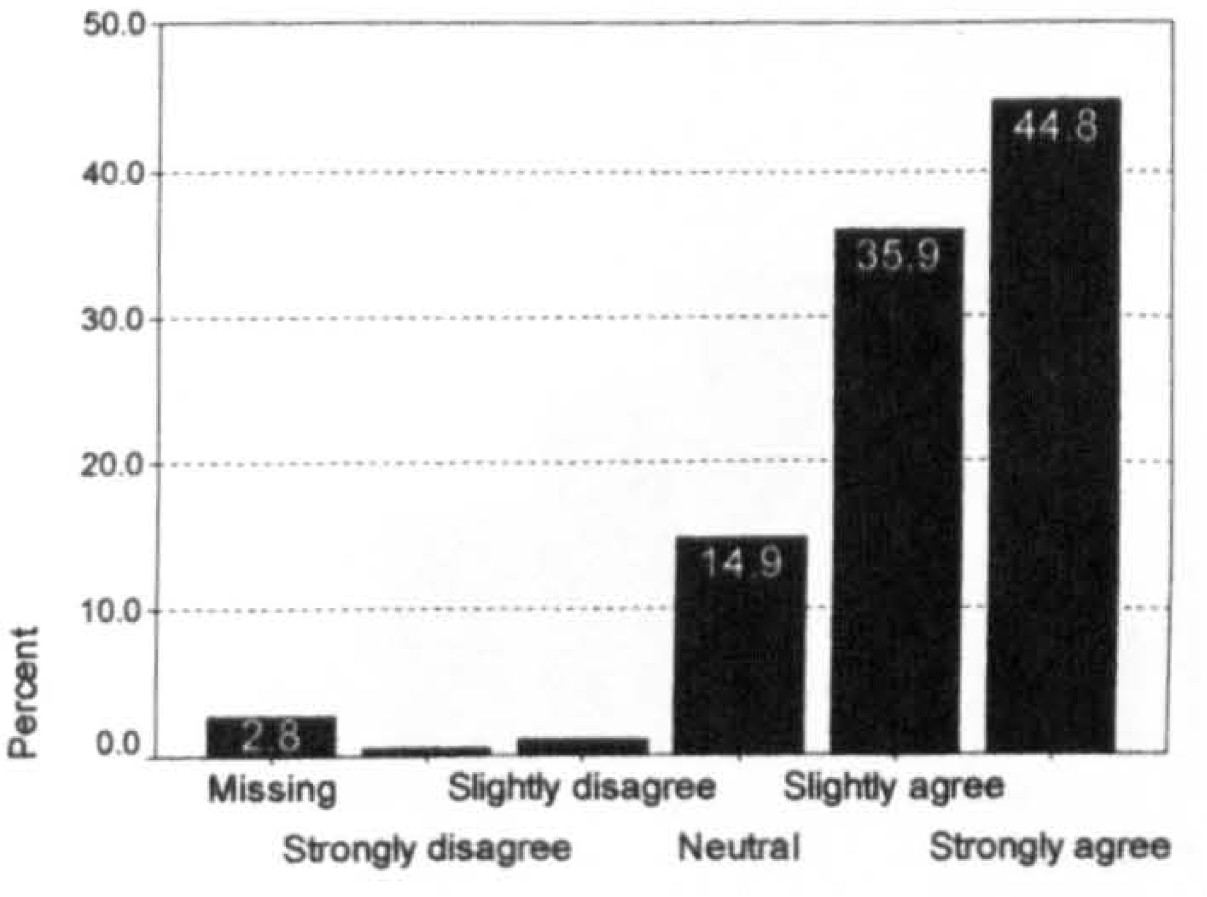
S29



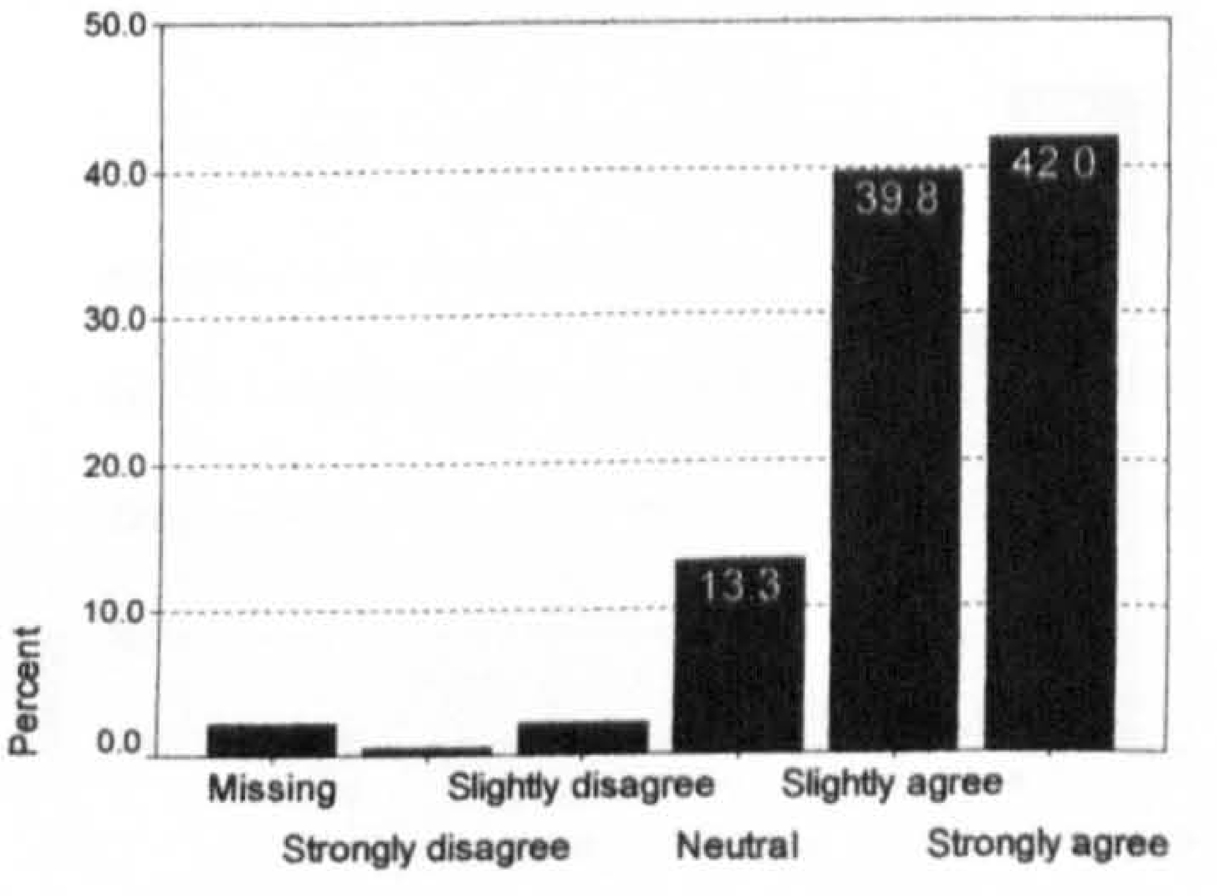
S30

S30: I can understand environmental issues better if there are slides showing the buildings					
		Frequency	**Percent**	**Valid Percent**	**Cumulative Percent**
Valid	**Strongly disagree**	2	1.1	1.1	1.1
	Slightly disagree	2	1.1	1.1	2.3
	Neutral	13	7.2	7.3	9.6
	Slightly agree	63	34.8	35.6	45.2
	Strongly agree	97	53.6	54.8	100.0
	Total	177	97.8	100.0	
Missing	**9**	4	2.2		
Total		181	100.0		

S31: I can understand environmental design if I can participate in a environmental project					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly disagree	1	.6	.6	.6
	Slightly disagree	2	1.1	1.1	1.7
	Neutral	27	14.9	15.3	17.0
	Slightly agree	65	35.9	36.9	54.0
	Strongly agree	81	44.8	46.0	100.0
	Total	176	97.2	100.0	
Missing	9	5	2.8		
Total		181	100.0		



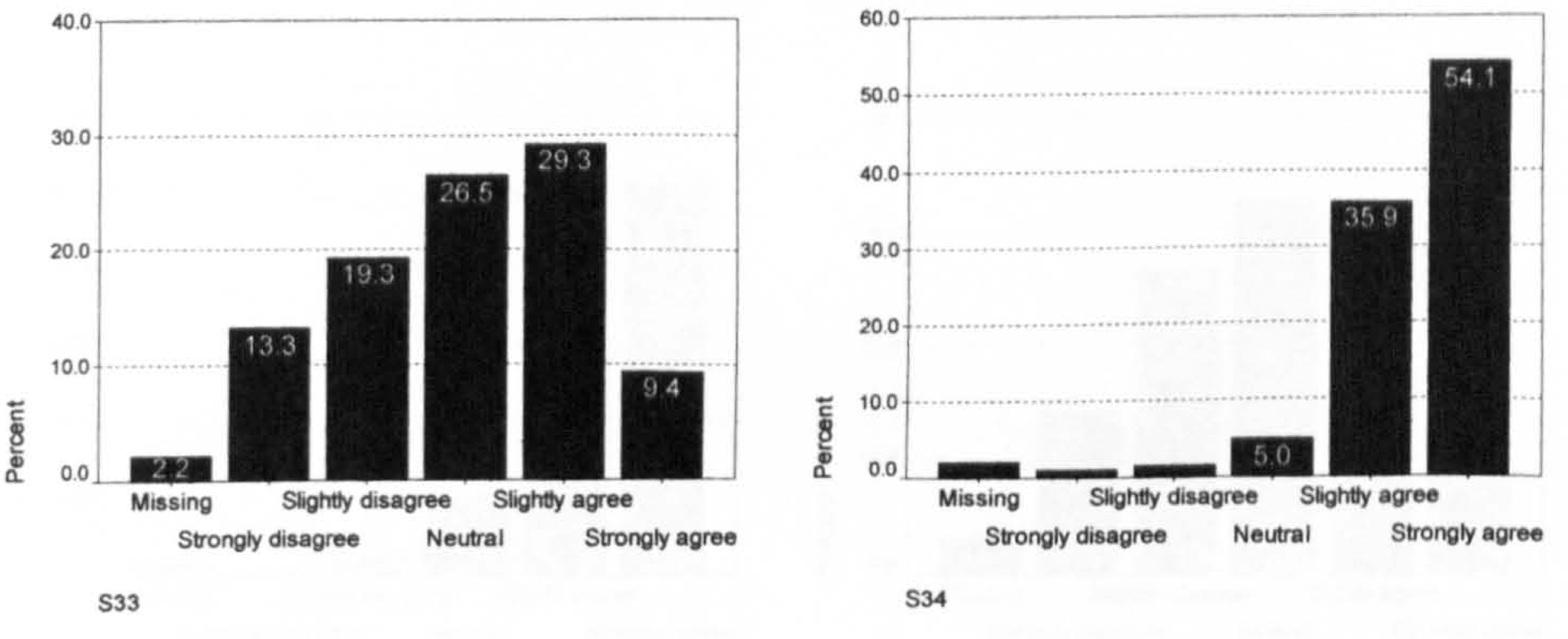
S31



S32

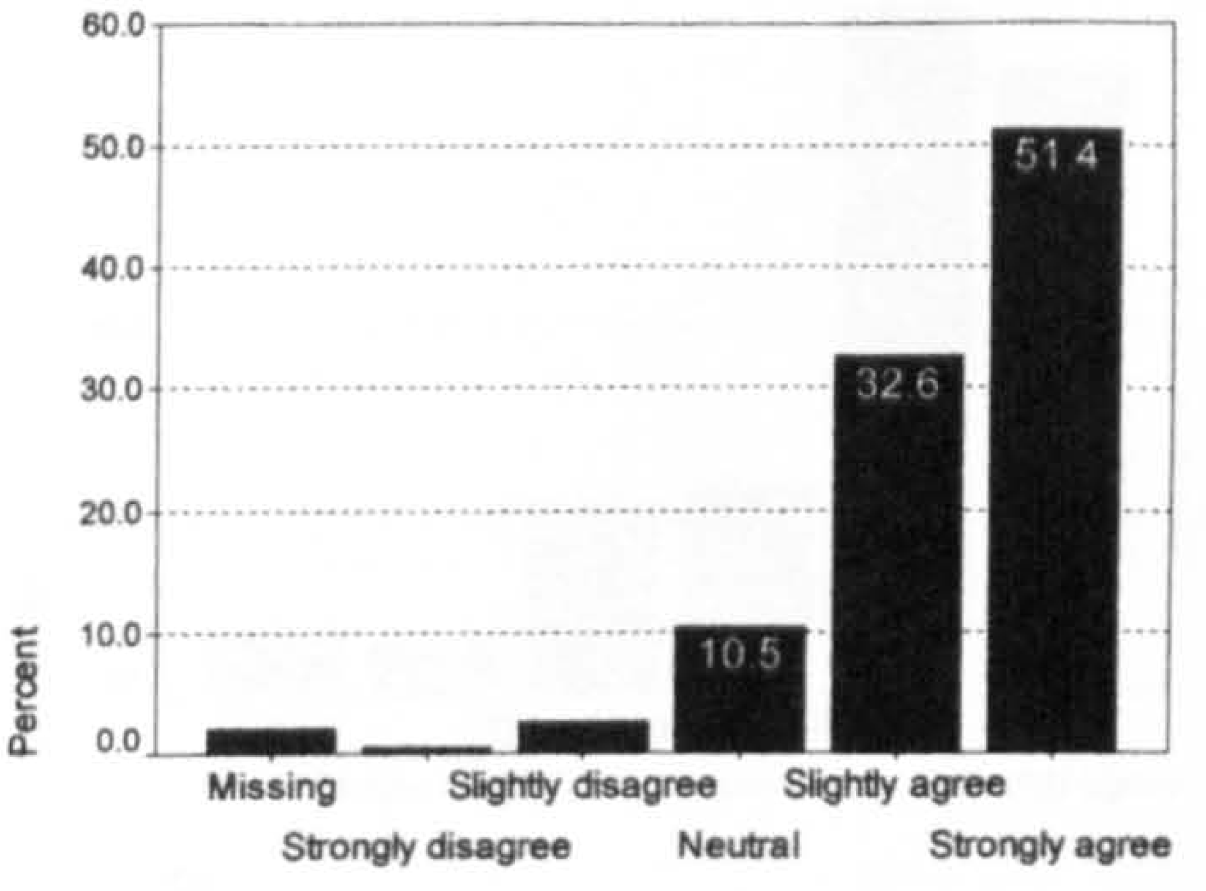
S32: I can understand environmental issues better if I am in a small group, so I can ask					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly disagree	1	.6	.6	.6
	Slightly disagree	4	2.2	2.3	2.8
	Neutral	24	13.3	13.6	16.4
	Slightly agree	72	39.8	40.7	57.1
	Strongly agree	76	42.0	42.9	100.0
	Total	177	97.8	100.0	
Missing	9	4	2.2		
Total		181	100.0		

S33: I find lectures difficult and quite boring					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly disagree	24	13.3	13.6	13.6
	Slightly disagree	35	19.3	19.8	33.3
	Neutral	48	26.5	27.1	60.5
	Slightly agree	53	29.3	29.9	90.4
	Strongly agree	17	9.4	9.6	100.0
	Total	177	97.8	100.0	
Missing	9	4	2.2		
Total		181	100.0		



S34: I understand better if we do different things in class, (lectures, visits, projects; etc...) it's good to change!					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly disagree	2	1.1	1.1	1.1
	Slightly disagree	3	1.7	1.7	2.8
	Neutral	9	5.0	5.1	7.9
	Slightly agree	65	35.9	36.7	44.6
	Strongly agree	98	54.1	55.4	100.0
	Total	177	97.8	100.0	
Missing	9	4	2.2		
Total		181	100.0		

S35: I feel more influence and motivation from guest architects that are actually doing environmental designs					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly disagree	1	.6	.6	.6
	Slightly disagree	5	2.8	2.8	3.4
	Neutral	19	10.5	10.7	14.1
	Slightly agree	59	32.6	33.3	47.5
	Strongly agree	93	51.4	52.5	100.0
	Total	177	97.8	100.0	
Missing	9	4	2.2		
Total		181	100.0		



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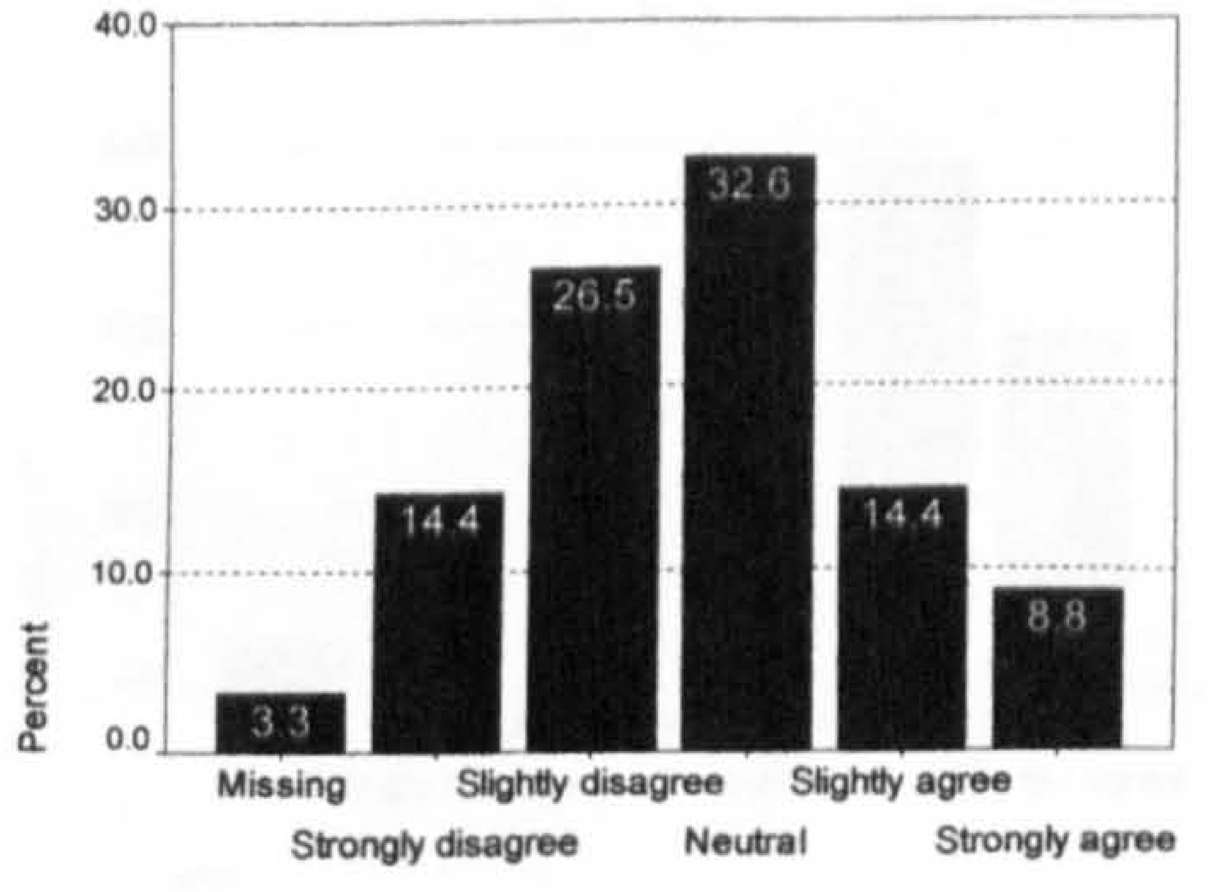
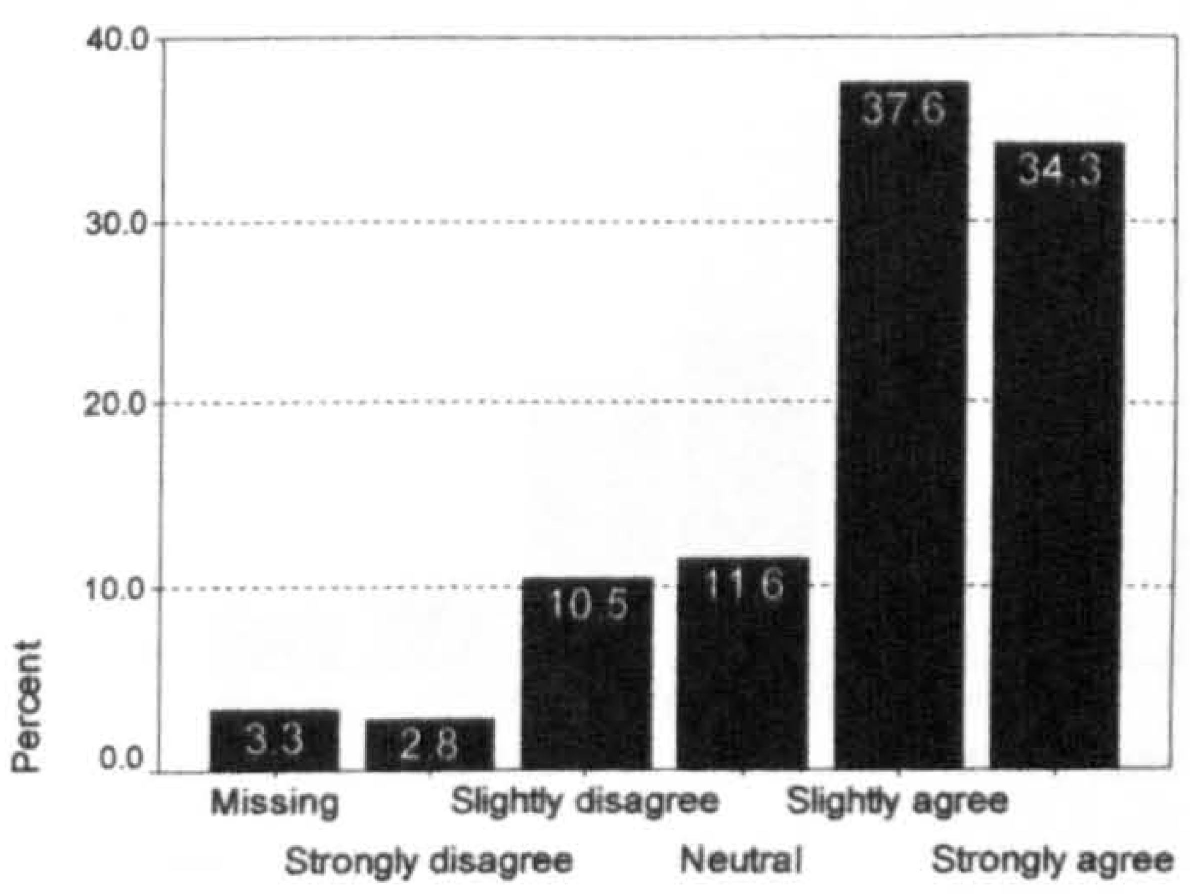


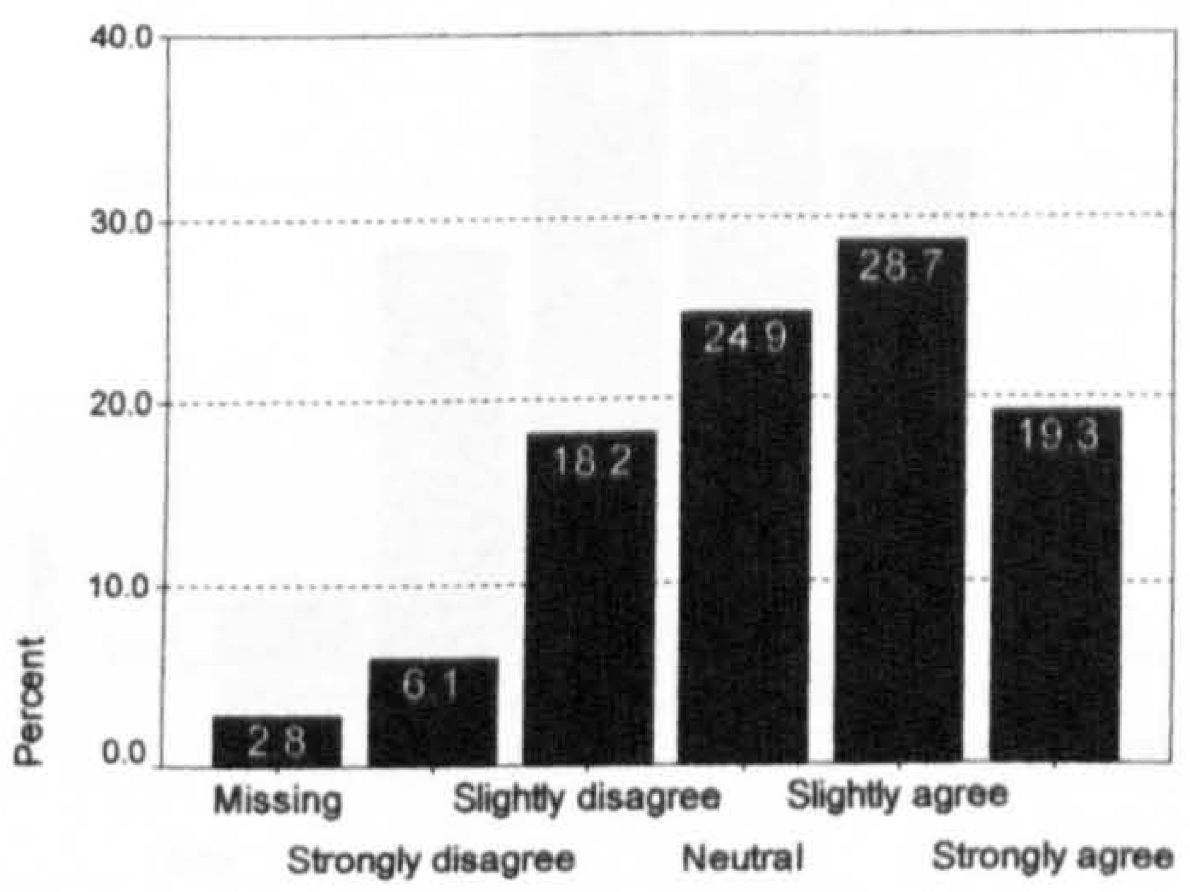
S36

S36: I am not really interested; as in class we talk a lot about environmental issues but nothing is done about it in practice					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly disagree	26	14.4	14.9	14.9
	Slightly disagree	48	26.5	27.4	42.3
	Neutral	59	32.6	33.7	76.0
	Slightly agree	26	14.4	14.9	90.9
	Strongly agree	16	8.8	9.1	100.0
	Total	175	96.7	100.0	
Missing	9	6	3.3		
Total		181	100.0		

S37: In my opinion environmental design is a very interesting subject					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly disagree	5	2.8	2.9	2.9
	Slightly disagree	19	10.5	10.9	13.7
	Neutral	21	11.6	12.0	25.7
	Slightly agree	68	37.6	38.9	64.6
	Strongly agree	62	34.3	35.4	100.0
	Total	175	96.7	100.0	
Missing	9	6	3.3		
Total		181	100.0		



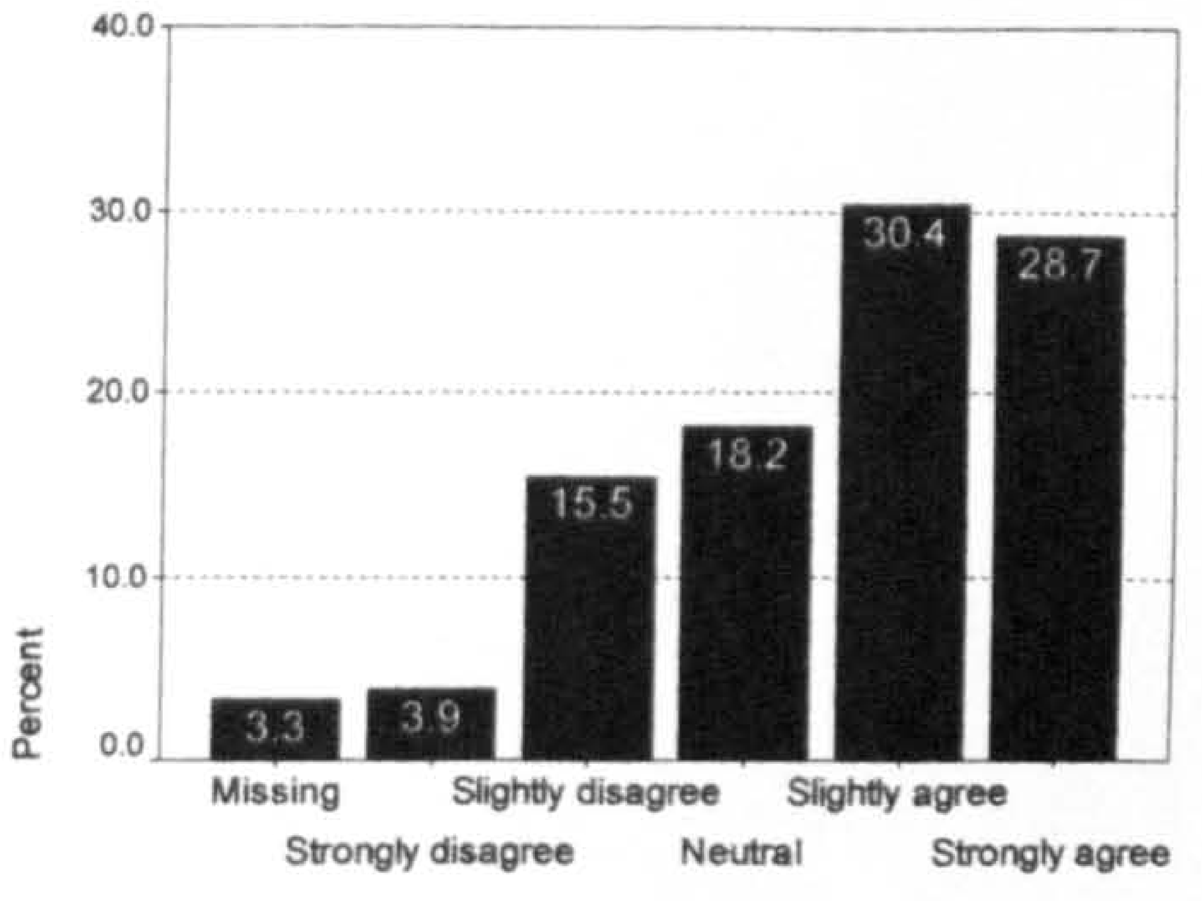
S37



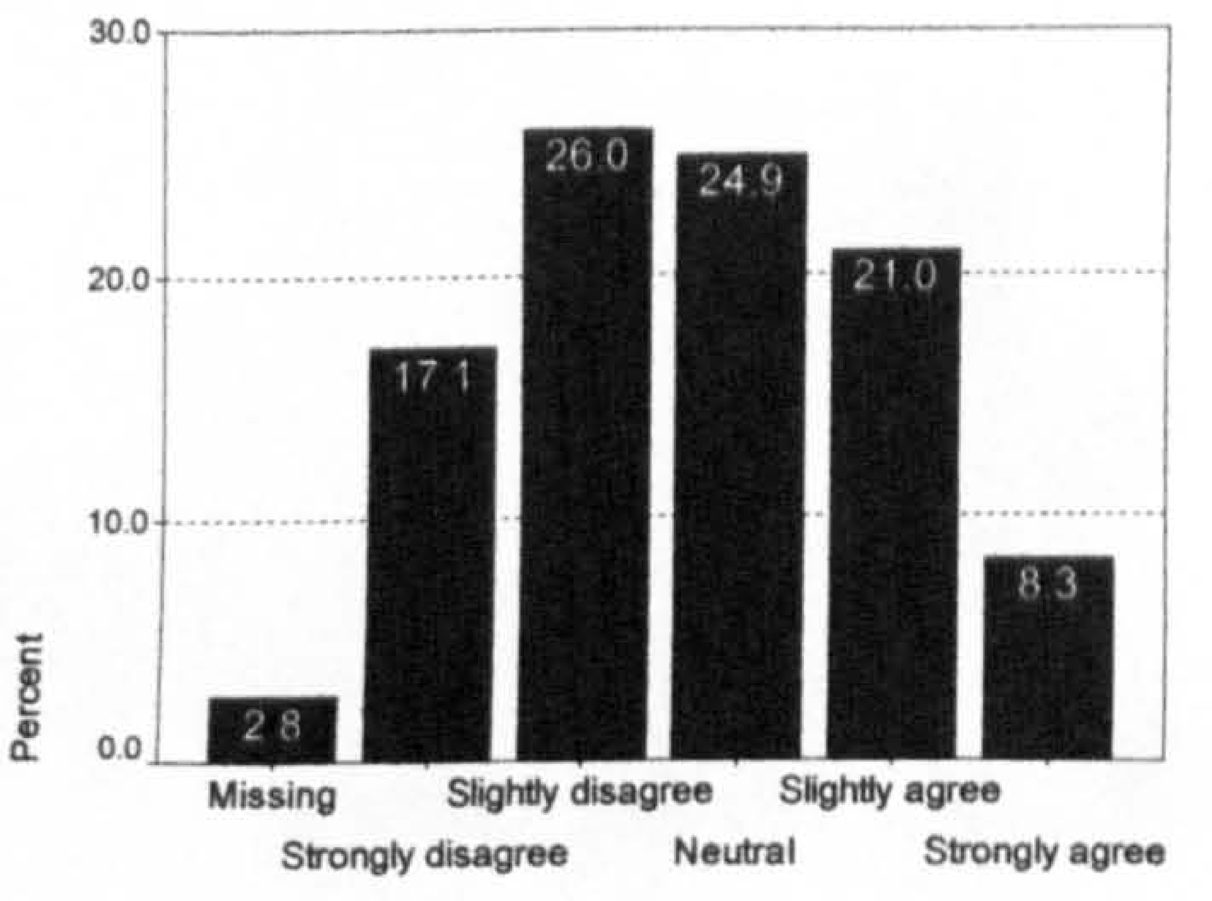
S38

S38: I always enjoy learning environmental design					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly disagree	11	6.1	6.3	6.3
	Slightly disagree	33	18.2	18.8	25.0
	Neutral	45	24.9	25.6	50.6
	Slightly agree	52	28.7	29.5	80.1
	Strongly agree	35	19.3	19.9	100.0
	Total	176	97.2	100.0	
Missing	9	5	2.8		
Total		181	100.0		

S39: I like to try an adventurous design regardless of the technical difficulties and alternative technologies					
		Frequency	Percent	Valid Percent	Cumulative Percent
	Strongly disagree	7	3.9	4.0	4.0
	Slightly disagree	28	15.5	16.0	20.0
	Neutral	33	18.2	18.9	38.9
	Slightly agree	55	30.4	31.4	70.3
	Strongly agree	52	28.7	29.7	100.0
	Total	175	96.7	100.0	
Missing	9	6	3.3		
Total		181	100.0		



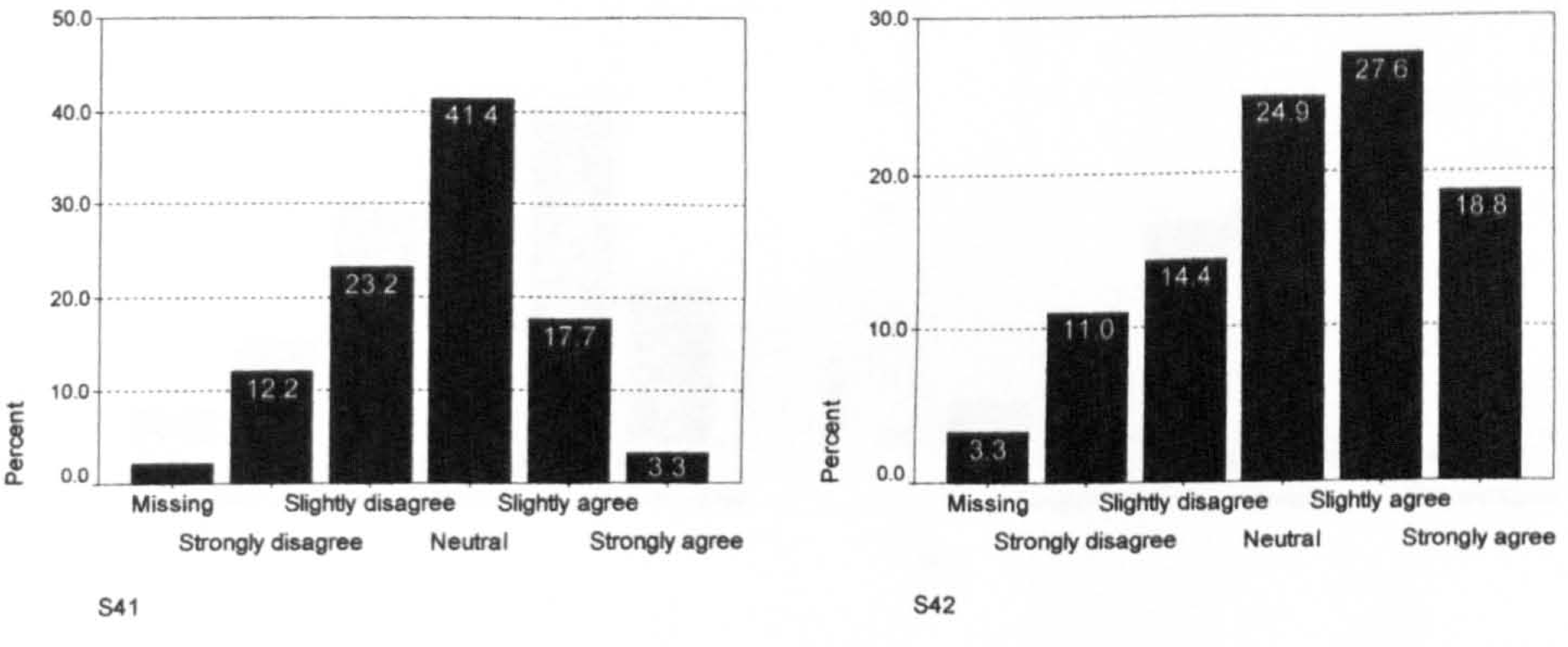
S39



S40

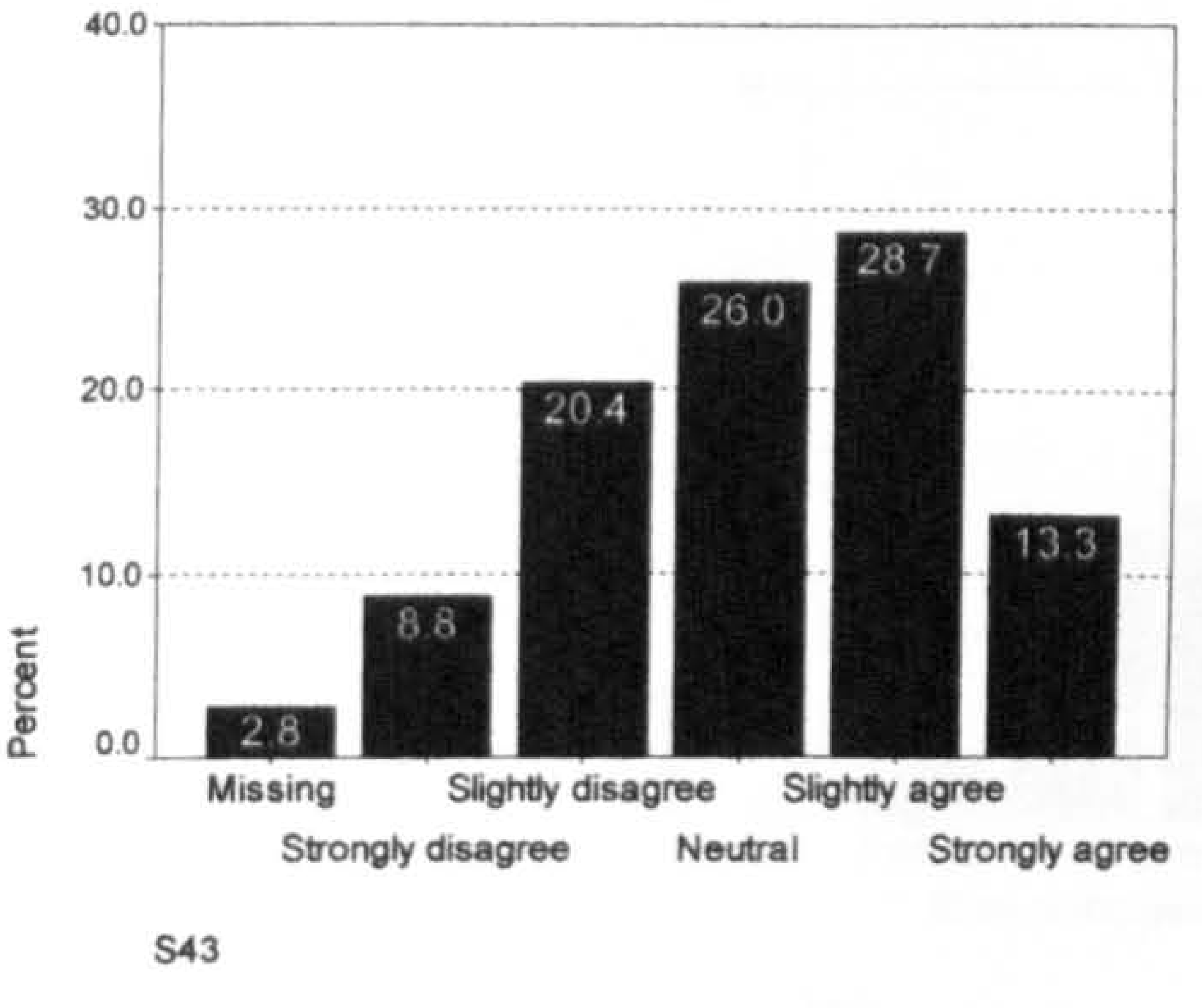
S40: I will discard a possibly flamboyant design if I consider it is not environmentally friendly					
		Frequency	Percent	Valid Percent	Cumulative Percent
	Strongly disagree	31	17.1	17.6	17.6
	Slightly disagree	47	26.0	26.7	44.3
	Neutral	45	24.9	25.6	69.9
	Slightly agree	38	21.0	21.6	91.5
	Strongly agree	15	8.3	8.5	100.0
	Total	176	97.2	100.0	
Missing	9	5	2.8		
Total		181	100.0		

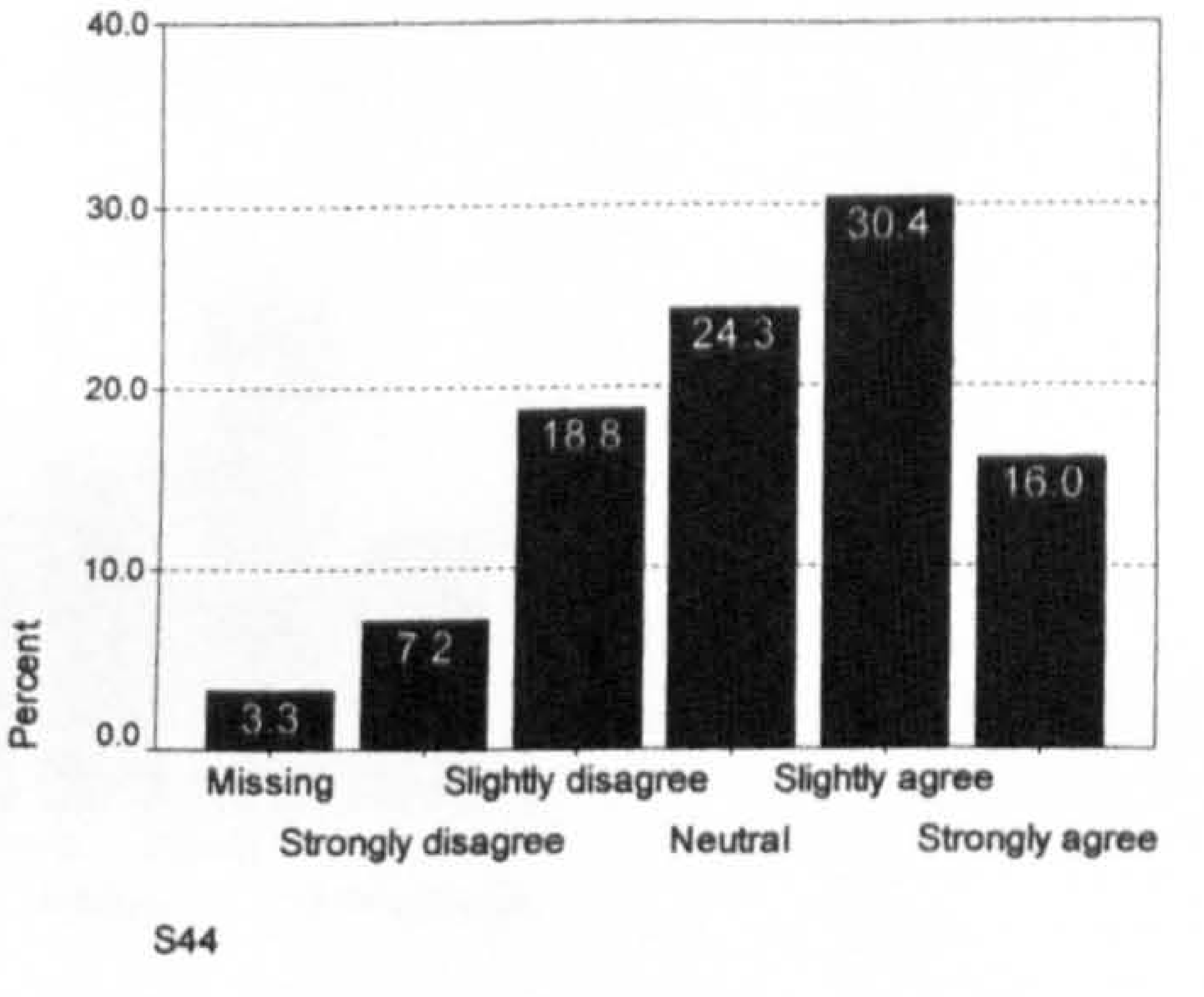
S41: I really enjoy environmental architecture because it tends to get a bit more theoretical than any other kind of architecture					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly disagree	22	12.2	12.4	12.4
	Slightly disagree	42	23.2	23.7	36.2
	Neutral	75	41.4	42.4	78.5
	Slightly agree	32	17.7	18.1	96.6
	Strongly agree	6	3.3	3.4	100.0
	Total	177	97.8	100.0	
Missing	9	4	2.2		
Total		181	100.0		



S42: I always dislike the fact that environmental design has too many calculations					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly disagree	20	11.0	11.4	11.4
	Slightly disagree	26	14.4	14.9	26.3
	Neutral	45	24.9	25.7	52.0
	Slightly agree	50	27.6	28.6	80.6
	Strongly agree	34	18.8	19.4	100.0
	Total	175	96.7	100.0	
Missing	9	6	3.3		
Total		181	100.0		

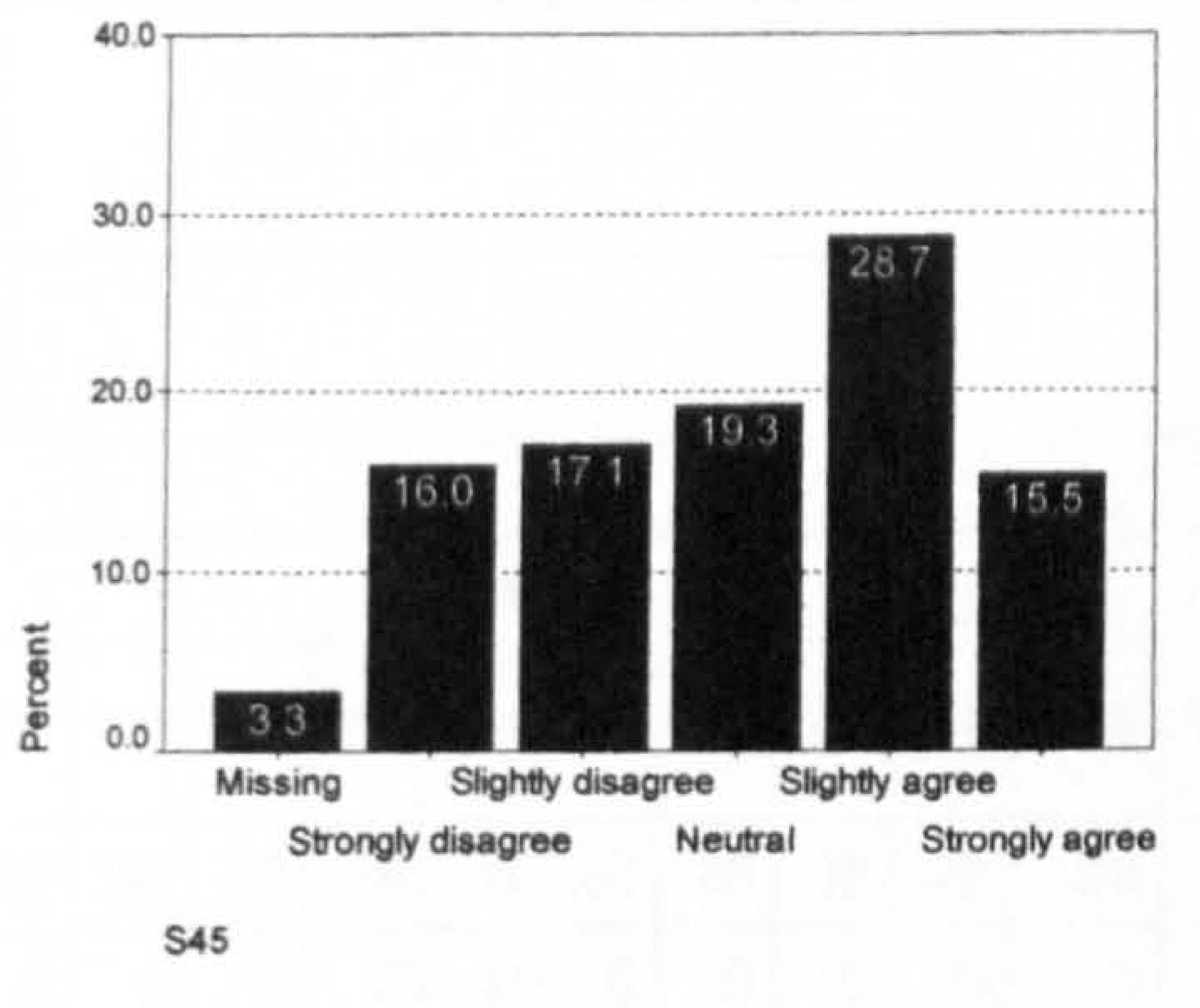
S43: It took me quite a lot of time to understand the terminology					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly disagree	16	8.8	9.1	9.1
	Slightly disagree	37	20.4	21.0	30.1
	Neutral	47	26.0	26.7	56.8
	Slightly agree	52	28.7	29.5	86.4
	Strongly agree	24	13.3	13.6	100.0
	Total	176	97.2	100.0	
Missing	9	5	2.8		
Total		181	100.0		





S44: Environmental architecture is very technical and lecturers don't slow down so we can go back and review the physics and do few things with it.					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly disagree	13	7.2	7.4	7.4
	Slightly disagree	34	18.8	19.4	26.9
	Neutral	44	24.3	25.1	52.0
	Slightly agree	55	30.4	31.4	83.4
	Strongly agree	29	16.0	16.6	100.0
	Total	175	96.7	100.0	
Missing	9	6	3.3		
Total		181	100.0		

S45: The difficulty in understanding environmental design results from lecturers dealing mainly with calculations					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly disagree	29	16.0	16.6	16.6
	Slightly disagree	31	17.1	17.7	34.3
	Neutral	35	19.3	20.0	54.3
	Slightly agree	52	28.7	29.7	84.0
	Strongly agree	28	15.5	16.0	100.0
	Total	175	96.7	100.0	
Missing	9	6	3.3		
Total		181	100.0		



Frequencies

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T31	T32	T33	T34	T35	T36	T37	T38
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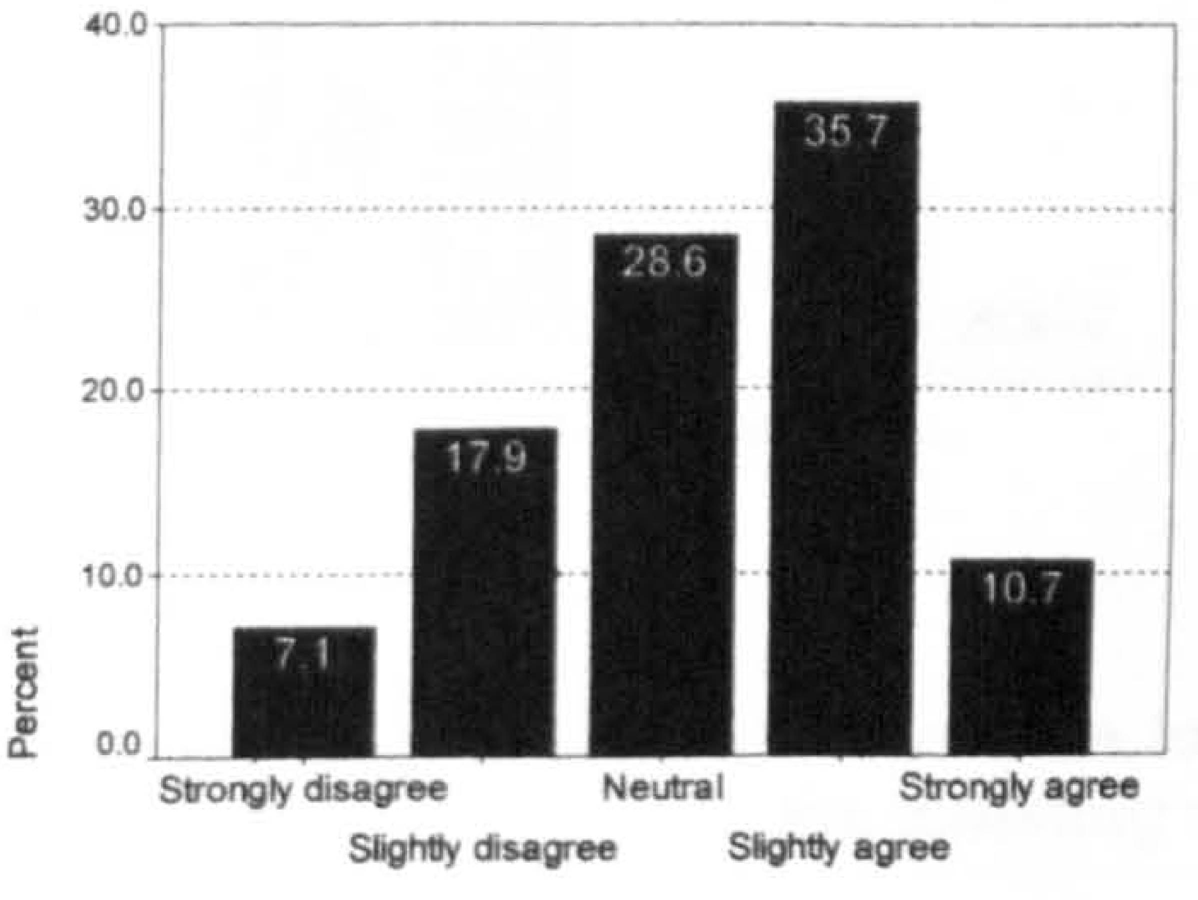
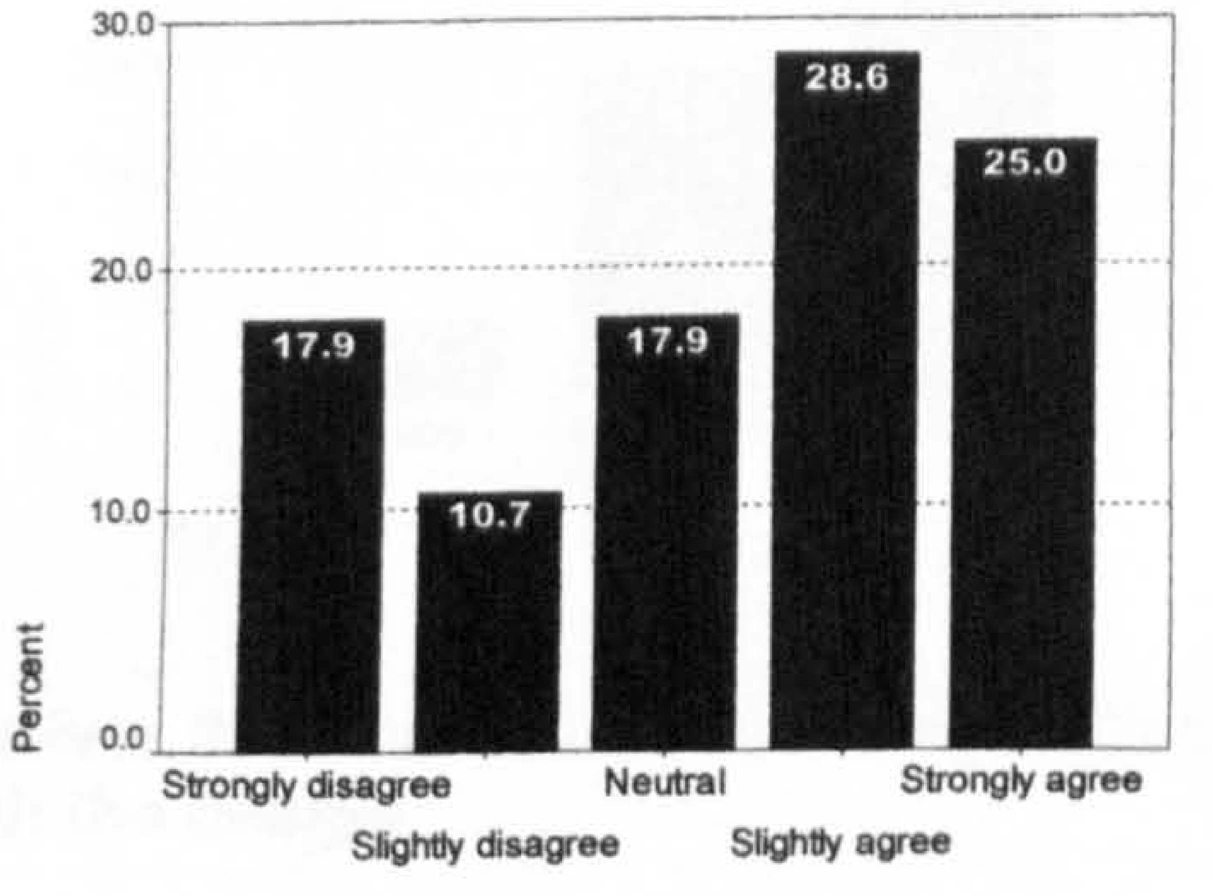
Frequency Table

T1: My most frequent method of teaching environment and sustainability issues is giving lectures

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly disagree	2	7.1	7.1	7.1
	Slightly disagree	5	17.9	17.9	25.0
	Neutral	8	28.6	28.6	53.6
	Slightly agree	10	35.7	35.7	89.3
	Strongly agree	3	10.7	10.7	100.0
	Total	28	100.0	100.0	



T1

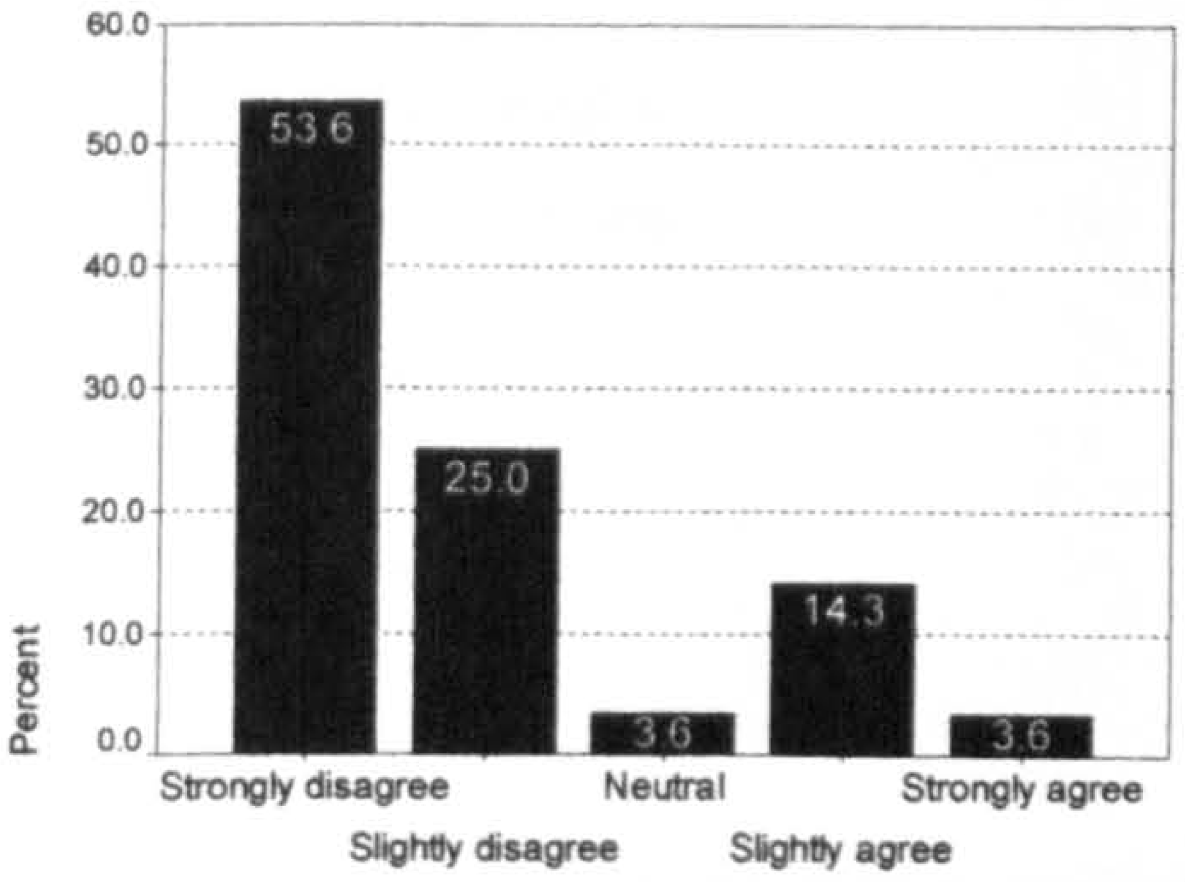


T2

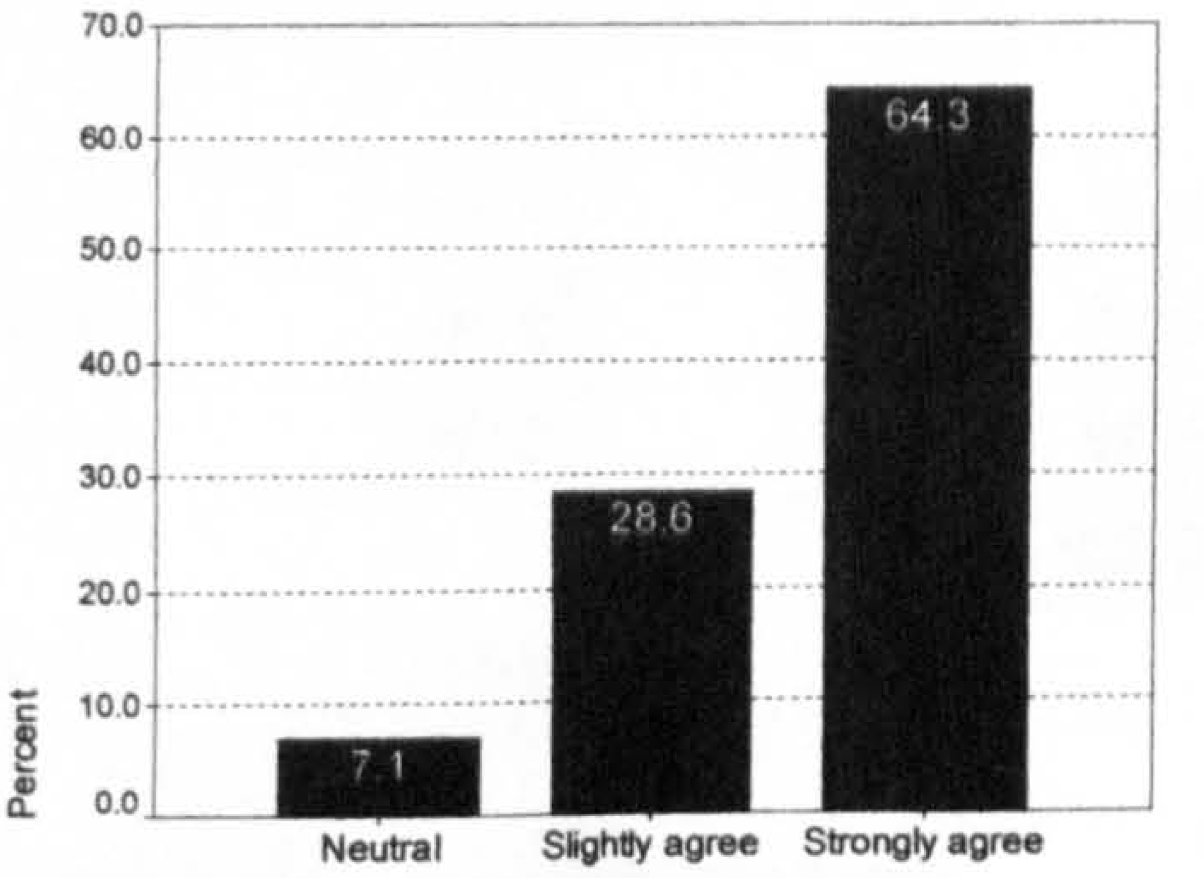
T2: I frequently take students to site visits to learn about and see environmental designs

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly disagree	5	17.9	17.9	17.9
	Slightly disagree	3	10.7	10.7	28.6
	Neutral	5	17.9	17.9	46.4
	Slightly agree	8	28.6	28.6	75.0
	Strongly agree	7	25.0	25.0	100.0
	Total	28	100.0	100.0	

T3: I believe technology issues should be dealt separately so students should make the connections while designing					
		Frequency	**Percent**	**Valid Percent**	**Cumulative Percent**
Valid	**Strongly disagree**	15	53.6	53.6	53.6
	Slightly disagree	7	25.0	25.0	78.6
	Neutral	1	3.6	3.6	82.1
	Slightly agree	4	14.3	14.3	96.4
	Strongly agree	1	3.6	3.6	100.0
	Total	28	100.0	100.0	



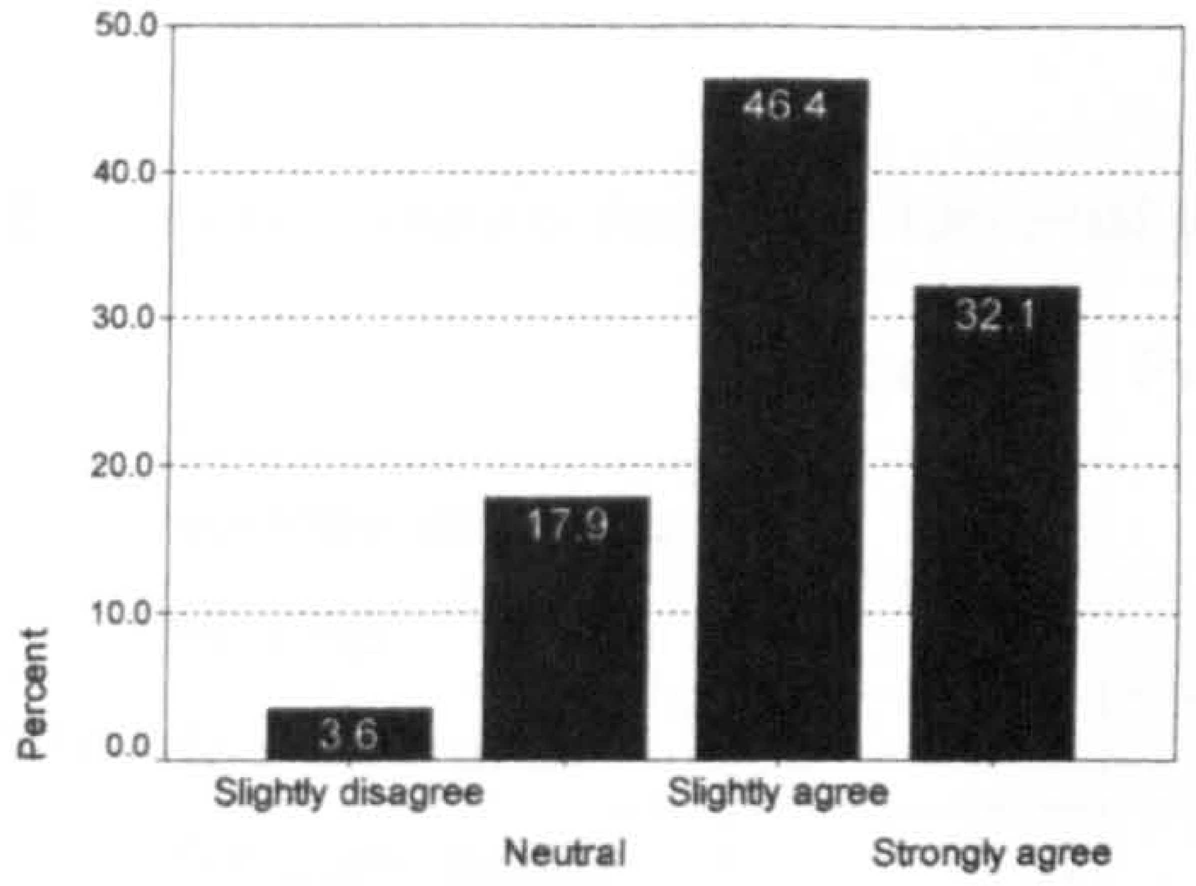
T3



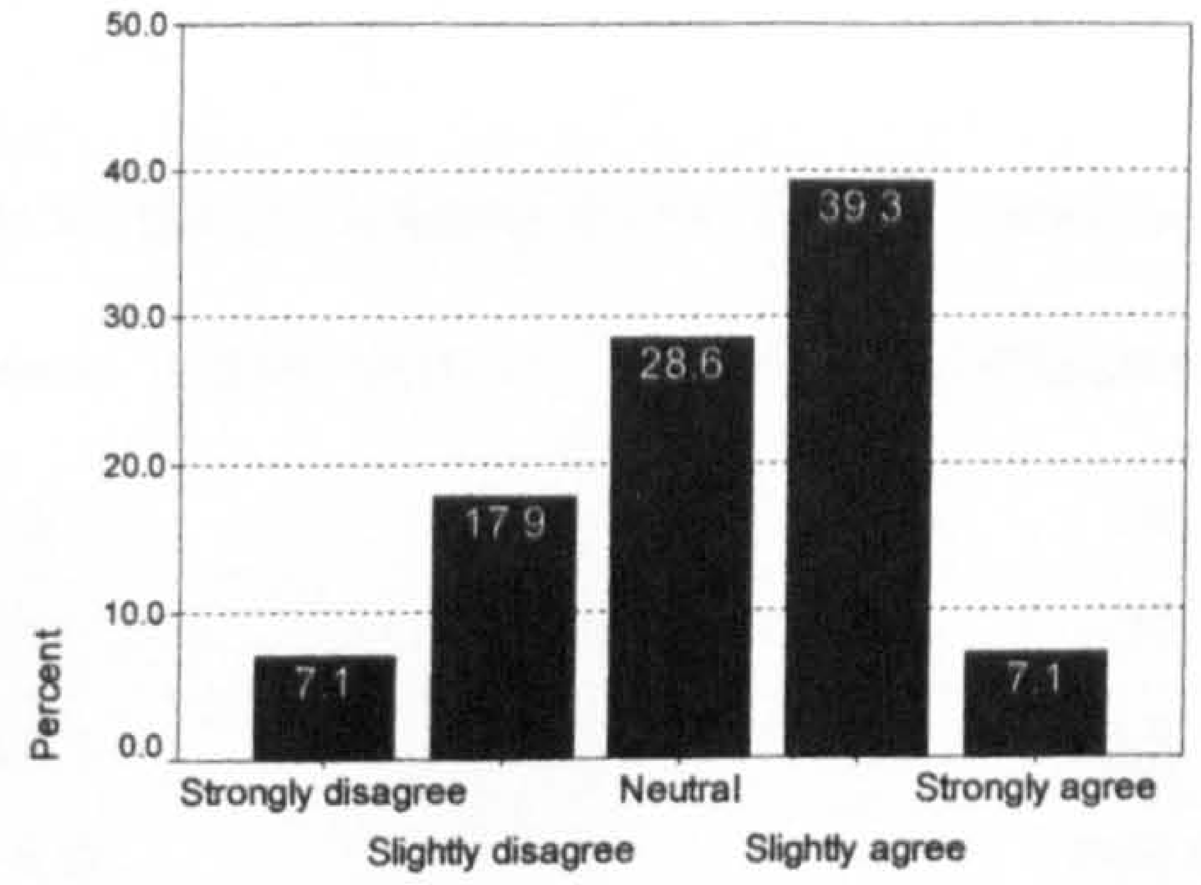
T4

T4: I use design projects as the vehicle to deliver the environmental material, so I tie the teaching with the design					
		Frequency	**Percent**	**Valid Percent**	**Cumulative Percent**
Valid	**Neutral**	2	7.1	7.1	7.1
	Slightly agree	8	28.6	28.6	35.7
	Strongly agree	18	64.3	64.3	100.0
	Total	28	100.0	100.0	

T5: I believe in teaching environmental design through case studies, by analysing existing buildings					
		Frequency	**Percent**	**Valid Percent**	**Cumulative Percent**
Valid	**Slightly disagree**	1	3.6	3.6	3.6
	Neutral	5	17.9	17.9	21.4
	Slightly agree	13	46.4	46.4	67.9
	Strongly agree	9	32.1	32.1	100.0
	Total	28	100.0	100.0	



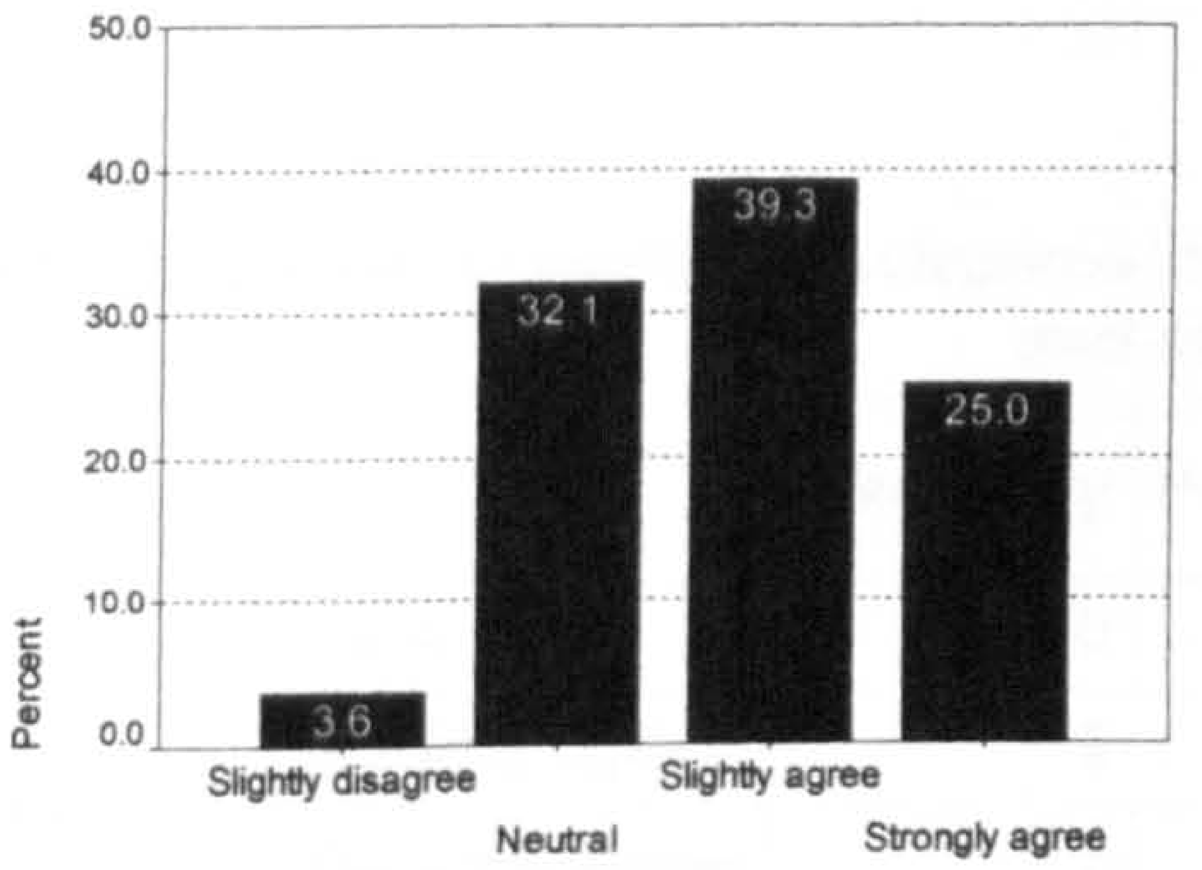
T5



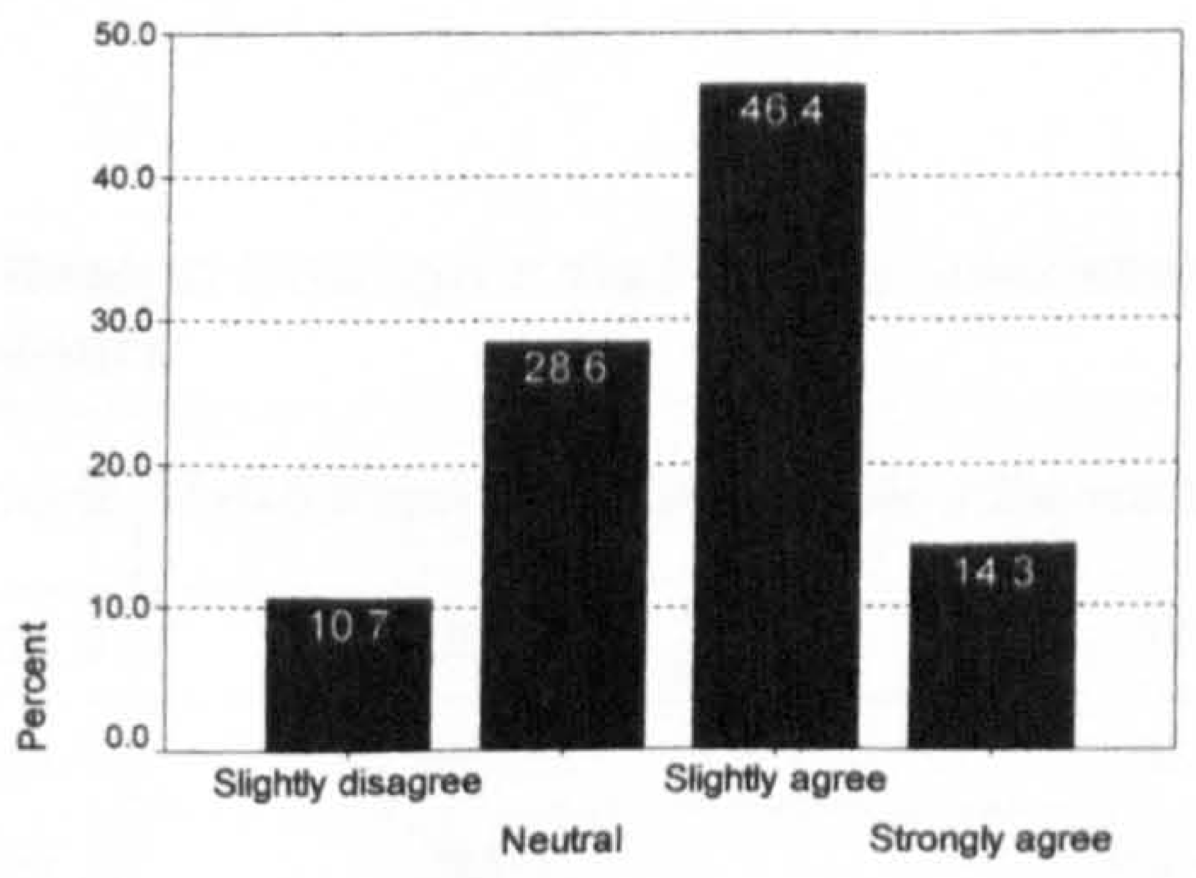
T6

T6: I believe in teaching environmental design through lab/experiment sessions					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly disagree	2	7.1	7.1	7.1
	Slightly disagree	5	17.9	17.9	25.0
	Neutral	8	28.6	28.6	53.6
	Slightly agree	11	39.3	39.3	92.9
	Strongly agree	2	7.1	7.1	100.0
	Total	28	100.0	100.0	

T7: I believe in teaching environmental design through hand-on-experience/real projects					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Slightly disagree	1	3.6	3.6	3.6
	Neutral	9	32.1	32.1	35.7
	Slightly agree	11	39.3	39.3	75.0
	Strongly agree	7	25.0	25.0	100.0
	Total	28	100.0	100.0	



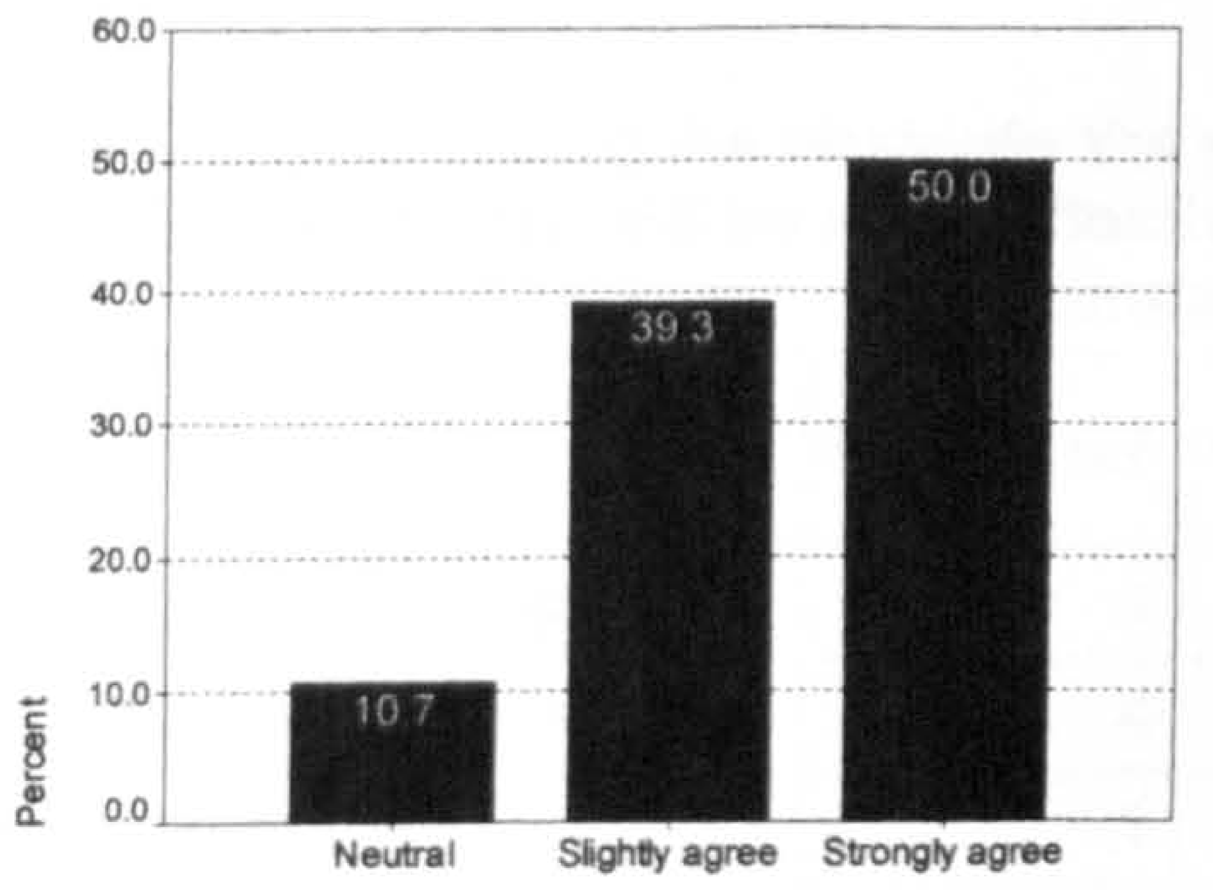
T7



T8

T8: I believe studio design is the best way to teach sustainability in architecture					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Slightly disagree	3	10.7	10.7	10.7
	Neutral	8	28.6	28.6	39.3
	Slightly agree	13	46.4	46.4	85.7
	Strongly agree	4	14.3	14.3	100.0
	Total	28	100.0	100.0	

T9: I believe in teaching environmental design through integrated projects					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Neutral	3	10.7	10.7	10.7
	Slightly agree	11	39.3	39.3	50.0
	Strongly agree	14	50.0	50.0	100.0
	Total	28	100.0	100.0	



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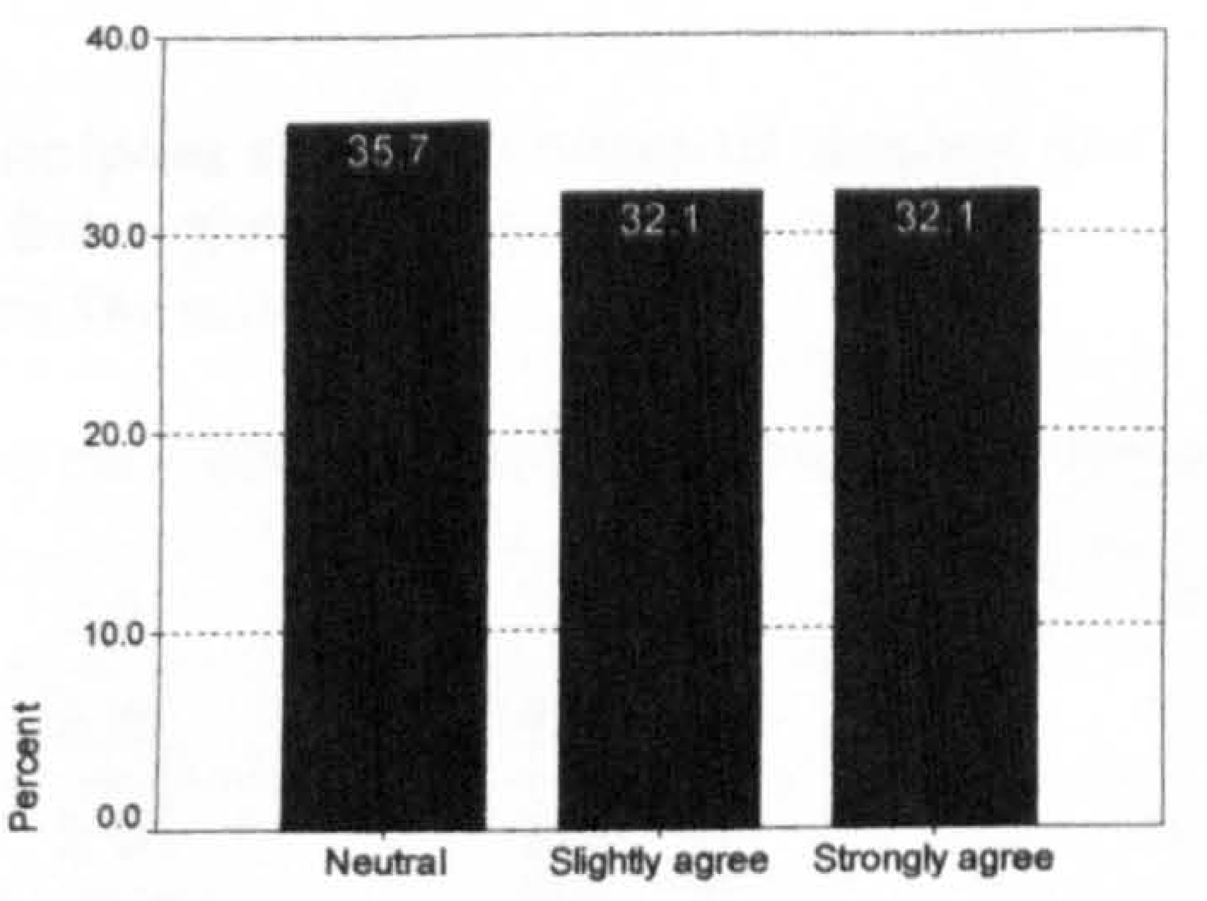
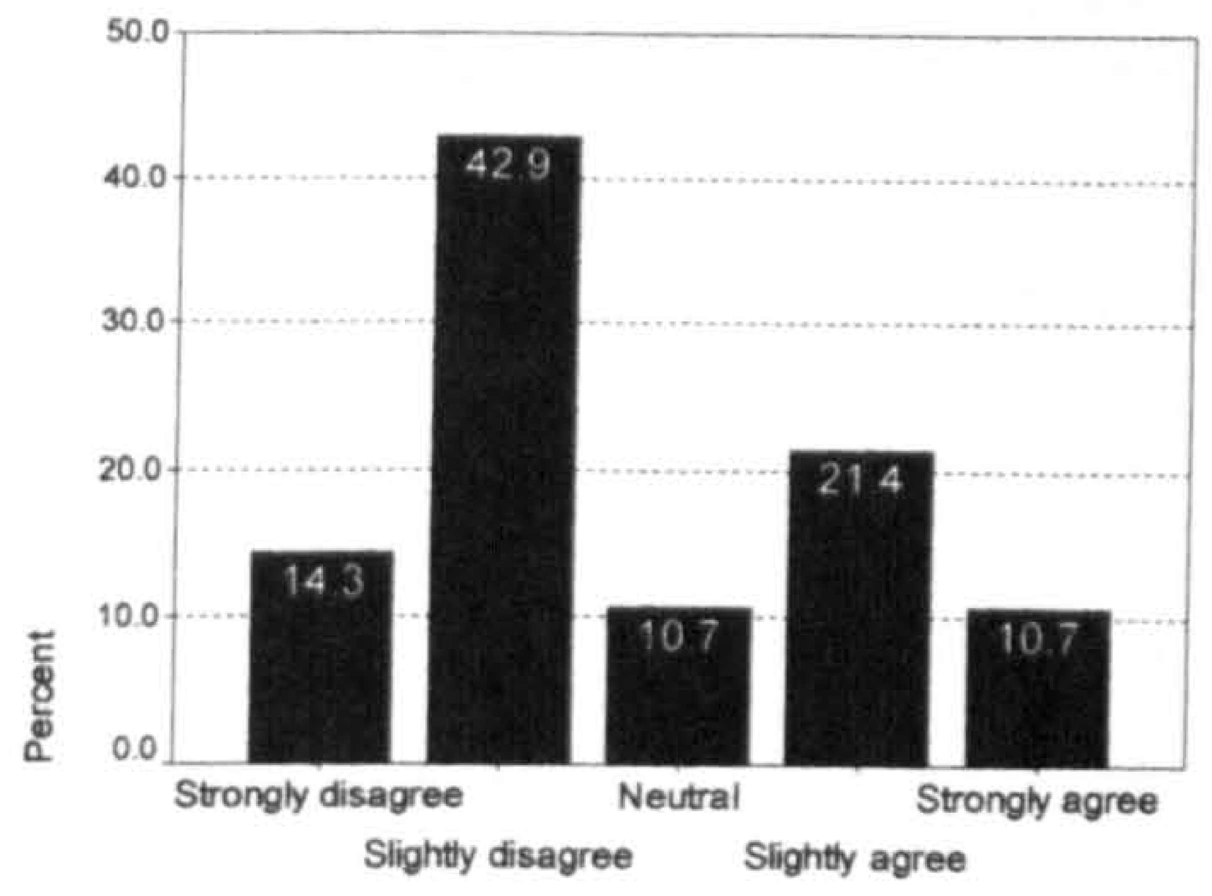


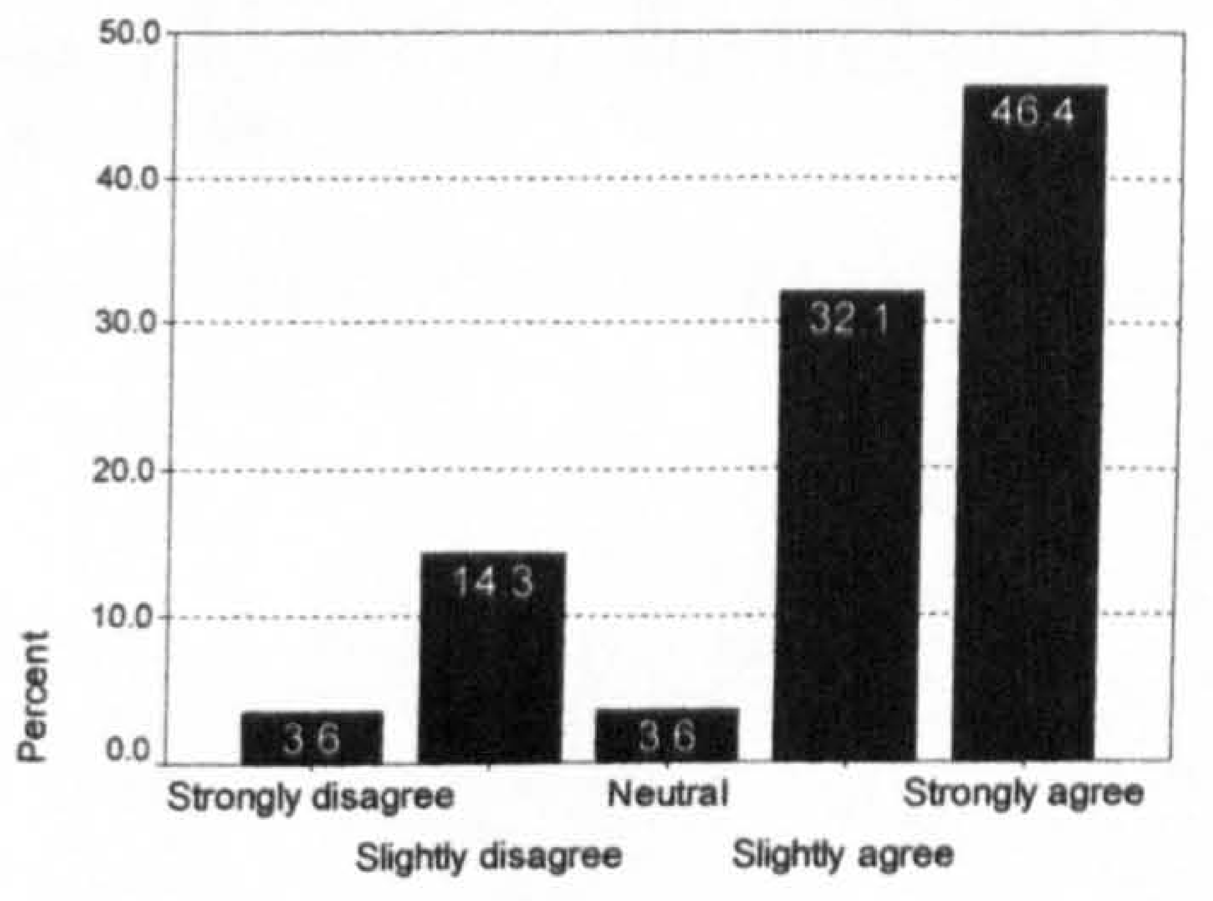
T10

T10: I believe in teaching environmental design through small group sessions and seminars					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Neutral	10	35.7	35.7	35.7
	Slightly agree	9	32.1	32.1	67.9
	Strongly agree	9	32.1	32.1	100.0
	Total	28	100.0	100.0	

T11: I believe examinations are very important in making students learn environmental design					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly disagree	4	14.3	14.3	14.3
	Slightly disagree	12	42.9	42.9	57.1
	Neutral	3	10.7	10.7	67.9
	Slightly agree	6	21.4	21.4	89.3
	Strongly agree	3	10.7	10.7	100.0
	Total	28	100.0	100.0	



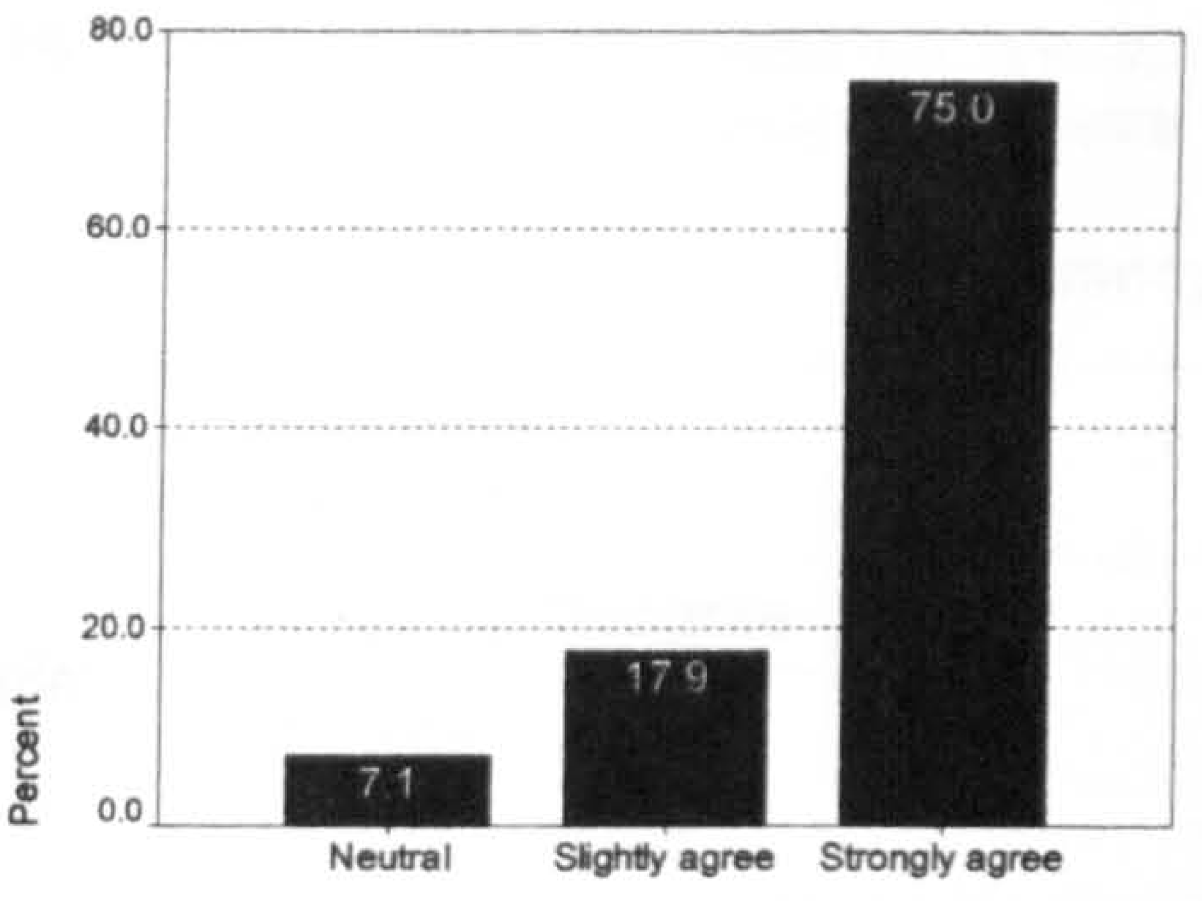
T11



T12

T12: I believe giving the students the principles of environmental design and sustainability will be more effective than giving them calculations of environmental factors					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly disagree	1	3.6	3.6	3.6
	Slightly disagree	4	14.3	14.3	17.9
	Neutral	1	3.6	3.6	21.4
	Slightly agree	9	32.1	32.1	53.6
	Strongly agree	13	46.4	46.4	100.0
	Total	28	100.0	100.0	

T13: I believe more contact with students at tutorials improves their learning experience					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Neutral	2	7.1	7.1	7.1
	Slightly agree	5	17.9	17.9	25.0
	Strongly agree	21	75.0	75.0	100.0
	Total	28	100.0	100.0	



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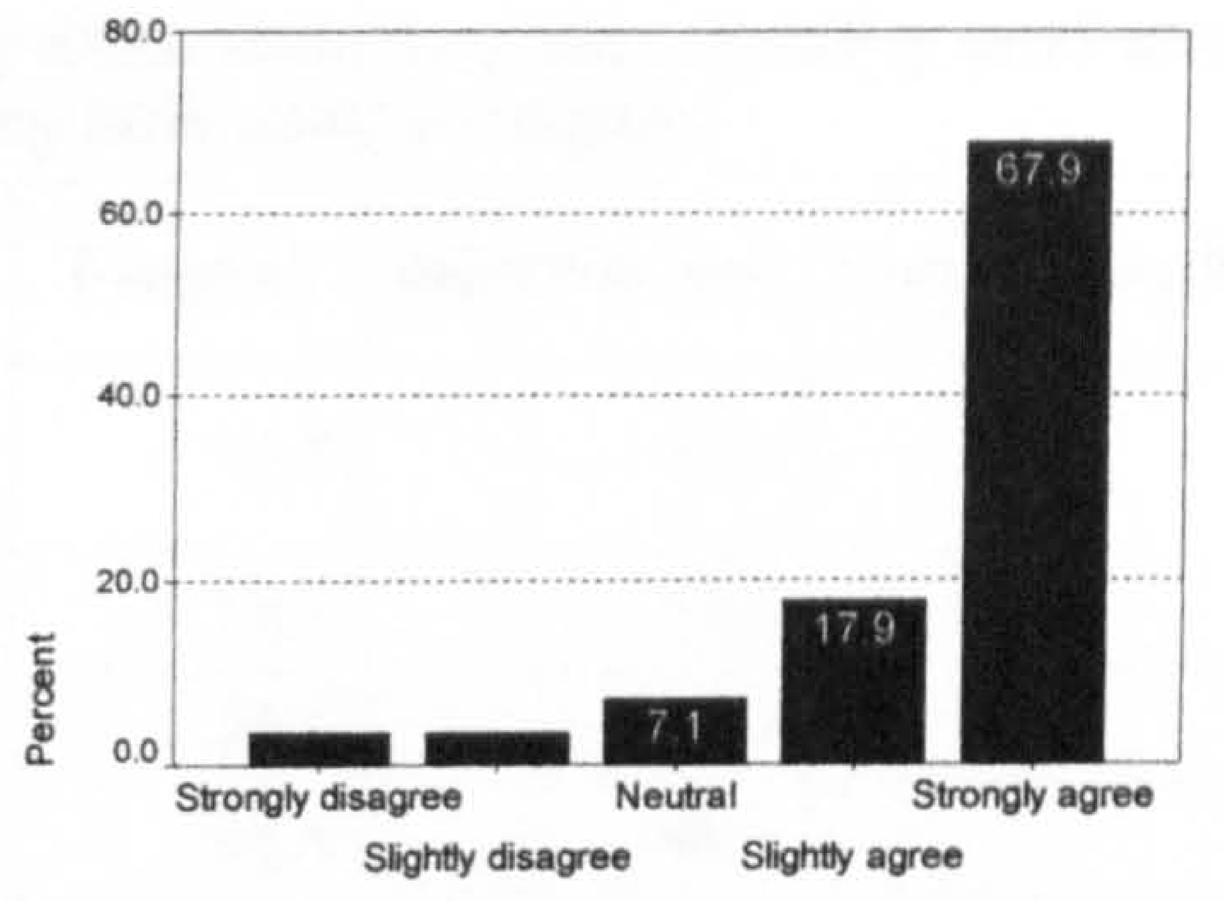
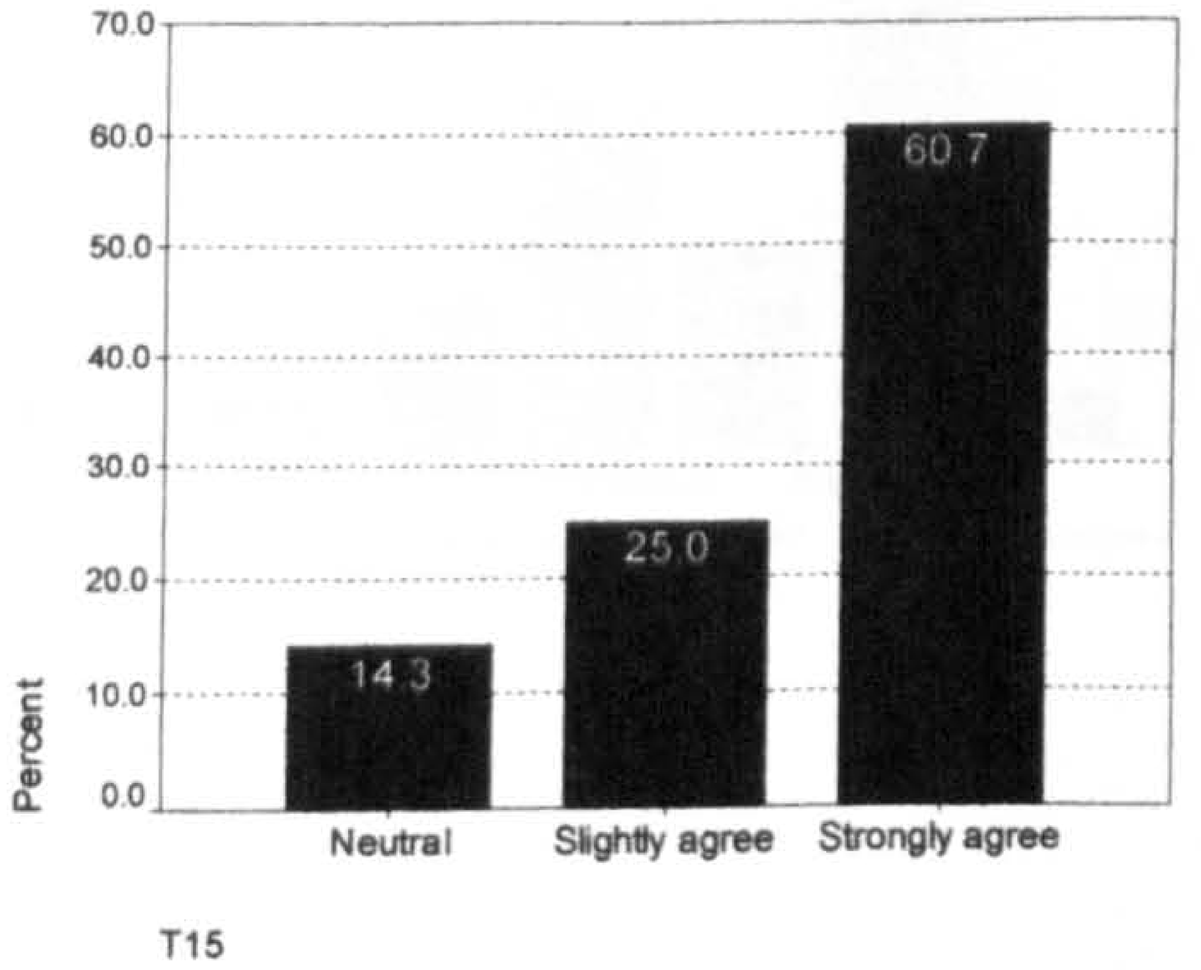


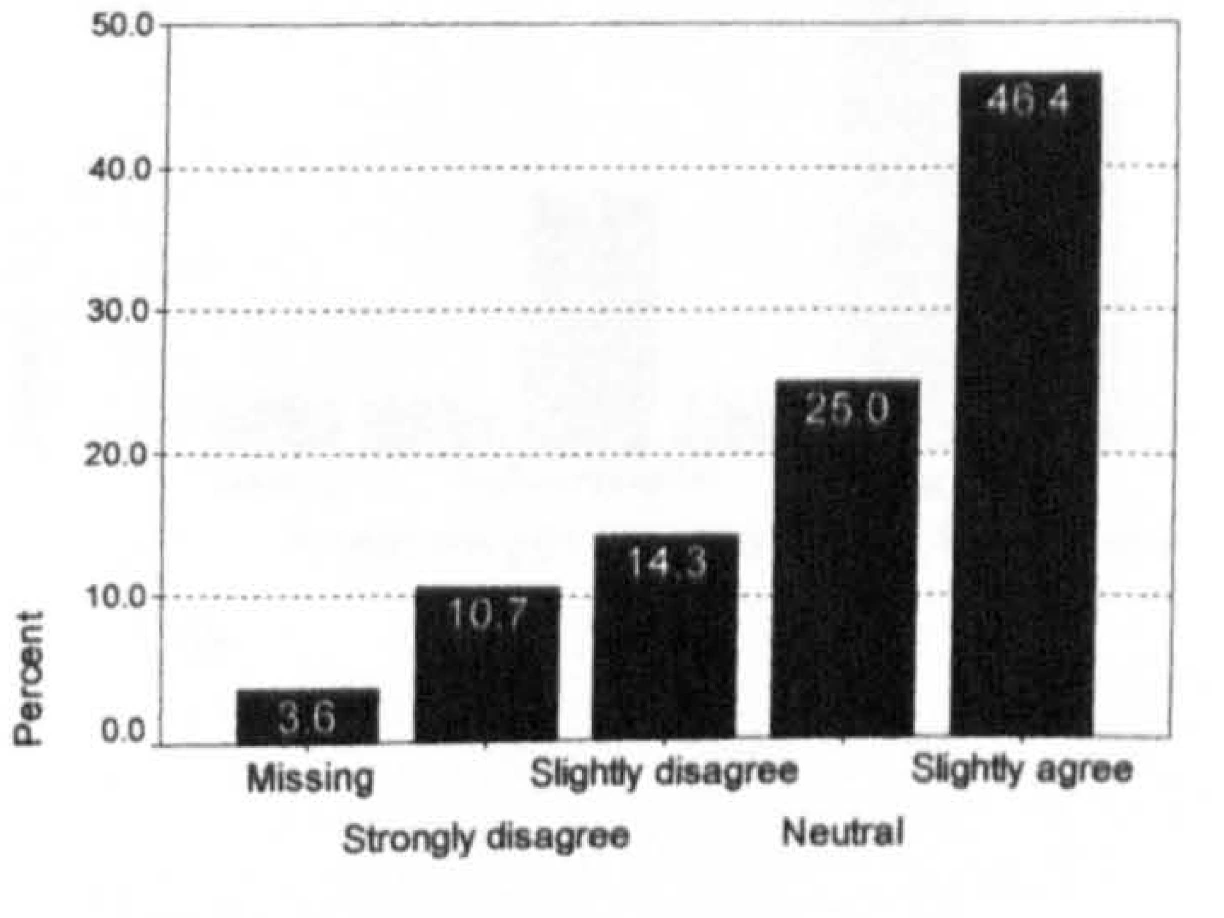
T14

T14: Delivering simultaneously the design project and the building engineering help students to get the idea that environmental design and architecture are actually the same thing					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly disagree	1	3.6	3.6	3.6
	Slightly disagree	1	3.6	3.6	7.1
	Neutral	2	7.1	7.1	14.3
	Slightly agree	5	17.9	17.9	32.1
	Strongly agree	19	67.9	67.9	100.0
	Total	28	100.0	100.0	

T15 I believe that knowing what students are doing in other modules will help improve teaching environmental design					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Neutral	4	14.3	14.3	14.3
	Slightly agree	7	25.0	25.0	39.3
	Strongly agree	17	60.7	60.7	100.0
	Total	28	100.0	100.0	



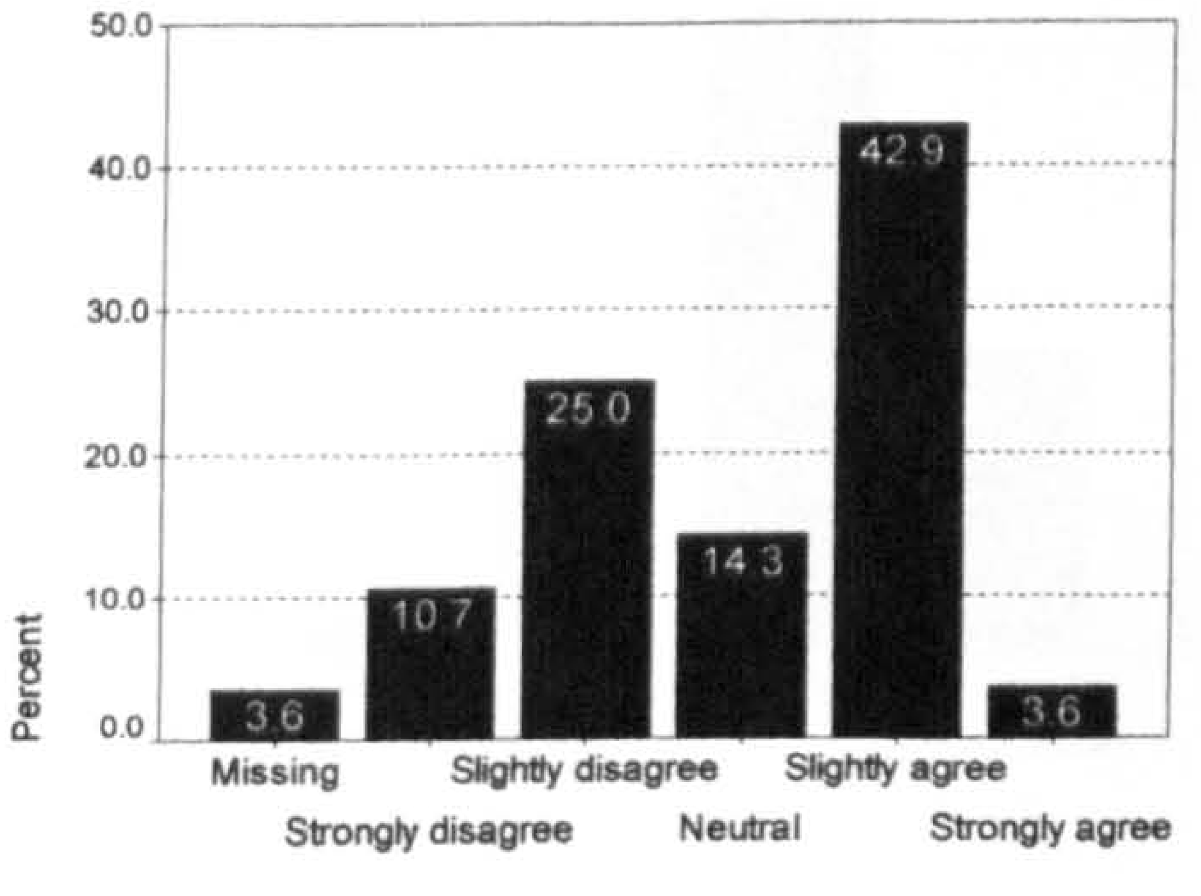
T15



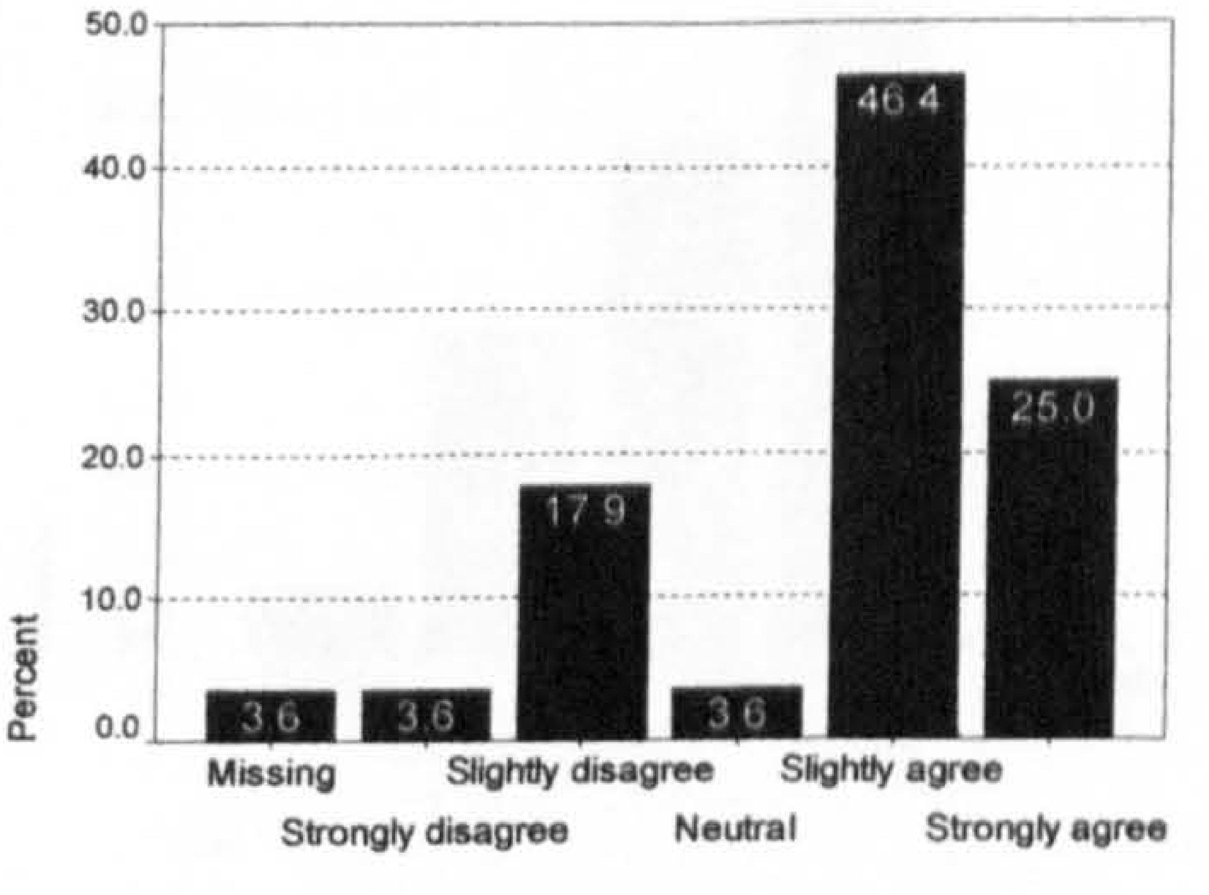
T16

T16: I can see that my students are facing difficulties in understanding environmental design because they lack daily examples					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly disagree	3	10.7	11.1	11.1
	Slightly disagree	4	14.3	14.8	25.9
	Neutral	7	25.0	25.9	51.9
	Slightly agree	13	46.4	48.1	100.0
	Total	27	96.4	100.0	
Missing	9	1	3.6		
Total		28	100.0		

T17: The students seem to have problems in understanding sustainability and environment in terms of design					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly disagree	3	10.7	11.1	11.1
	Slightly disagree	7	25.0	25.9	37.0
	Neutral	4	14.3	14.8	51.9
	Slightly agree	12	42.9	44.4	96.3
	Strongly agree	1	3.6	3.7	100.0
	Total	27	96.4	100.0	
Missing	9	1	3.6		
Total		28	100.0		



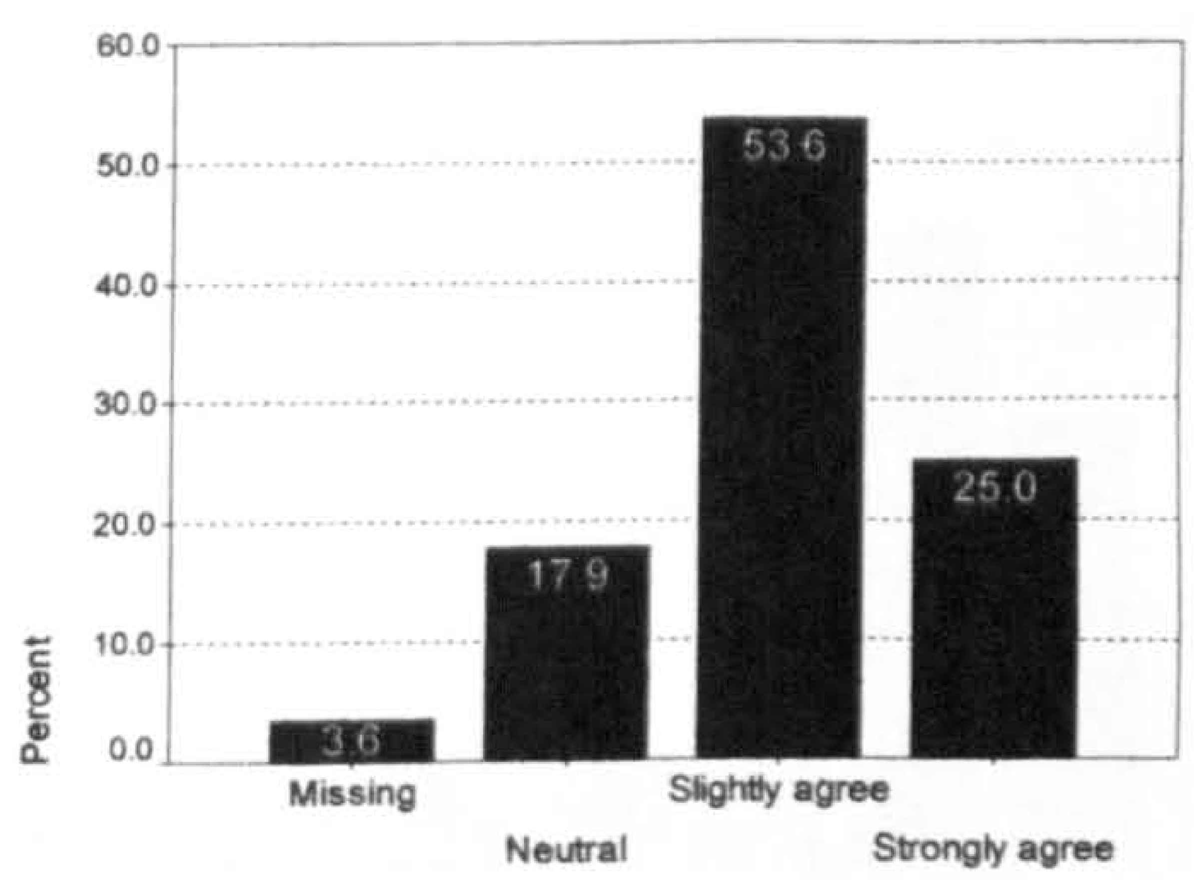
T17



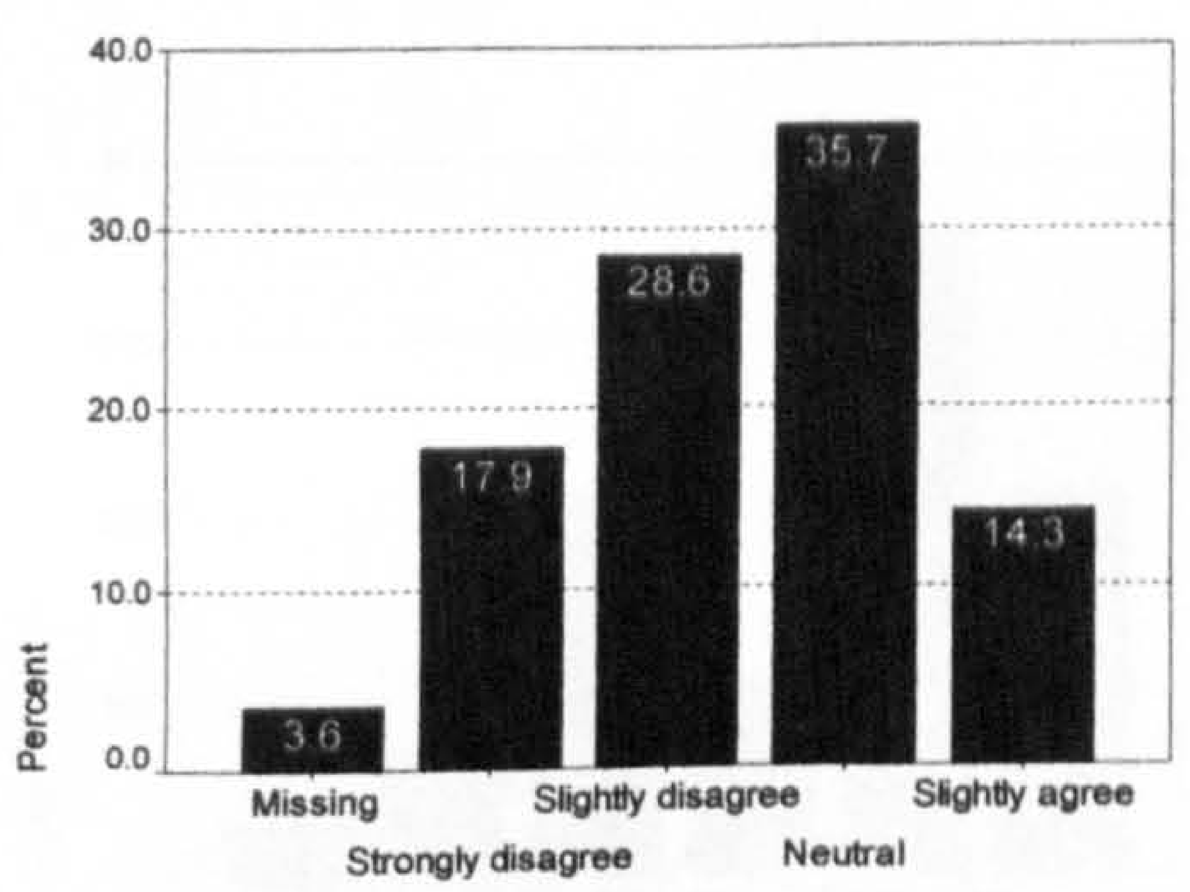
T18

T18: There seems to be compartmentalisation of knowledge between environment and other related architectural subjects, which is reflected into students learning					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly disagree	1	3.6	3.7	3.7
	Slightly disagree	5	17.9	18.5	22.2
	Neutral	1	3.6	3.7	25.9
	Slightly agree	13	46.4	48.1	74.1
	Strongly agree	7	25.0	25.9	100.0
	Total	27	96.4	100.0	
Missing	9	1	3.6		
Total		28	100.0		

T19: I noticed during my course that students ask questions based on their design problems					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Neutral	5	17.9	18.5	18.5
	Slightly agree	15	53.6	55.6	74.1
	Strongly agree	7	25.0	25.9	100.0
	Total	27	96.4	100.0	
Missing	9	1	3.6		
Total		28	100.0		



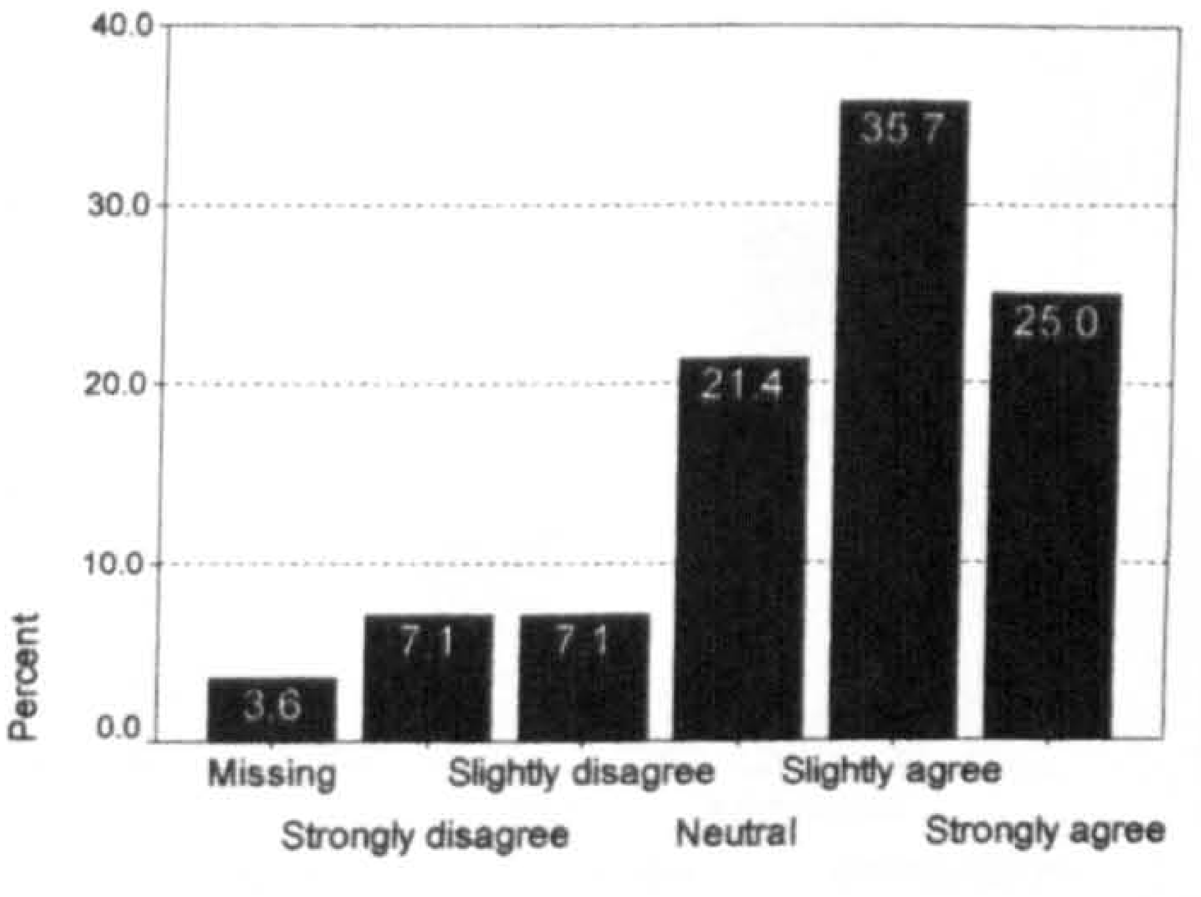
T19



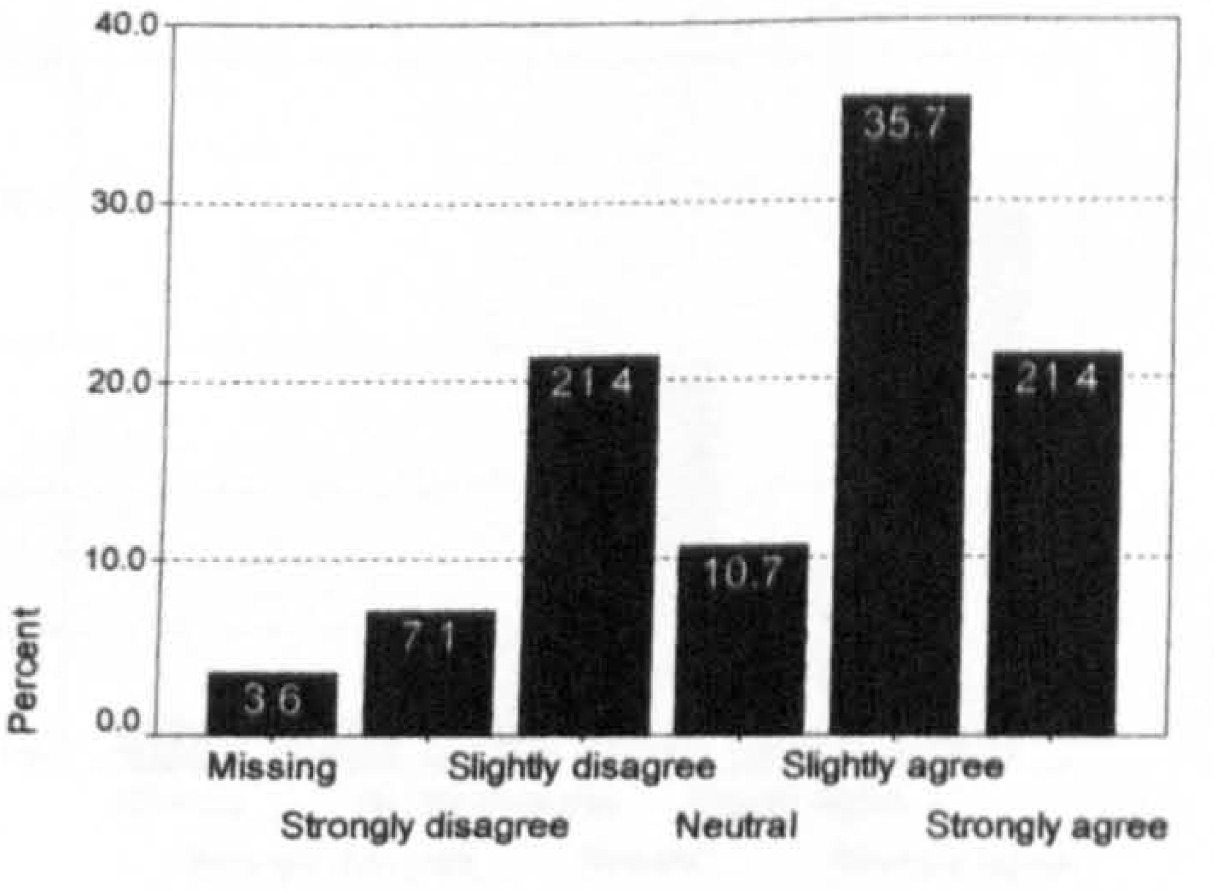
T20

T20: I noticed students tend to skip lectures and only attend tutorials and lab sessions					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly disagree	5	17.9	18.5	18.5
	Slightly disagree	8	28.6	29.6	48.1
	Neutral	10	35.7	37.0	85.2
	Slightly agree	4	14.3	14.8	100.0
	Total	27	96.4	100.0	
Missing	9	1	3.6		
Total		28	100.0		

T21: In students' design projects there are few talking gestures but not fundamental issues of environmental design and sustainability					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly disagree	2	7.1	7.4	7.4
	Slightly disagree	2	7.1	7.4	14.8
	Neutral	6	21.4	22.2	37.0
	Slightly agree	10	35.7	37.0	74.1
	Strongly agree	7	25.0	25.9	100.0
	Total	27	96.4	100.0	
Missing	9	1	3.6		
Total		28	100.0		



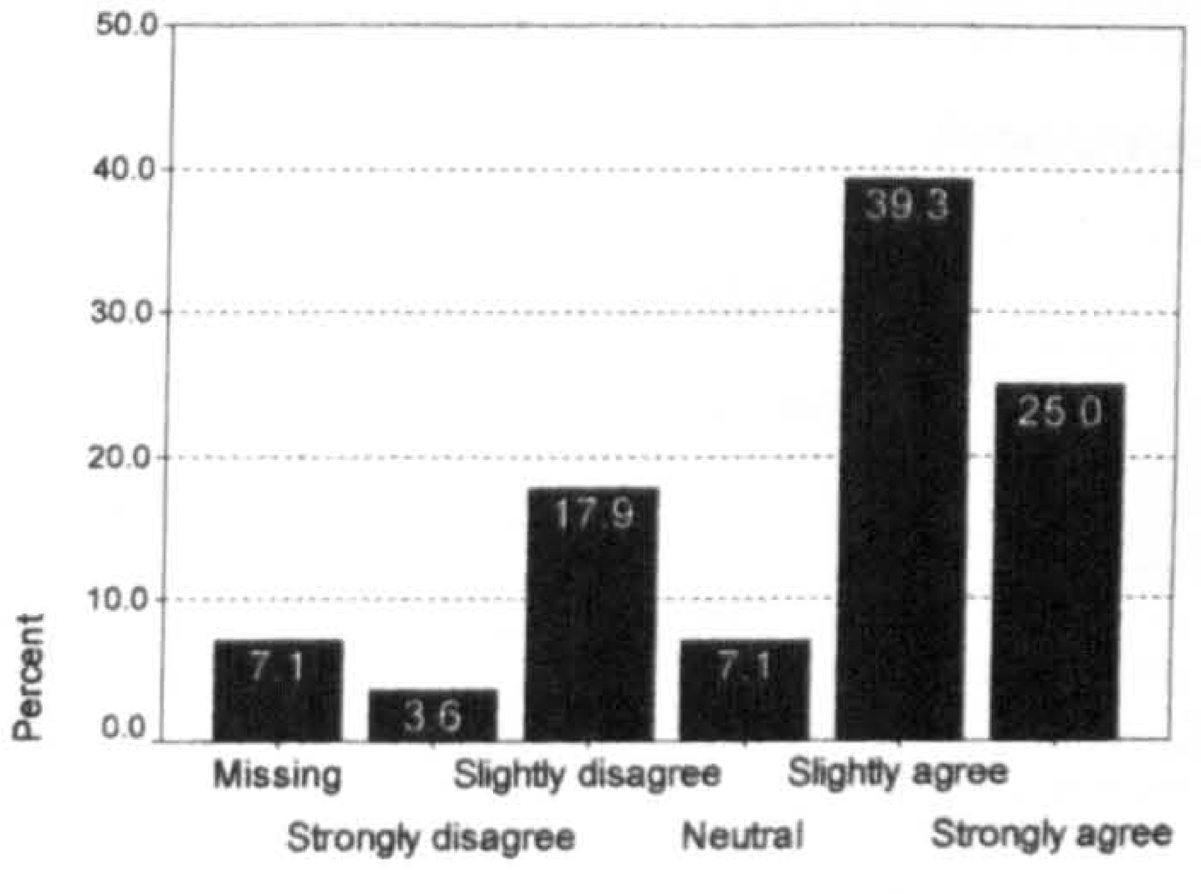
T21



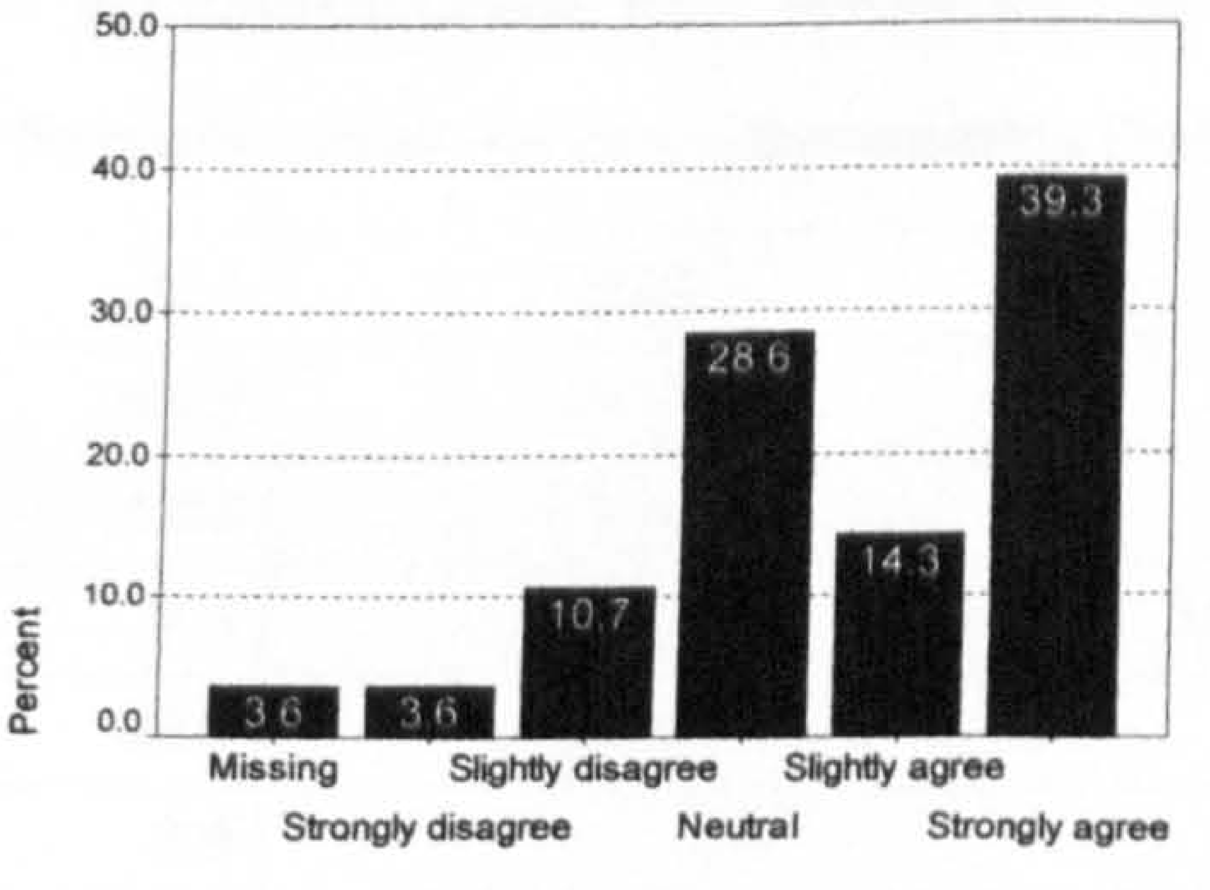
T22

T22: Students tent to avoid any subject that looks more like science					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly disagree	2	7.1	7.4	7.4
	Slightly disagree	6	21.4	22.2	29.6
	Neutral	3	10.7	11.1	40.7
	Slightly agree	10	35.7	37.0	77.8
	Strongly agree	6	21.4	22.2	100.0
	Total	27	96.4	100.0	
Missing	9	1	3.6		
Total		28	100.0		

T23: Students don't try to understand if something looks like it has anything to do with mathematics					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly disagree	1	3.6	3.8	3.8
	Slightly disagree	5	17.9	19.2	23.1
	Neutral	2	7.1	7.7	30.8
	Slightly agree	11	39.3	42.3	73.1
	Strongly agree	7	25.0	26.9	100.0
	Total	26	92.9	100.0	
Missing	9	2	7.1		
Total		28	100.0		



T23

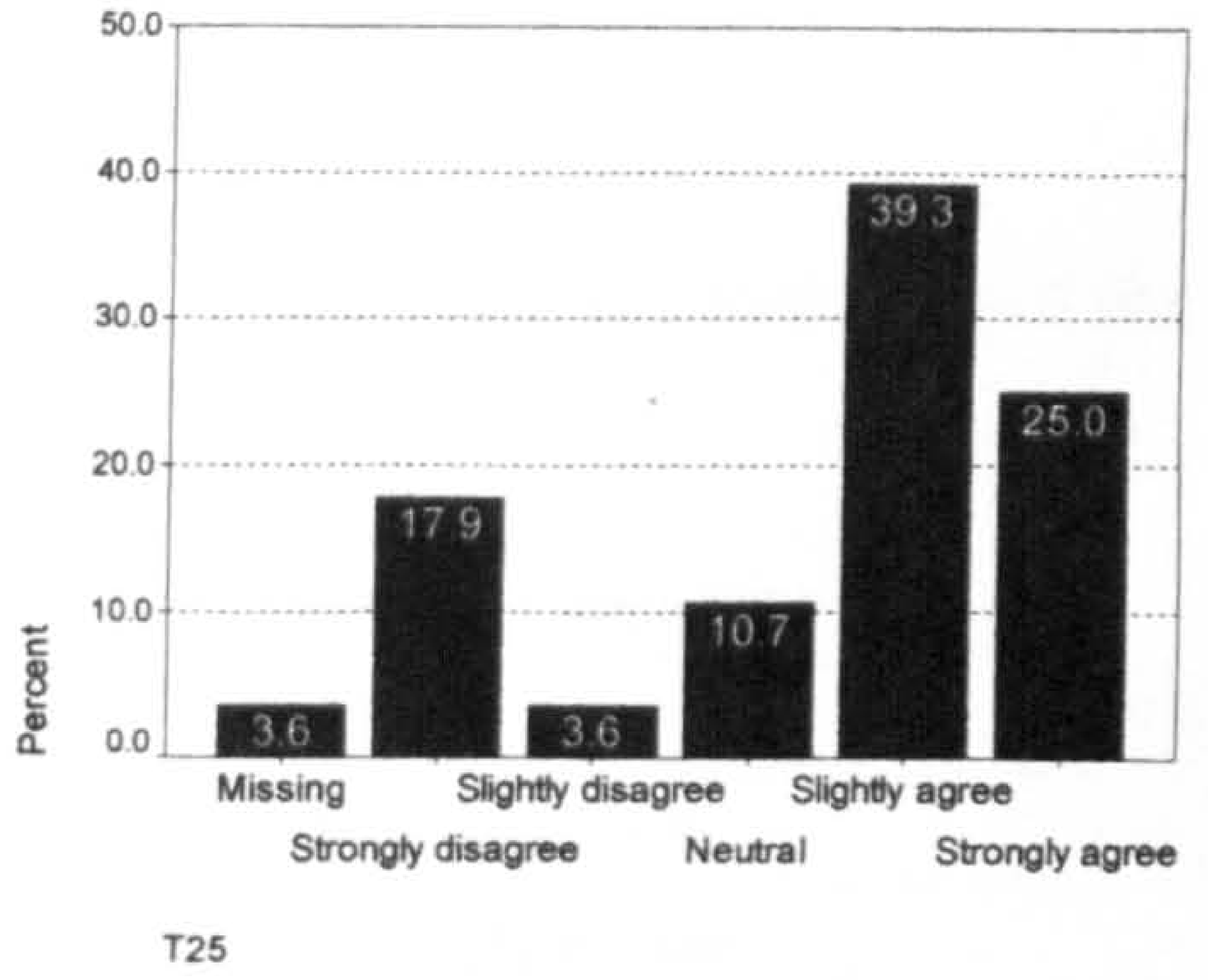


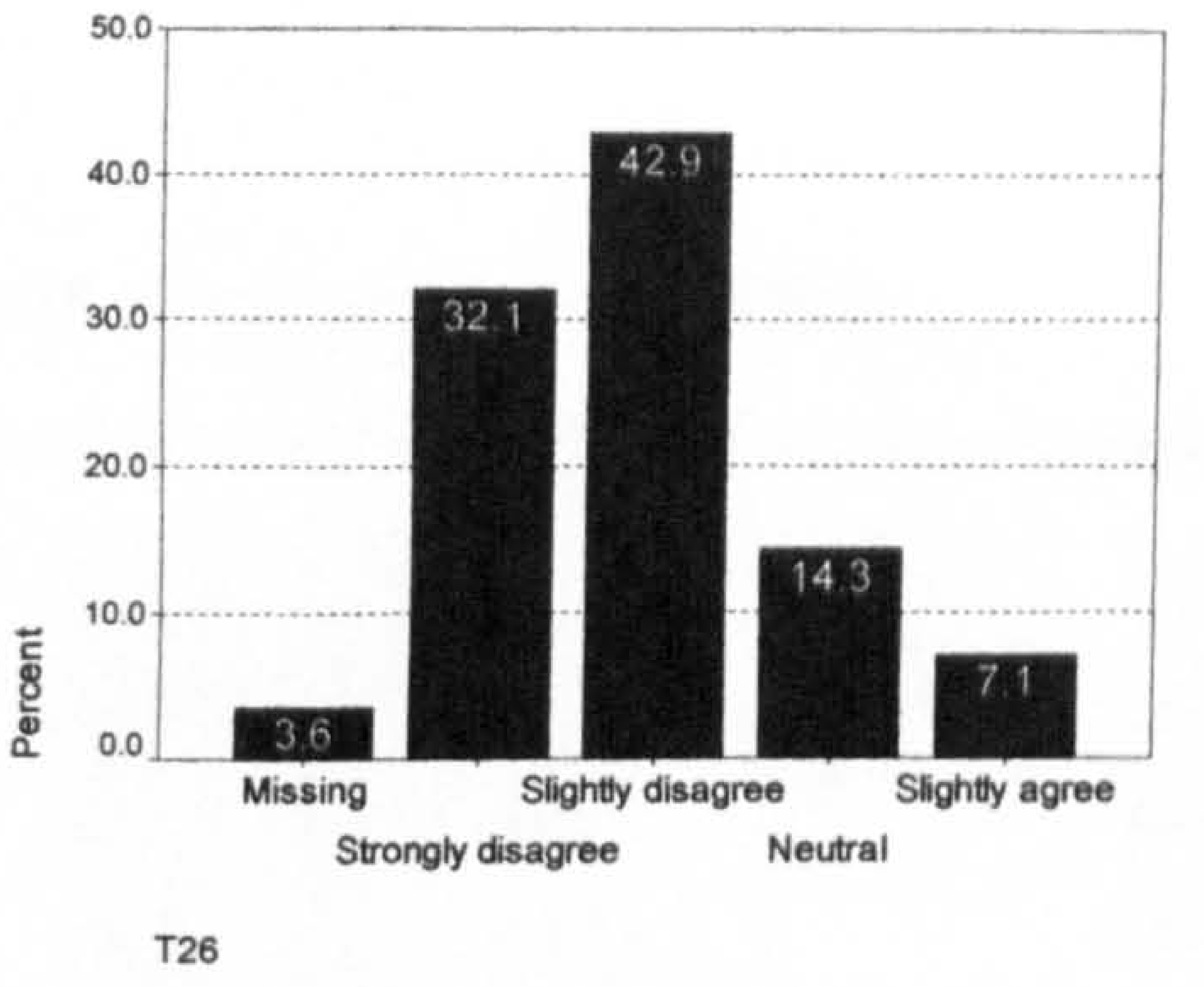
T24

T24: Environment and sustainability are part of technology subjects in architecture					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly disagree	1	3.6	3.7	3.7
	Slightly disagree	3	10.7	11.1	14.8
	Neutral	8	28.6	29.6	44.4
	Slightly agree	4	14.3	14.8	59.3
	Strongly agree	11	39.3	40.7	100.0
	Total	27	96.4	100.0	
Missing	9	1	3.6		
Total		28	100.0		

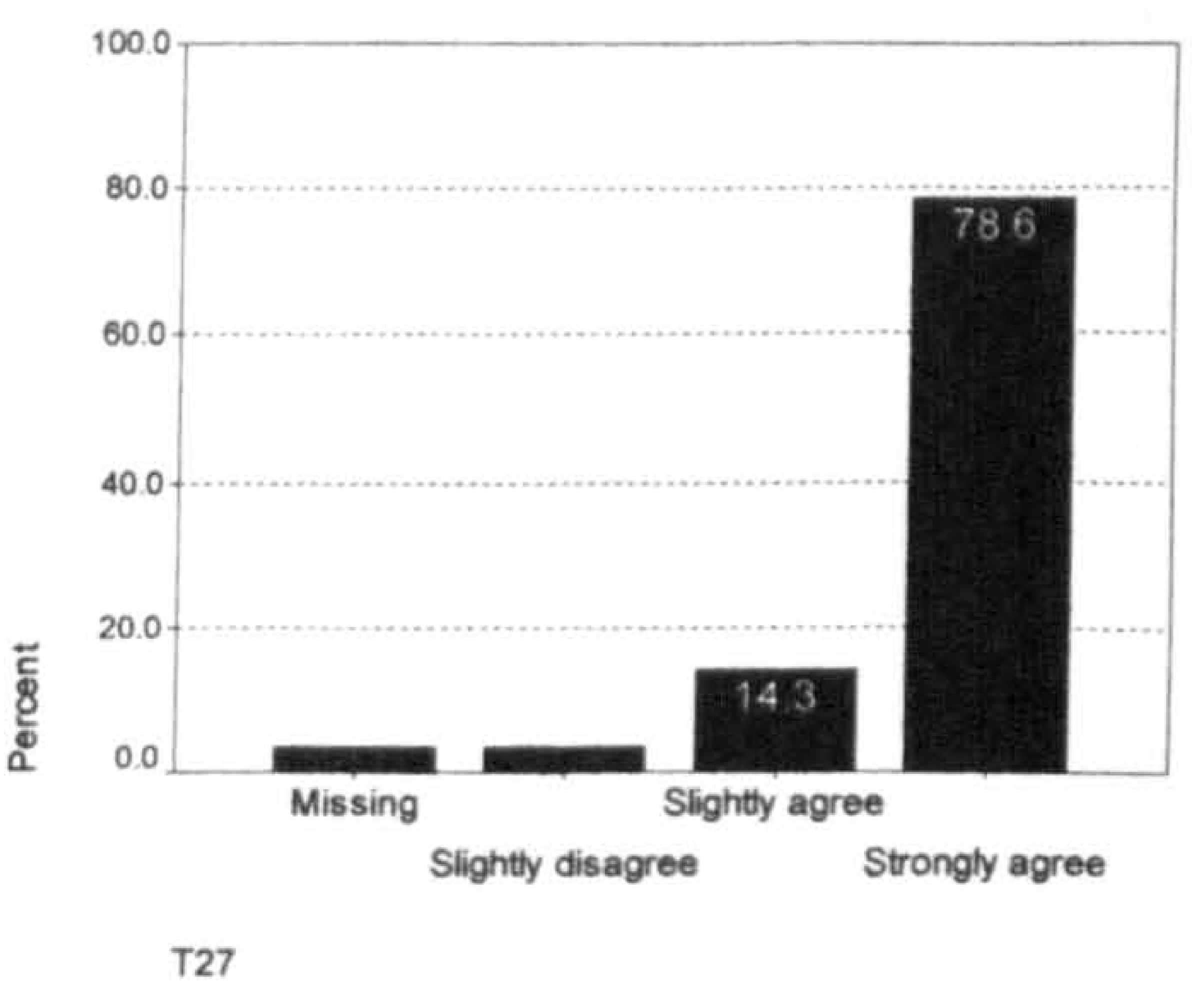
T25: Architecture is actually Environmental design					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly disagree	5	17.9	18.5	18.5
	Slightly disagree	1	3.6	3.7	22.2
	Neutral	3	10.7	11.1	33.3
	Slightly agree	11	39.3	40.7	74.1
	Strongly agree	7	25.0	25.9	100.0
	Total	27	96.4	100.0	
Missing	9	1	3.6		
Total		28	100.0		

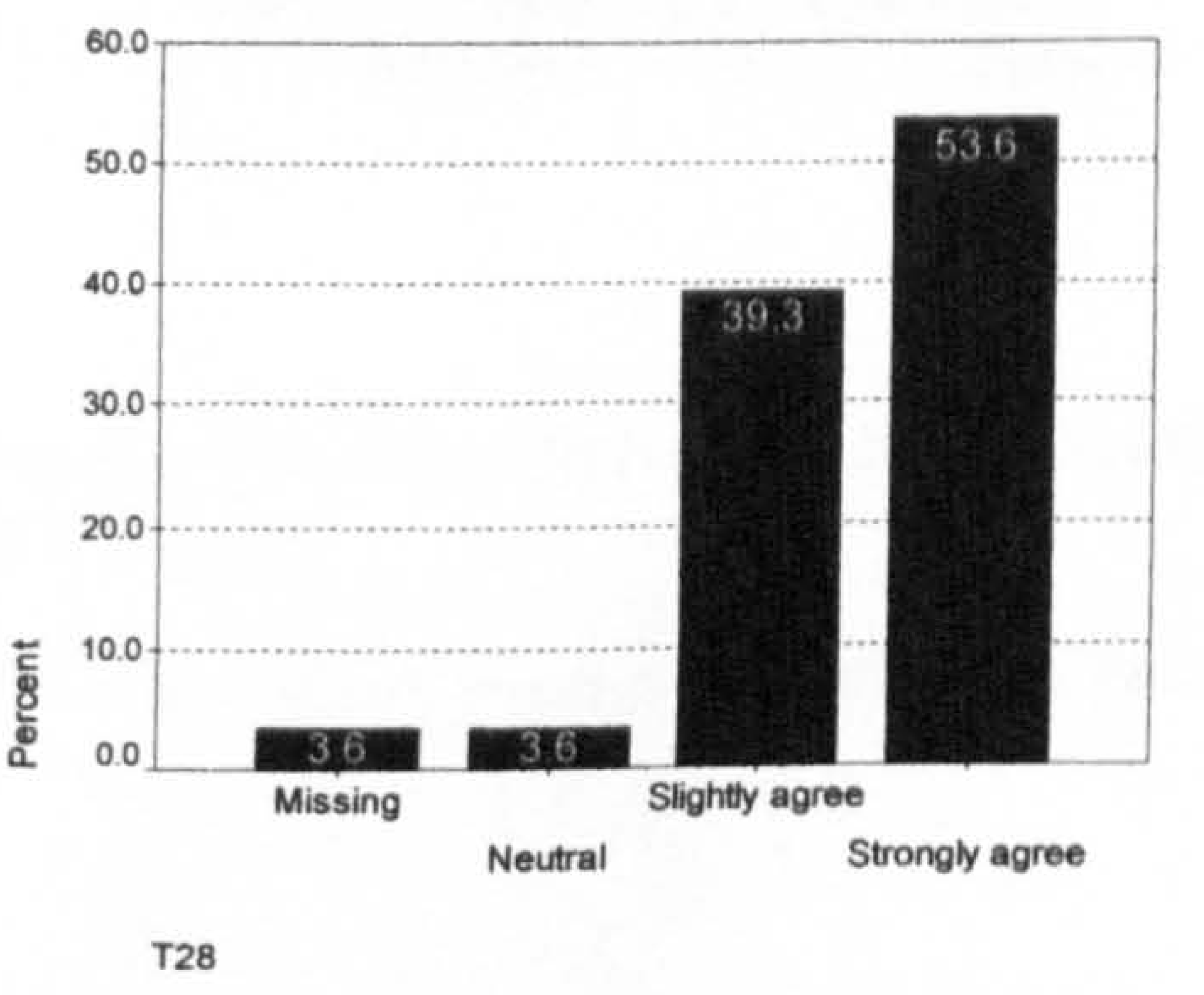
T26: In my class we talk about scientific principles rather than the design aspect					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly disagree	9	32.1	33.3	33.3
	Slightly disagree	12	42.9	44.4	77.8
	Neutral	4	14.3	14.8	92.6
	Slightly agree	2	7.1	7.4	100.0
	Total	27	96.4	100.0	
Missing	9	1	3.6		
Total		28	100.0		





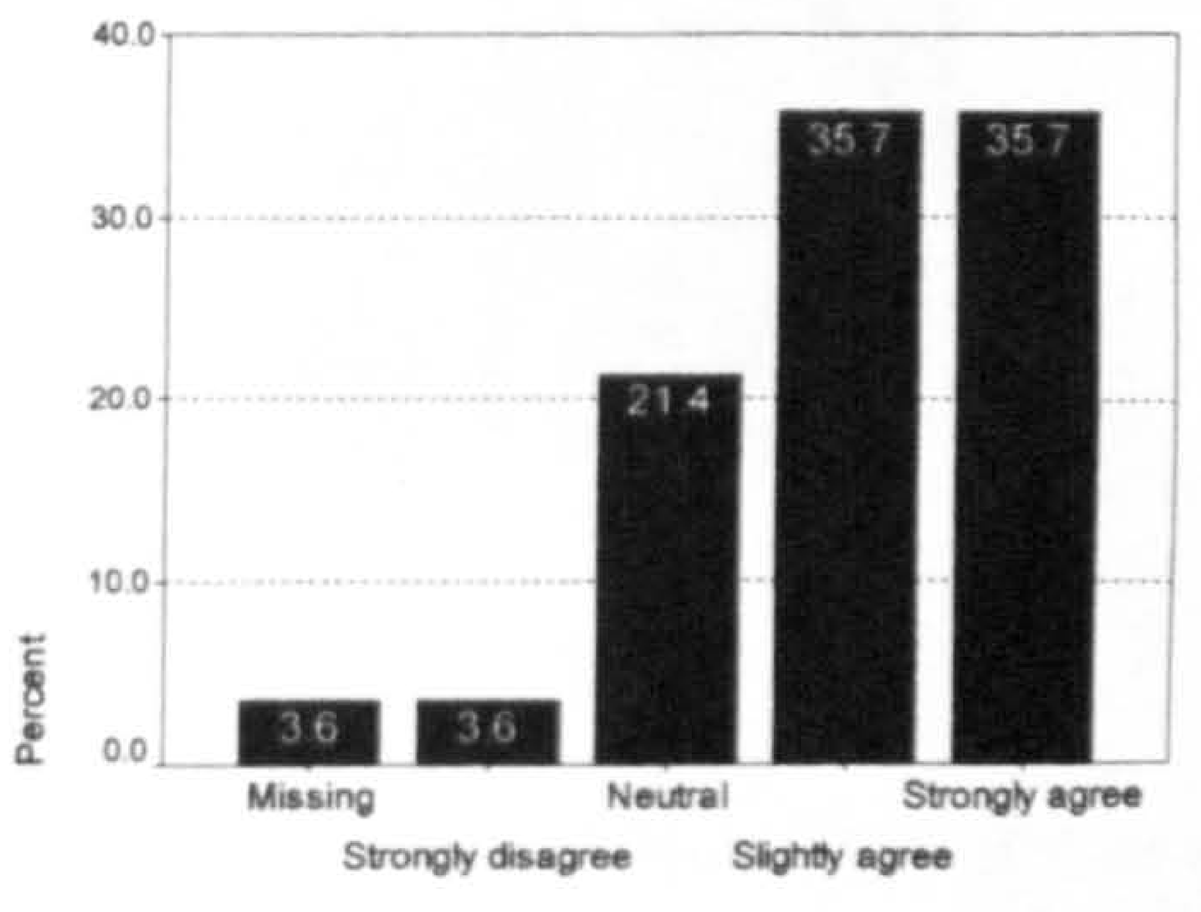
T27: We are teaching how to design things; sustainable design has to start from the first idea, its not something added at the end					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Slightly disagree	1	3.6	3.7	3.7
	Slightly agree	4	14.3	14.8	18.5
	Strongly agree	22	78.6	81.5	100.0
	Total	27	96.4	100.0	
Missing	9	1	3.6		
Total		28	100.0		





T28: Environmental design is part technology, part how to do things and a part of the history how people have done it					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Neutral	1	3.6	3.7	3.7
	Slightly agree	11	39.3	40.7	44.4
	Strongly agree	15	53.6	55.6	100.0
	Total	27	96.4	100.0	
Missing	9	1	3.6		
Total		28	100.0		

T29: I believe that we use the environment to create buildings					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly disagree	1	3.6	3.7	3.7
	Neutral	6	21.4	22.2	25.9
	Slightly agree	10	35.7	37.0	63.0
	Strongly agree	10	35.7	37.0	100.0
	Total	27	96.4	100.0	
Missing	9	1	3.6		
Total		28	100.0		



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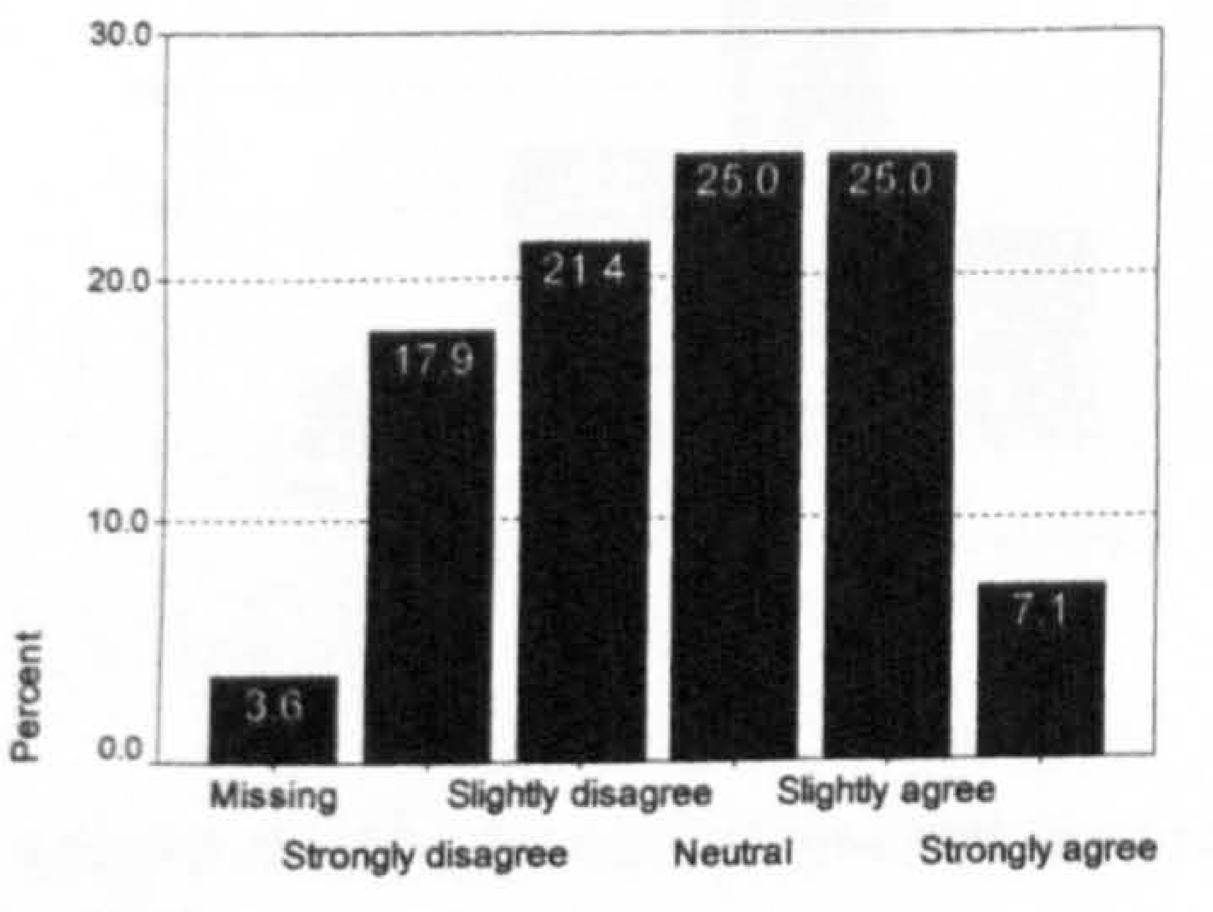
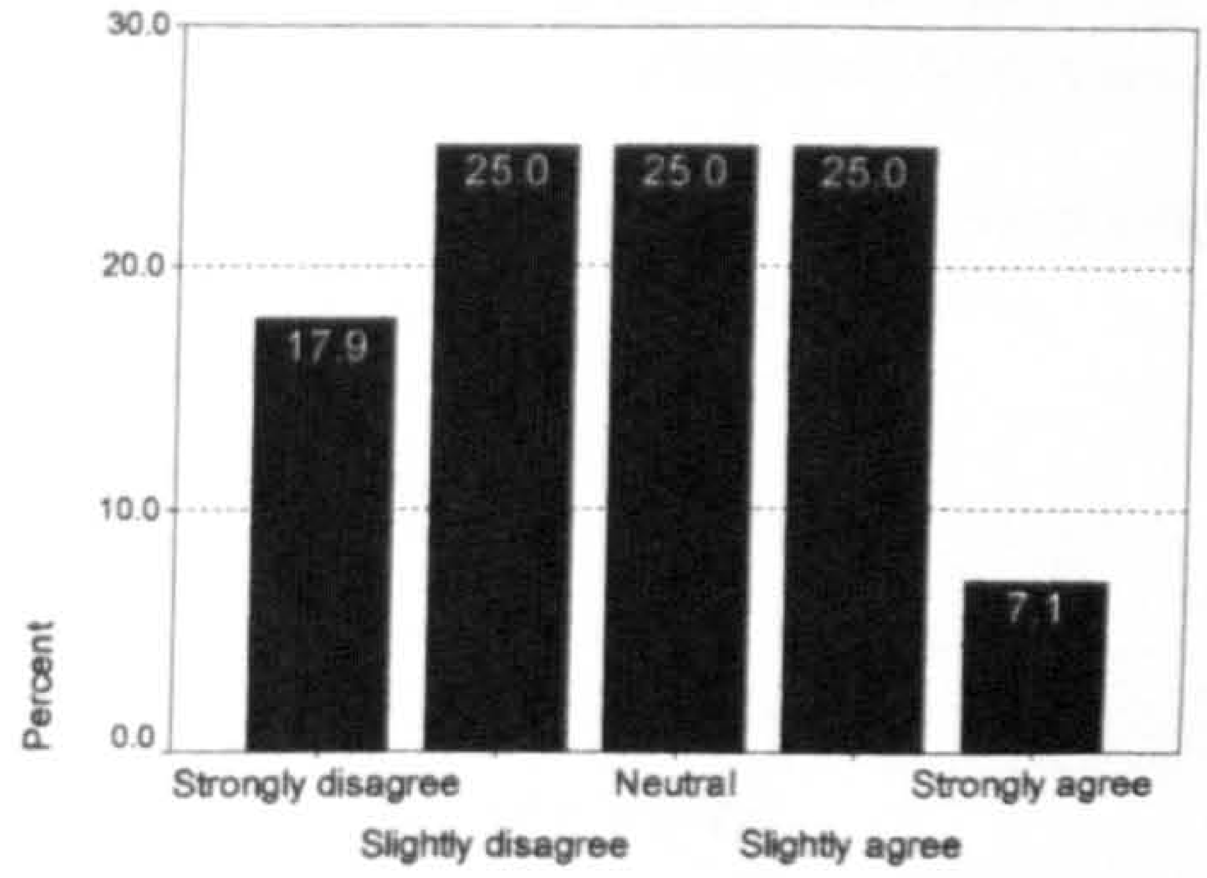


T30

T30: Environmental design classes are more about how students interpret scientific facts into their designs					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly disagree	5	17.9	18.5	18.5
	Slightly disagree	6	21.4	22.2	40.7
	Neutral	7	25.0	25.9	66.7
	Slightly agree	7	25.0	25.9	92.6
	Strongly agree	2	7.1	7.4	100.0
	Total	27	96.4	100.0	
Missing	9	1	3.6		
Total		28	100.0		

T31: Environmental design is more about a mixture of abstract philosophy and technology					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly disagree	5	17.9	17.9	17.9
	Slightly disagree	7	25.0	25.0	42.9
	Neutral	7	25.0	25.0	67.9
	Slightly agree	7	25.0	25.0	92.9
	Strongly agree	2	7.1	7.1	100.0
	Total	28	100.0	100.0	



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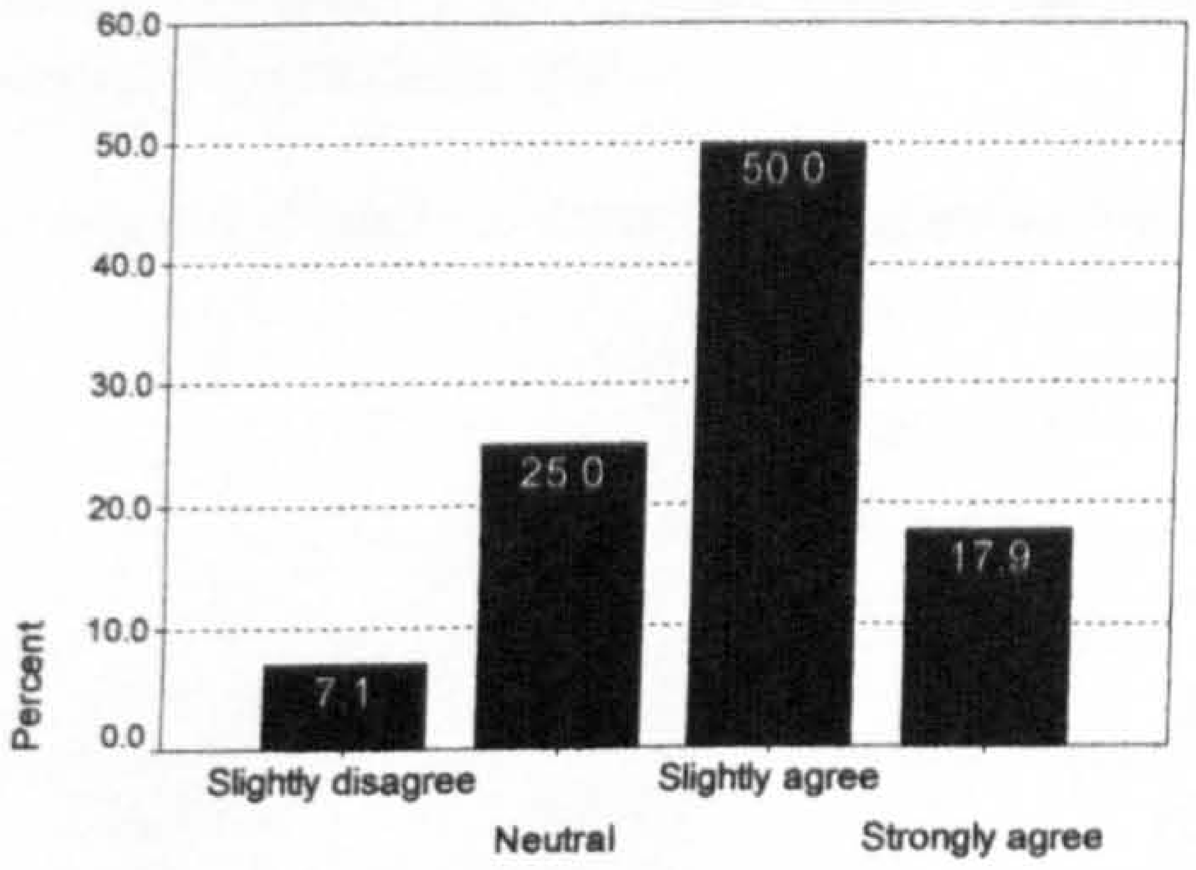
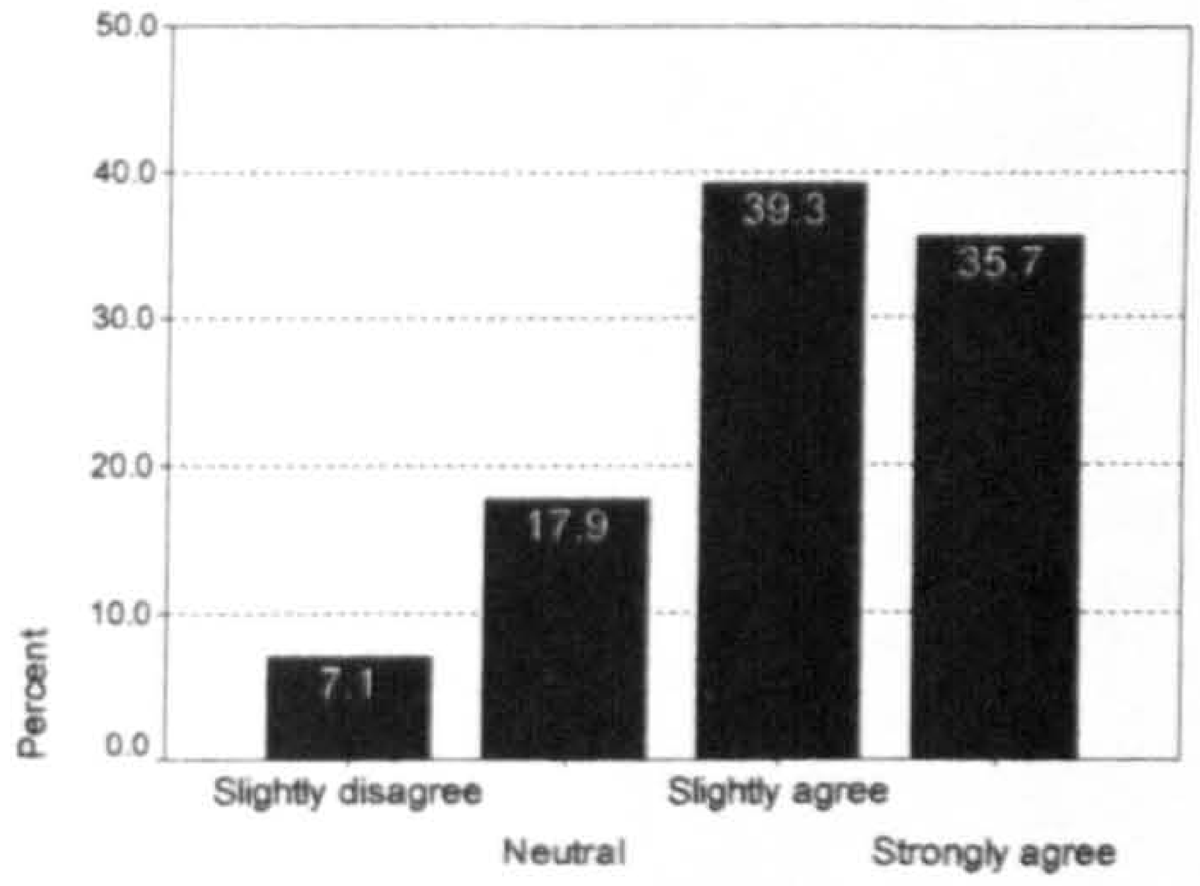


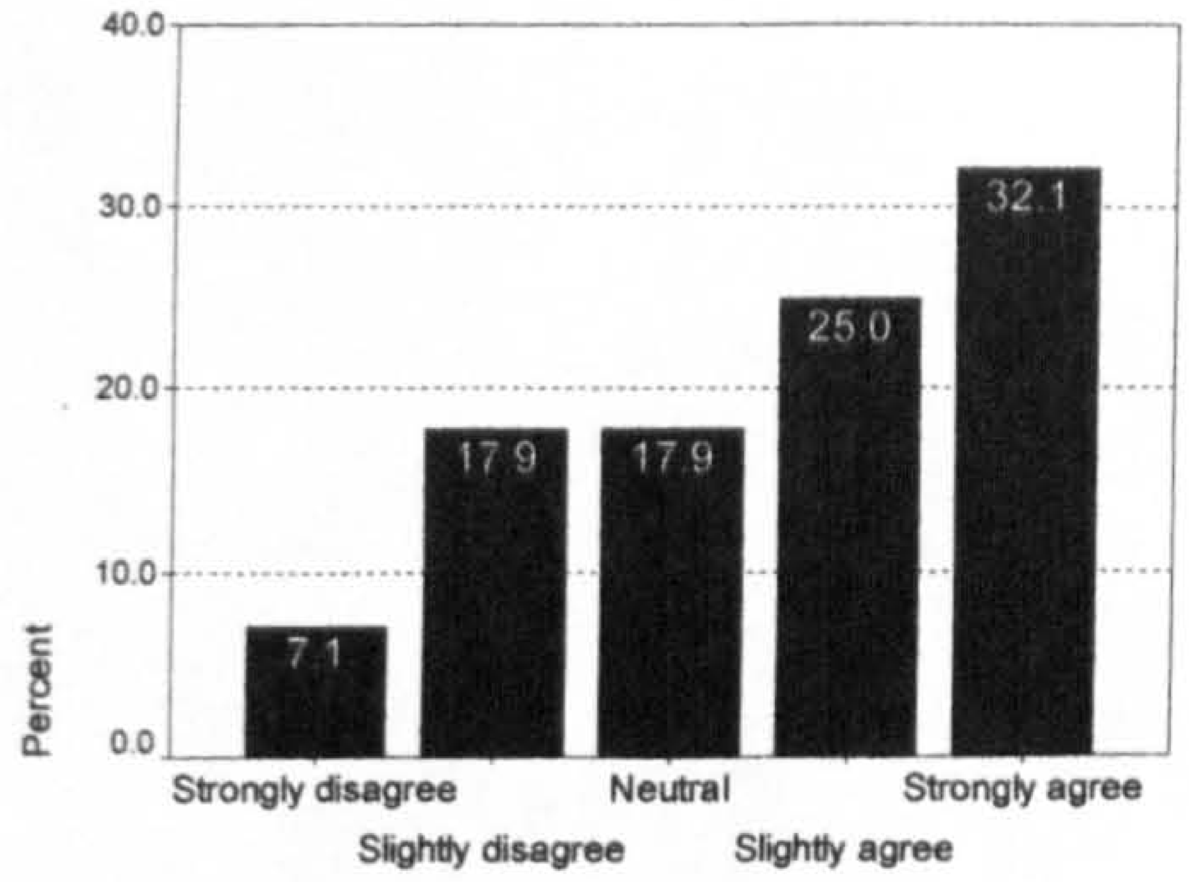
T32

T32: I think the assessment weight in the studio related to environmental issues should increase					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Slightly disagree	2	7.1	7.1	7.1
	Neutral	7	25.0	25.0	32.1
	Slightly agree	14	50.0	50.0	82.1
	Strongly agree	5	17.9	17.9	100.0
	Total	28	100.0	100.0	

T33: I find that big classes are problematic to teach environmental design					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Slightly disagree	2	7.1	7.1	7.1
	Neutral	5	17.9	17.9	25.0
	Slightly agree	11	39.3	39.3	64.3
	Strongly agree	10	35.7	35.7	100.0
	Total	28	100.0	100.0	



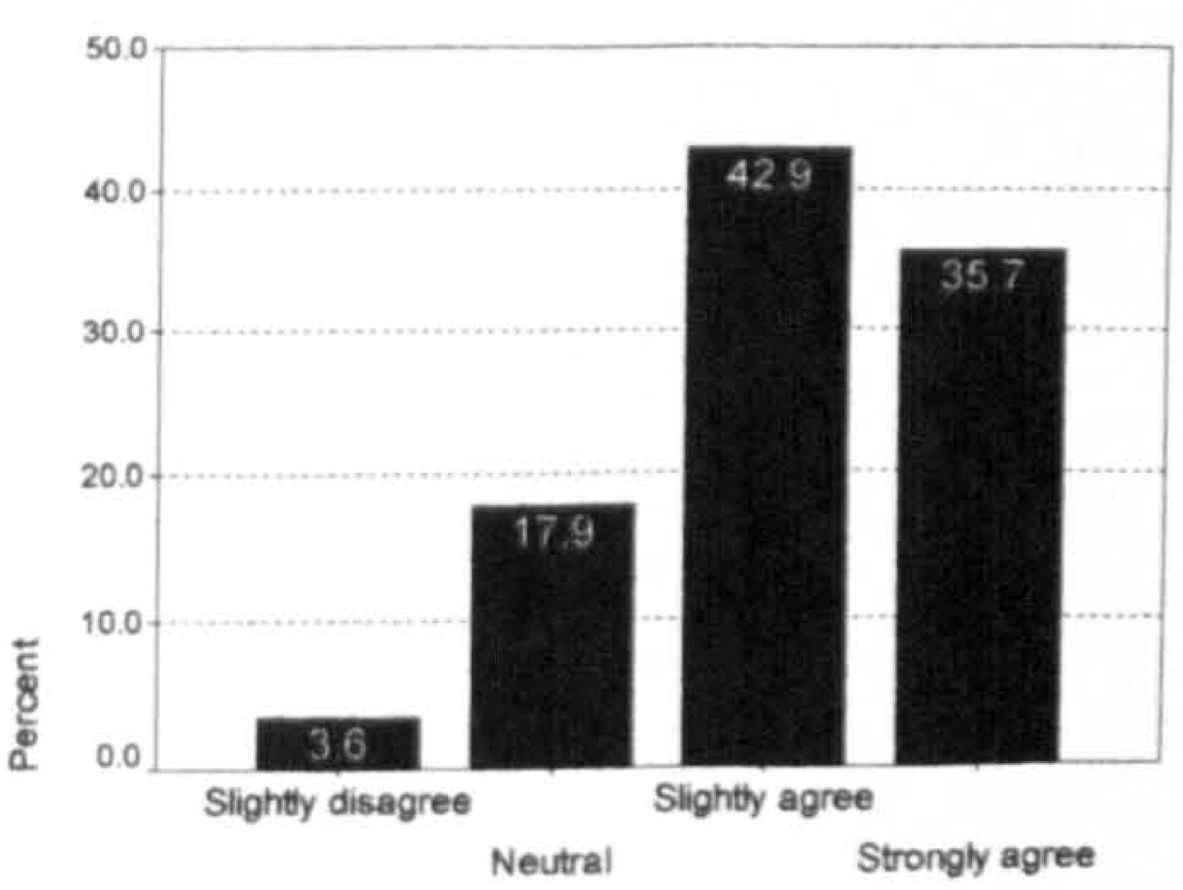
T33



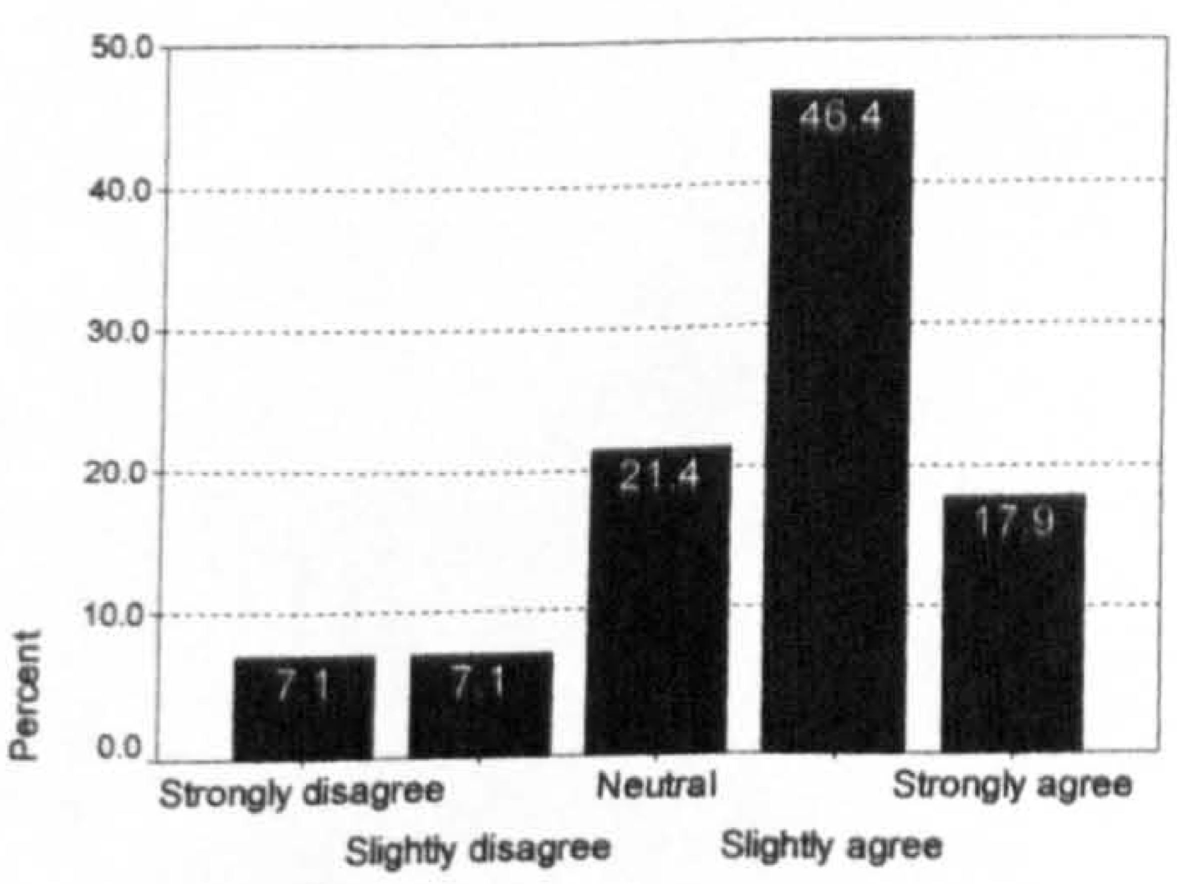
T34

T34: I think this is a design school and I think there is a reluctance for many of the design teachers to embrace technology, not only environmental sciences, but building technology, structures, etc...					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly disagree	2	7.1	7.1	7.1
	Slightly disagree	5	17.9	17.9	25.0
	Neutral	5	17.9	17.9	42.9
	Slightly agree	7	25.0	25.0	67.9
	Strongly agree	9	32.1	32.1	100.0
	Total	28	100.0	100.0	

T35: Sustainability needs more experimentation, a place where students can take risks					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Slightly disagree	1	3.6	3.6	3.6
	Neutral	5	17.9	17.9	21.4
	Slightly agree	12	42.9	42.9	64.3
	Strongly agree	10	35.7	35.7	100.0
	Total	28	100.0	100.0	



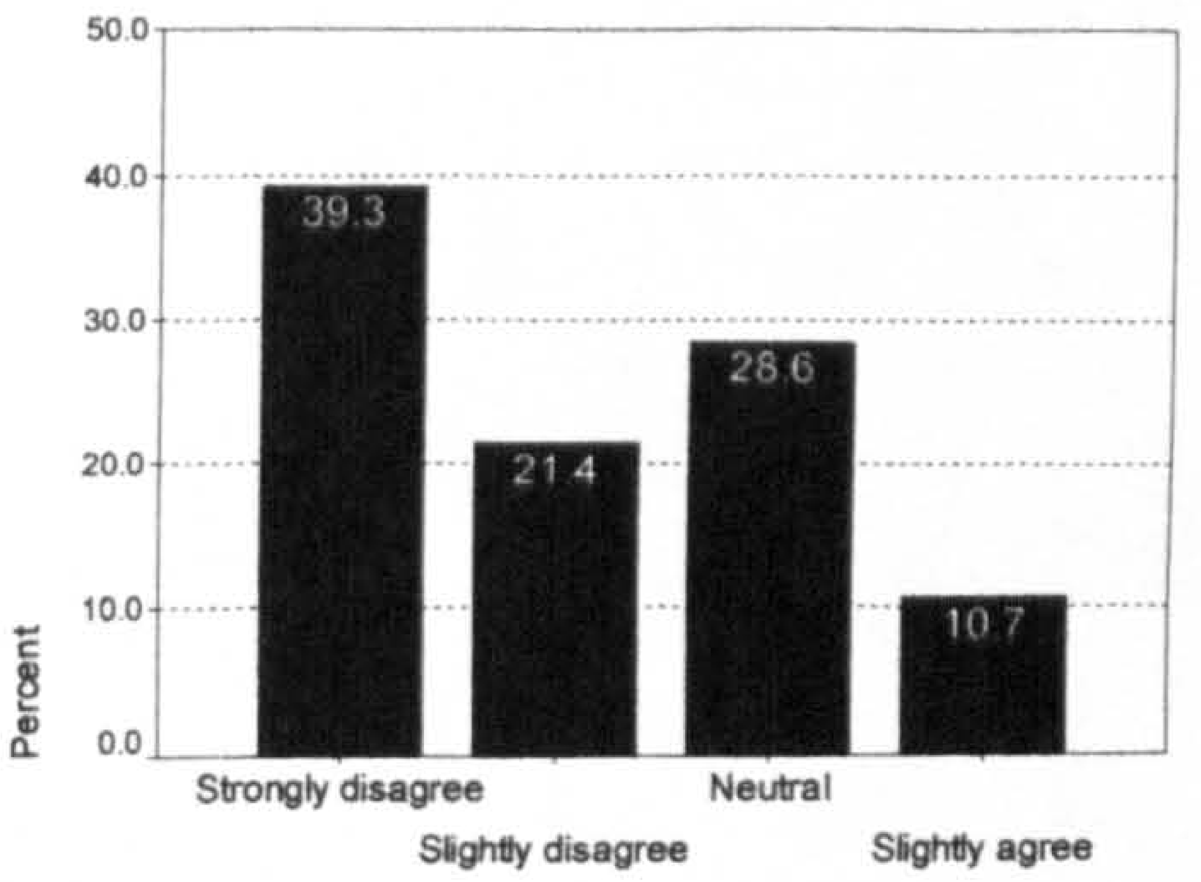
T35



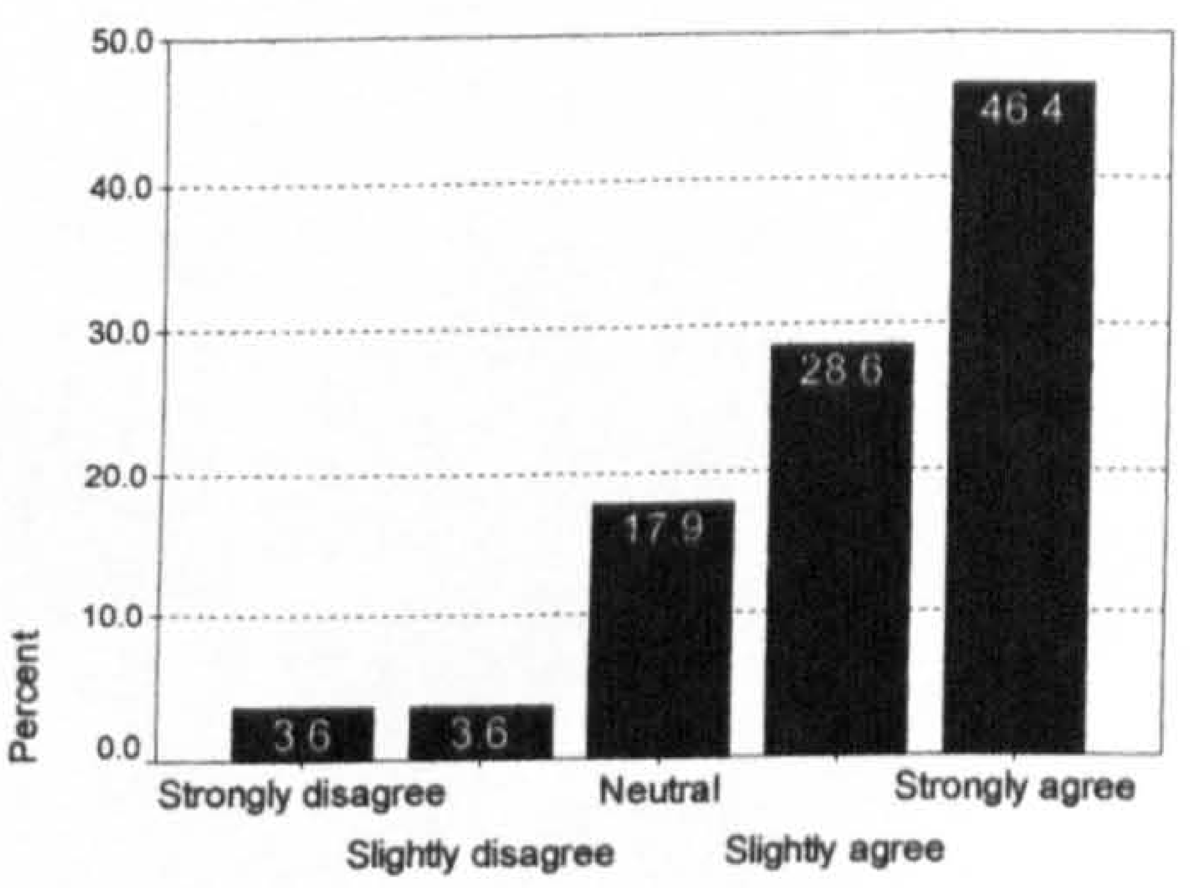
T36

T36: In general design tutors are environmentally disappointing					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly disagree	2	7.1	7.1	7.1
	Slightly disagree	2	7.1	7.1	14.3
	Neutral	6	21.4	21.4	35.7
	Slightly agree	13	46.4	46.4	82.1
	Strongly agree	5	17.9	17.9	100.0
	Total	28	100.0	100.0	

T37: We don't know the answer to sustainability, so how can we teach it?					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly disagree	11	39.3	39.3	39.3
	Slightly disagree	6	21.4	21.4	60.7
	Neutral	8	28.6	28.6	89.3
	Slightly agree	3	10.7	10.7	100.0
	Total	28	100.0	100.0	



T37



T38

T38: The structure of the school is an important element in teaching of environmental design					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly disagree	1	3.6	3.6	3.6
	Slightly disagree	1	3.6	3.6	7.1
	Neutral	5	17.9	17.9	25.0
	Slightly agree	8	28.6	28.6	53.6
	Strongly agree	13	46.4	46.4	100.0
	Total	28	100.0	100.0	