STUDENT SELECTION CRITERIA FOR THE STUDY OF ARCHITECTURE

WITH SPECIAL REFERENCE TO IRAN

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بسم الله الرحمن الرحيم

In the Name of God
the Most Gracious the Most Merciful

ABSTRACT

The underlying aim of this research is to gain a better knowledge of the relationship between the selection criteria and academic performance of the students of architecture; and the specific aim is to evaluate and improve the methods of student selection in Iranian schools of architecture. The thesis consists of three parts.

The first part (Chapters 1 to 3) prepares the theoretical ground for the study.

Chapter 1 introduces the general issues of student selection, and Chapter 2 presents a review of the related studies. To supplement the review, a survey was conducted to learn about the present state of affairs in a number of university schools of architecture. Describing this survey, Chapter Three reports differing views on the selection criteria and procedures, and the lack of objective knowledge on this subject.

The second part (Chapters 4 to 6) is a close examination of two different student selection methods in Iran by means of a qualitative and a quantitative survey.

Chapter Four describes the educational practices in Iran which form the background to the case studies. Chapter Five is a quantitative study on the relationship between selection criteria and the subsequent academic performance of the selected students. The possibility of significant non-academic differences between groups of students who were selected through two different methods, and also the predictive ability of some non-academic variables, are studied in a qualitative survey in Chapter Six.

In the third part (Chapter 7) various findings of the previous chapters are brought together.

It is concluded that the choice between alternative selection methods is more a matter of compromise than perfection. However, the research findings call into question some of the assumptions of the currently applied selection methods. For instance, little evidence was found to support the customary application of an identical entrance examination for all schools of architecture. Moreover, evidence was found for the noticeable relationship between the academic performance of the students and some non-academic characteristics which the rigid academic selection criteria tend to overlook.

Finally, some recommendations are proposed for the improvement of selection procedures for the study of architecture in Iran.

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Acknowledgement and Dedication

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I would like to dedicate this modest piece of work to those youngsters who do not receive the education they deserve.

PREFACE

In the mid-1970s, the present author was one of the students in the Department of Architecture, at Tehran University. The experience of studying architecture for me and my fellow students was very different from what our high school friends were experiencing in other higher education courses. There were two conspicuous differences: the first lay in the nature and educational methods of our courses, and the second (seemingly as a consequence of the former) was the intimate and wide-range friendships among the students of architecture which was barely comparable to that of students on other courses. As a result of such relationships every student was aware of almost every aspect of academic (and sometimes non-academic) life of his/her fellow students and vice versa. It was very easy to witness and have a good grasp of each others' performance and growth during the course.

Shortly after graduation, I was invited to join the academic family in which I had grown. This time the experience was very different. Earlier, studentship required us to be mainly good *receivers* of the material and feedback our tutors were giving us, and use them as springboards to view wider horizons or to grasp higher levels of knowledge and skill. But later as a tutor, I had to take mainly the *transmitter* role which was totally different from the earlier role. Nevertheless, one experience in my new position was very similar to what I had observed earlier in my student life.

At the time of studying the course, I witnessed how each of my classmates' level of performance in the middle or final stages of the course was similar to the level he/she had performed in the early stages. Of course there were fluctuations, and there were a couple of students who initially showed indistinctive performances but who gradually turned out to be among the top students. However, for the majority of classmates very few variations were observed.

Later, I experienced a similar phenomenon among the students whom I tutored more than once at different stages of the course. A student's performance in the second stage was hardly ever noticeably different from how he/she had performed earlier.

This often provoked a question in my mind as to what made one student perform better than another. How was it that one student showed a better grasp of the subject at hand and responded better than another?

The question that came into my mind, every now and then, was whether some students were actually more suited to studying the course than others. Since most of the students would show their potential early in the course, was it possible to find evidence for their abilities in their admission records?

As a result of a new policy introduced in 1994, questions which had formerly been merely personal ones became the subject of public discussion, at least among the educators and candidates of architecture courses. The body responsible for the National Examination for Entrance to Universities declared changes to (the unified and centrally administered) entrance examinations for architecture courses. The previously administered design related sub-exams were removed, and more emphasis was placed on scientific subjects.

As could be expected, a new kind of entrant gained admission to university schools of architecture. At first it was not easy to comment as to whether the new students were better or worse than the previous ones. But as this new generation of students went through their study, contrasting appraisals of their suitability for studying architecture emerged among their educators. Some teachers were happy that their new students were more diligent and disciplined than previous students. Others complained that their new students lacked a proper grasp of the course, and were overly inclined to mechanical approaches.

Bearing in mind the questions above, the emergence of differing (and subjective) views among the educators encouraged me to investigate the relevance of student selection criteria for the study of architecture through a systematic study. In this regard, the consecutive occurrence of different (i.e. the old and new) selection methods was an opportune occasion, because it prepared a proper ground for a comparative study (the advantage of this approach is discussed in more detail in Chapter 1). Therefore, the operational aim of the present study was based on the comparison of the two methods through the investigation of their (academic and non-academic) outcomes, and the main body of the thesis was allocated to this. It was believed that this comparative approach would also pave the way for arriving at recommendations for the improvement of the current student selection processes.

Before proceeding, I would like to make two points, especially for prospective researchers and end users who will become involved in the matter of student selection. One is the frequent instances of encouragement and threat one may face in this kind of research, and the other is the importance of our initial expectations of the findings in this area.

Encouragement arises from the fact that this area, despite earlier studies, is still new and demands further investigation. Many studies on similar subjects exist in the literature on education. However, the findings are still limited and partly questionable. As regards the specific case of architecture, only a small number of disseminated studies are available. Therefore, there are numerous issues to be explored and discovered.

Threat to this sort of study lies in the complicated nature of the factors involved. A multitude of factors which defy monitoring and measurement may influence our observations and distort the results. It is very difficult to detect and establish causal patterns among the variables studied. Klitgaard (1985, p153) quotes one of the Harvard Deans of Admission who wrote, in a letter to his college's President, about student selection after his long established experience in that area. A telling piece of the letter is as follows:

> *The factor that kept me excited during my twenty-five years in admission was the mystery in human growth and development. ... My work for many years as Dean of Freshmen enabled me to test my selections. I had hoped to master the art of human assessment. I didn't.*

In connection with this sort of study, then, one's expectations of the outcomes can lead to frustration or courage. For those who seek exact and formulaic answers to selection questions, few satisfactory results may be found. However, for those who are ready to face the uncertainties of the field, and think that the non-determinative findings may also contribute to the improvement of methods, the field seems worth exploring.

CHAPTER 1

Introduction and General Issues

Chapter 1

Introduction and General Issues

The Outline of the Chapter

This chapter consists of three sections. The first section introduces the outline of the thesis.

The second section firstly discusses the importance of the subject of student selection. After a glance at historical cases of selective exams/tests, the section reviews some of the typical previous studies in this field in order to provide a general perspective of the studies and their findings.

The third section deals with several technical problems which either affect the design and application of selective exams, or influence the study of their predictive ability.

1.1. The Aim and Structure of the Thesis

1.1.1. The Aim of the Research

The practical objective of this work is to improve the methods by which students are selected to enter undergraduate courses in Architecture in Iran. The underlying aim is a better knowledge of the relationship between pre-university (entrance) tests and the later academic performance of students.

The study is focused on a significant change to entry examinations which took place in Iranian architectural education. A traditional method which included drawing and design-related tasks was replaced with a method which relied mainly on mathematical and scientific abilities. This gave an opportunity to study, in three schools of architecture, the performance of successive cohorts of students who were selected on different criteria but followed broadly unchanged courses. The thesis compares two different student selection methods by means of the academic and non-academic consequences of the two systems.

1.1.2. Background to the Problem

The change in entry examinations led to differing subjective views about the 'relevance' of the new method and its relationship to the abilities and skills which students are required to develop during the course.

The term 'relevance' can have different interpretations, and thus calls for dissimilar approaches to the problem. More details about this and specific questions of our investigation will be given below. Suffice it here to say that the dominant interpretation of 'relevance' in studies similar to ours concerns the ability of the selection method to 'predict' the future performance of the selected students. In other words, the principal attention is paid to the 'predictive validity' of the selection methods/tools. Below, however, an additional interpretation is introduced, and the subject is pursued from two viewpoints, involving both the conventional and additional interpretations.

1.1.3. Structure of the Thesis

This thesis consists of three major divisions or 'parts'. Briefly, Part One prepares the theoretical ground, Part Two investigates the subject empirically, and Part Three concludes the research. These three parts comprise seven chapters altogether. A general view of the progression of the research and content of the chapters is given below.

The topic of our research involves two contexts. One is the actual *local* context (Iran) which brings its related prior and higher education particularities to bear on the subject under study, and the other is the *theoretical* context in which our study occurs. Related previous studies, methodological points, and such materials which can enhance our approach to the problem fall into the latter context. The first step of the research, was allocated to the identification of the sources and the collection of information related to this theoretical context (Figure 1.1). The outcome of this shaped Chapters 1 and 2 of the thesis.

de Vaus (1996, p29) suggests four types of sources which can provide useful information about the factors involved in the subject of research. They are: (1) 'previous research', (2) 'the facts', (3) 'our own hunches', and (4) 'talk to informants'. The present author benefited from all these kinds of sources in the course of this research.

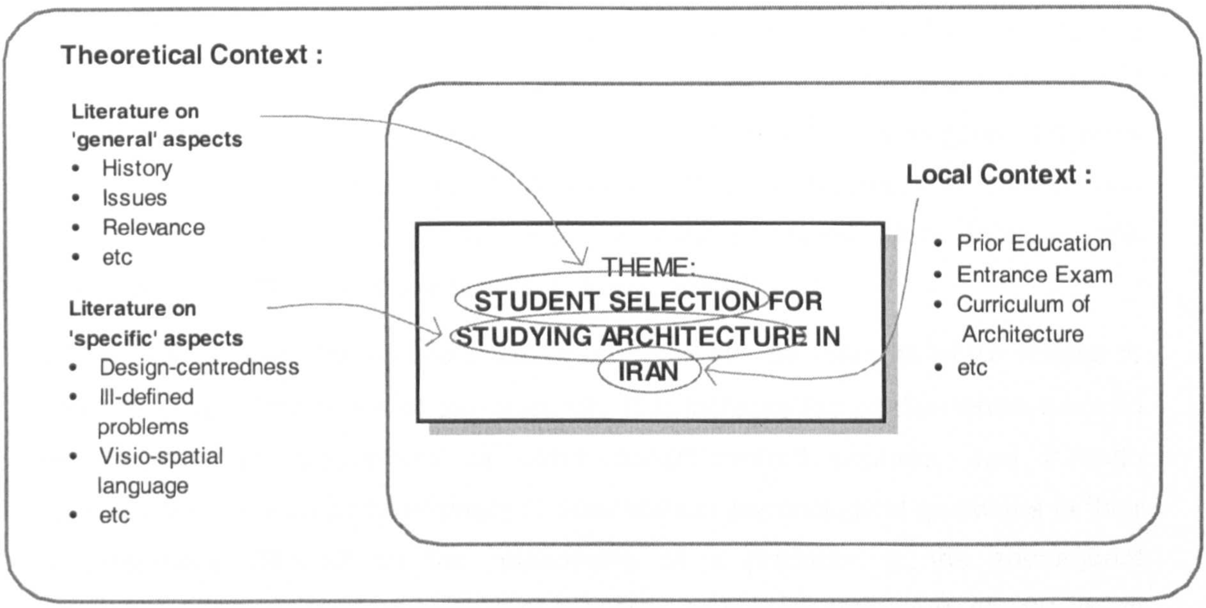

Figure 1.1. Contexts involved in the present research

In order to identify relevant 'previous research', available databases were consulted and a number of scholars were questioned about relevant pieces of literature of which they might have been aware. By employing a range of relevant keywords, available databases and catalogues were searched. These ranged from the most familiar resources, such as accessible universities' library catalogues; the British Library, and Library of Congress catalogues, Index to Theses, and Dissertation Abstracts databases to more specialised resources such as the BEI, BIDS, Architectural Publications Index, and the Allison Research Index of Art and Design (ARIAD).

Two sorts of sources emerged: 1) the literature which was related to the 'general' dimensions of our work; and 2) the literature which contributed to the 'specific' aspects of the present research (see 'theoretical context' in Figure 1.1). This latter kind, however, was unexpectedly limited; published studies which had a similar interest to that of our study, and which focused on architecture or its cognate courses especially were extremely rare.

The review of the first kind of sources is mainly incorporated in the following section of this chapter.

Chapter 1 then, after presenting the outline of the thesis, deals with a series of introductory, and background issues which prepare the ground for the following chapters of the thesis. Firstly, a general view is presented of the subject matter of student selection. Secondly, instances are given of the classic and general studies which examined the relationship between conventional selection criteria and subsequent performance. Finally, some technical problems, which influence the practice and study of selective exams, are described.

Chapter 2 reviews the second class of sources, i.e. the material which relates to more 'specific' dimensions of our research. This includes the studies which focused on students of architecture or other design-centred courses, and through quantitative means sought answers to academic or psychological questions in their investigations. Studies on the relationship of a predictor to the subsequent academic performance of architecture students, or investigations into psychological differences between the students of design and other people are such instances.

Chapter 3 is allocated to a survey of admissions tutors in schools of architecture. As mentioned above, the number of systematic studies directly related to this research was very limited. Therefore, it was thought that the experience and views of those who were practically involved in student selection affairs were potential resources which could contribute to our study (corresponding to de Vaus's fourth class of sources, mentioned above). With this goal in mind, a number of admissions tutors in British and international schools of architecture were addressed through a questionnaire. Chapter Three describes the design and outcome of this survey.

Chapters 1 to 3, constitute Part One of the thesis which prepares the theoretical ground for the second, or empirical, part of the research. These chapters help to achieve the following purposes:

- Recognition of key issues.
- Identification of the methods applied for research in this field.
- Communication of the previous findings.

Chapters 4 to 6 form Part Two of the thesis which involves the empirical investigation of the subject through specific cases. To provide a clear image of what was mentioned above, and what follows, the different 'parts' of the thesis, their constituent chapters, and the relationship between them are shown in Figure 1.2. Before the examination of our specific cases, it is important to introduce the particularities of the 'local context' in which the cases fell.

Chapter 4, therefore, represents the local circumstances and factors which, explicitly or implicitly, influence the specific cases, and consequently, our study of the cases. The characteristics of Iranian secondary education, the centralised system of student selection, and the curriculum of architecture courses are the main subjects discussed in Chapter 4.

The remainder of Part Two consists of two (quantitative and qualitative) surveys conducted in order to compare the two student selection methods through their outcomes.

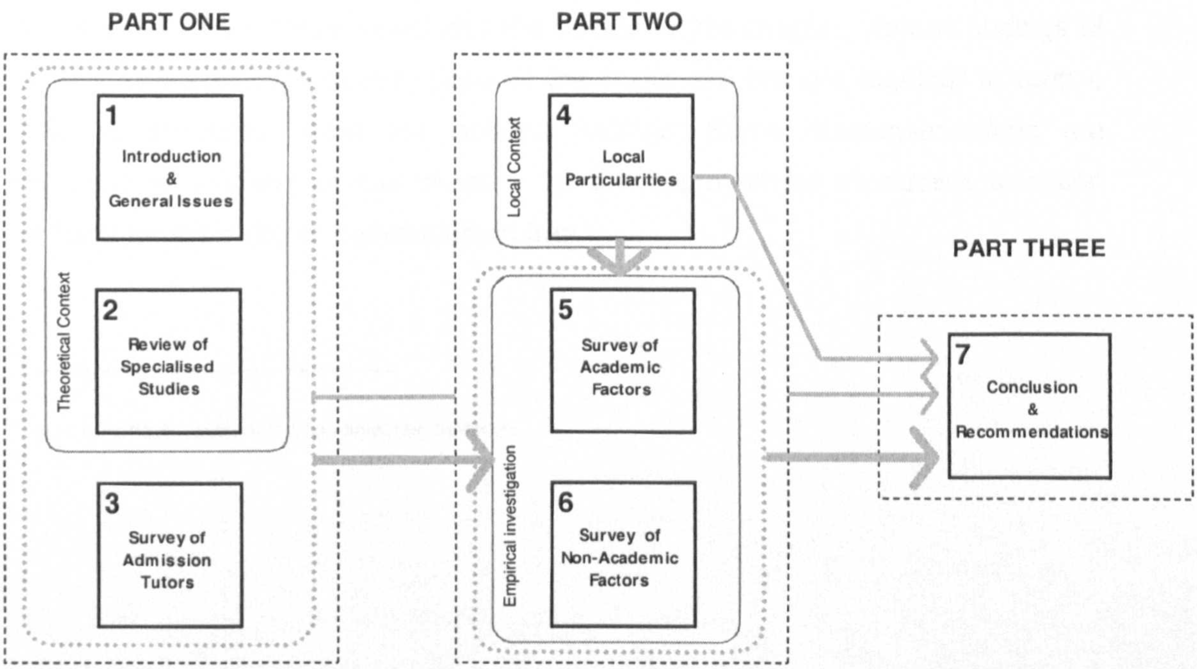

Figure 1.2. Constituent Parts and Chapters of the Thesis

Chapter 5 reports the method used in, and results of, the quantitative survey. By the application of both the entrance examination and university records of six cohorts[1] of architecture students, the survey investigates the relationship between the student selection criteria and the academic performance of the students over the course. By means of common statistical tools, this relationship is analysed from two contrasting perspectives to enhance our evaluation of the selection methods.

Chapter 6 describes the qualitative (questionnaire) survey which attempted to identify the non-academic differences between the students of the two selection methods. In the review of previous studies evidence was found for the existence of important non-academic differences among the students of different disciplines. It was decided, therefore, to investigate whether non-academic differences were also associated with the two selection methods, and to discover whether such non-academic characteristics showed any relationship to academic performance. The description of the questionnaire, its administration and results are included in Chapter 6.

Chapter 7, or Part Three, concludes the thesis. In this chapter, various findings of the first and especially second parts of the thesis are brought together to form a coherent conclusion from the isolated findings. Some recommendations are proposed, at the end of this chapter, for the improvement of student selection methods for the study of architecture in Iran.

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[1] Three cohorts for each of the two selection methods.

1.2. An Overview of Student Selection

1.2.1. Student Selection, Right, and Merit

Everyone has the right to education. Education shall be free, at least in the elementary and fundamental stages. Elementary education shall be compulsory. Technical and professional education shall be made generally available and higher education shall be equally accessible to all on the basis of merit.

Paragraph 1 of Article 26, the Universal Declaration of Human Rights

The passage above is part of the man-made charter on which there is the most widespread agreement, and it clearly asserts everyone's unquestionable right to education. It addresses and responds subtly to the problem of the excessive gap between demand for higher education and the availability of places and resources. The Article has foreseen implicitly that the inevitable need for the application of selective or screening processes will persist. Yet the Charter has striven to extend its core notion of equal rights to also include peoples' higher education.

Although the Article stipulates 'merit' for eligibility for higher education, it does not waver in its emphasis on the equality of opportunity of higher education for those who do 'merit' it. This places a great burden of responsibility on the bodies in charge of student selection.

Various student selection processes have been practised so far in different countries or educational settings placing dissimilar weights to the equality or merit dimensions. The 1978 European symposium on the subject of admission to higher education (held in Bad Homburg, Germany) provided a forum for fourteen participating countries to introduce their approaches to the subject and discuss the challenges they faced.

In the symposium, Hofstee (1979, p66) reported the common use of a weighted lottery method (in which chances were weighted according to grade point averages) to select students from among eligible candidates for entrance to universities in the Netherlands. The rationale behind the system, he stressed, was a political compromise between 'unconditional equality of applicants and meritocracy'. At the same time, in Belgium, as in France, the main policy was open access to most higher education courses, followed by high rates of dropout especially at the end of the first year. Bonte (1979, p54) claimed that there was a general agreement in Belgian university circles that 'examinations at the end of the first year [were] the least harmful and least unfair, albeit the most costly procedure of selection.' In the same context, the German education system gave the most importance to high school leaving certificates for admission to universities, and in countries such as Greece national entrance examinations were administered.

At present, on the one hand, there is an effort to expand and diversify access to higher education; on the other, the increase in the adoption of more selective admission methods is observable in comparative international studies on higher education policy. Subsequent editions of the Higher Education Policy (by the International Association of Universities) show that countries which had previously had more liberal processes of access to higher education have tended to adopt more strict policies than before.

Harman (1994) drew upon a World Bank report to stress the importance of the selectivity issue in a regional Asian context. The report comments that:

> *To educate their students effectively, institutions should be able to enrol only as many applicants as they can responsibly teach, and to accept only students who possess the knowledge and ability to fully benefit from their studies. Selectivity should help ensure that enrolment growth is related to instructional capacity and, if selection criteria have good predictive validity, that opportunities for further study will be allocated to those who are most likely to benefit academically. Students perform best when they follow courses of study that match their abilities and interests.*
>
> *(The World Bank 1993, p.32)*

Goedegebuure (1993, p1) highlights the increasing intervention of governments in higher education systems to 'ensure greater economic efficiency, quality of outcome, student access and accountability' by referring to them as 'the magic words of modern day higher education policy-making.'

It appears that the issue of balance between 'equality' and 'merit' for gaining access to higher education is an ongoing problem. The critical point in this equation involves the definition and measurement of merit. The definition dimension is inevitably connected with political views and varies in different societies. Where merit is defined in terms of academic suitability, however, its measurement becomes a technical task which falls in the area of educational assessment.

In the present circumstances of extensive demand for access to higher education, and the application of more selective processes, a larger percentage of candidates may be denied access to their favourite courses. To observe the principle of equality then, the relevance of student selection criteria and the methods of assessment of a candidate's suitability for studying a certain course is of prime importance, because the outcome is a sort of judgement about a person and this may have consequential effects on his/her life.

This importance is usually pronounced in the works of researchers who investigate the very subject of student selection, or educational assessment methods from a comprehensive viewpoint.

In the opening of his inclusive investigation of the subject (i.e. relevance of student selection criteria and processes) at Harvard, Klitgaard (1985) maintained that '[h]ow young people are chosen for the fast track says a lot about a university or a corporation or, for that matter, a nation. It is a sign of how the institution thinks about efficiency, about mobility and justice'. In a broader context of educational assessment (not limited only to student selection, but including it) Rowntree (1994, p1) held the view that '[i]f we wish to discover the truth about an educational system, we must look into its assessment procedures.' Gipps and Stobart (1993, p25), in their examination of assessment theories and the pros and cons of assessment methods, stressed that: '[t]here are many limitations, and some dangers in assessment. There are also a lot of uses, many of them valid.' Admitting the fact that educational systems are wedded to assessments of one form or another, they continued that 'it is important to know and to understand the disadvantages so that we can make the best job possible of assessment'.

Despite the importance of assessment for selection, isolated pieces of evidence indicate that the problem of relevance of selection criteria (in both educational, and social areas) has been a perennial problem.

Below, after a glance at a couple of historical instances of selective exams or tests, we will focus on examples of studies which investigated the relationship between the common measures of student selection and academic success in higher education to see if a convincing relationship exists.

1.2.2. Instances of Selective Exams in the Past

According to Gardner et al (1996, p12), the Chinese's civil service examinations are known as the most long-lived systematic selective examinations. The examinations which dated back to the seventh century had been applied systematically (through several local, provincial, and national levels) until the early twentieth century. The exams were believed to select the most competent, capable, and also moral men for governmental responsibilities. Rowntree (1994, p66) draws on earlier sources to show that the imperial Chinese examination was based initially on the real and practical skills a governor needed (including horse riding and archery among others). However, the emphasis is said to have gradually 'shifted from the subject to what the classics said about them, then the classics themselves, until fossilization set in.' Later, the core of the examinations was based on the Chinese classical texts, inspired by Confucian teachings, and required the contestants to have undergone laborious education to memorise a huge amount of such texts, and show remarkable poetic and verbal abilities.

Despite the fact that Confucian belief also dominated the social system of the country, the question surrounding the Chinese civil service examinations involves the lack of similarity between the content of the examinations and the actual problems which the selected officials were expected to tackle. Gardner et al claim that, despite many reforms for improvement to the exams, the civil servants' 'storehouse of classics often rendered them out of touch with the worldly problems they were supposed to manage.'

In Britain, the first formal qualifying examination was the medical profession's examination in 1815, followed by similar exams for solicitors and accountants in 1835 and 1880 respectively. Due to the upward social mobility and increase in demand for entry to universities, Oxford, Cambridge, London, and Durham set up examination boards and introduced selective exams in 1850 (Gipps and Stobart, 1993).

The other example of civil service examinations is the mid-19th century British examinations which replaced the patronage way of civil servants' recruitment.

According to Gardner et.al (1996), the first series of such British exams (1870-1925) drew on the curriculum of Oxford and Cambridge and like the Chinese exams placed emphasis on 'writing ability' dealing with 'traditional subject material.' However, the exams are said to have also included additional questions which dealt 'more directly with government work'.

As regards academia in America, the same source reports that until the mid-19th century, as in the examples above, 'the model of a learned person was one who was steeped in the knowledge of the ancients'. Despite the fact that colleges were free in their student selection, there was a dominant belief that it was the classical curriculum which provided sound 'mental discipline'. However, this belief began to diminish as technological innovations began to grow.

1.2.3. Intelligence Test as a Selection Tool?

Alfred Binet and Theodore Simon are known as the first developers of intelligence tests for schoolchildren. The tests were developed in France between 1904 and 1911 (in response to the French Ministry of Public Instruction's request) in order to help schools to identify those schoolchildren who needed remedial education. Earlier, Francis Galton had carried out studies on intelligence, and through his book *Hereditary Genius* (1869) he had disseminated the view that intelligence was inherited. He had also established his Anthropometric Laboratory in 1884 which prepared the ground for the initiation of eugenics studies.

Binet and Simon, on the contrary, did not subscribe to the view that intelligence was simply inherited. Their studies on intelligence originated from their interest in the development of thinking in children. They believed that through the study of individual differences among children, they could help retarded children to receive a proper education to enhance their mental abilities.

The proximity of the application of the Binet-Simon tests (which were designed for pragmatic purposes) to some other incidents, however, led to the emergence of a new culture of testing which was inclined towards the hereditary or fixed view of intelligence (Gipps and Stobart, 1993; Gardner et al, 1996).

The other incidents included, for example, the dissemination of Charles Spearman's classic paper on General Intelligence[1] (apparently providing a theoretical foundation for intelligence); interest among other psychologists (such as Henry Goddard, Lewis Terman, and Robert Yerkes in the United States) to emulate the Binet-Simon tests for both educational and widespread army recruitment purposes[2]; and substantial growth in demand for compulsory education. Gardner et al (1996) claim that, in the early decades of the 20th century in the United States, the tests became so reified that were applied even towards baseless eugenic aims[3].

Despite the view and intention of the main originators, the widespread application of intelligence tests (without due attention to the content of the tests and its relationship to real intelligent behaviour) tended to buttress the hereditary or fixed view of intelligence in the early decades of the 20th century. Gipps (1994) argues that the latter view has had a detrimental effect on educational assessment through its cultivation of norm-referenced testing, and failure to pay adequate attention to the matter of criterion in assessment.

1.2.4. Emergence of Modern Public Entrance Exams

Along with the development of vocational education and the introduction of modern subjects into the high school curricula a need was felt for the development of new entrance examinations. In the American context of higher education, it was in 1900 when the College Entrance Examination Board was launched to meet that need, and to provide a more co-ordinated basis for admission decisions. It was a common practice, however, to judge the entrance examination papers holistically (not on the basis of the exact marks) to decide on the candidates' suitability to be offered a place. Gardner et al (1996, p.17) cite a passage from an old College Board document which reads: '... if a mistake has been made ... the readers are not necessarily to mark on an exact mathematical basis, but from a study of the

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[1] Spearman, C. (1904). General intelligence, objectively determined and measured. American Journal of Psychology, 15, 201-293. It should be noted that Spearman and Binet had different views towards intelligence, Spearman being influenced by Galton's works.

[2] Gardner et al (1996, p19) report that Yerkes and his co-workers administered their intelligence tests to '1.75 million soldiers under the authority of the Committee for Classification of Personnel in the Army'.

[3] For the sterilisation of prison inmates and residents in homes for retarded (ibid, p86).

examination book to judge whether a candidate is prepared to undertake college work and to mark accordingly' (Farrand, 1926, p26)[4].

This lack of objectivity, and problems of efficiency, together with the early 20th century psychometric testing developments paved the way for the sort of test exams in which the questions simply had right or wrong answers.

The first such test whose development was 'influenced by the extensive use of objective testing for army recruits during the First World War' was the Scholastic Aptitude Test (SAT). The test was first offered in 1926. After more than three decades, the American College Test (ACT) was introduced (McDonald et al, 2001b). The SAT has been used with the intention of gauging the candidates' potential to study at a college level. Therefore, focusing on two verbal and mathematical (or quantitative) parts, the SAT tends to assess a candidate's reasoning skills in the two generic areas. On the other hand, the ACT is oriented towards the candidates' ability to tackle problems in specific subjects areas. This makes it an 'achievement' test. New versions of both the SAT and ACT are used currently in the United States as the entire or part of the requirement for admission to higher education.

The use of the tests is not limited to their homeland. This was one of the main themes in the agenda of the 1978 symposium in Germany (Mitter 1979) on admission to higher education. While some of the participating countries (such as Sweden) were planning to apply tests similar to SAT or ACT, other countries (such as Hungary and Turkey) were already applying them. This was also the case in the specific context of our study, Iran. McDonald et al (2001b) report that the Singaporean Ministry of Education is making preparations for the application of an aptitude test as part of admission procedures to higher education from 2003.

1.2.5. Mainstream Intellective Thresholds for Admission to Higher Education

Today, standardised public examinations, and selective (aptitude/achievement) tests constitute the most common instruments for admission to higher education.

[4] Farrand, D. (1926). A brief history of college entrance examination board. In College Entrance Examination Board (Ed.). The work of the college entrance examination board 1901-1926. Boston: Ginn and Company.

Usually, measures of high school achievement, particularly final school leaving examinations, are regarded as the first threshold, and one or more additional tests/exams constitute the second threshold for studying a higher education course. These thresholds are regarded as indicators of the candidates' capability of being successful in the courses they apply for; and higher education systems vary in the weight(s) they give to one or both of the thresholds.

There also exist cases in which a higher education institution has the autonomy to apply other (non-intellective) criteria for admission. For instance, the financial, political, or other sorts of contribution a candidate can make to the institution may be taken into account for his/her admission. Such cases, however, fall outside the focus of our study.

1.2.6. Indicator of Relevance

As implied earlier, one of the main issues regarding the selective exams/tests involves the relevance of their content to the type of future activities and processes that the selected students are required to learn/manage. A large number of educational studies have investigated this relevance by measuring the relationship between the selection criteria and the future performance of the students. This is normally undertaken by performing correlation or regression analysis on the data to see how students' performance during or over the course corresponds to their abilities (or scores) at entrance.

In simple terms, the calculation of correlation results in a coefficient which ranges from -1.00 through 0.00 to +1.00. While the -1.00 signifies a perfect negative (or inverse) linear relationship, 0.00 means that no relationship exists, and +1.00 is the sign of a perfect positive relationship. It should be noted that it is the second power of the correlation coefficient which denotes the extent of variance in one variable that is accounted for by variance in the other (e.g. variance in A-level, and degree results).

The size of the correlation, referred to as 'predictive validity' (or predictive ability), is taken as the indicator of relevance of the selection criteria. There is implicit agreement that the first threshold is the best single predictor of future academic success, and that additional tests come next. There is also a general doubt about the accuracy and usefulness of interview, and psychological testing for the prediction of future academic performance (Mitter, 1979). These issues, however, may not be easily generalised for each and every case under study because a considerable part of the studies which have investigated the prediction of academic success have pooled data from diverse educational settings, and, thus, have blurred the contrast that would have otherwise emerged among dissimilar courses or departments.

This and a couple of other technical issues will be discussed later in this chapter. But, first, examples of studies which investigated the predictive ability of the first and second thresholds are reviewed below.

1.2.7. Predictive Validity of the First Threshold

In a longitudinal study, Khammash (1978) examined the relationship between the measures of secondary education performance and the 'Senior year grade average' of a cohort of 266 students who studied from 1973 to 1977 in the Faculty of Art[5], University of Jordan.

Khammash found a correlation of .37 between Secondary Education Certificate Examination and university performance. A combination of other secondary data such as average grade of the last year of high school improved the relationship to a correlation of .45.

She also reports a number of similar studies in America which were carried out between the 1940s and 1960s and which arrived at correlations of about .50 between high school and college achievement. For instance Fishman and Pasanella (1960, p300)[6] said that, according to their review, the best intellective predictor of college performance was the high school record, 'usually expressed as total average grade or rank in class'. They found that in over 360 studies the measure had correlated .50 with Freshman year performance; and in 31 studies a correlation of .48 had been observed beyond the first year. However, due to variations in high school grades 'most colleges found it necessary to include some standardised aptitude and/or achievement tests in their selection measures'.

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[5] Faculty of Art consisted of 1) Arabic language and literature; 2) English language and literature; 3) History; 4) Archaeology; 5) Geography; 6) Philosophy; and 7) Sociology courses.

It should be noted, however, that some studies have reported even larger relationships. The achievement of higher correlations is in fact due to the implementation of 'scaling adjustments'.

One of the well-known studies which is frequently cited as an example of high correlation between measures of high school and college achievement is Bloom and Peters' (1961) study. The researchers assembled data on the high school and college Grade Point Average (GPA) for more than 25,000 American students. Through conventional regression calculations, the researchers obtained correlations of about .50 between high school and college averages.

Bloom and Peters believed that difference in standards among the schools, and also among the colleges in their study, was an uncontrolled source of variation which distorted the original outcomes. Therefore, they proposed a weighting technique which took into account the differences in the quality of the institutions. After the application of this scaling adjustment they found a correlation of .77 between high school and college freshman grades in a sample of about 4,500 students. Subsequent studies regarded this to be the upper limit of predictability. Not many of the following researchers welcomed Bloom and Peters' approach, and rarely was such a large relationship reported later.

Contrary to the above studies, Rowntree (1994) drew upon some British studies, which were carried out at the time of, or after Bloom and Peters' study, and stressed that 'comparison of A-level grades and degree class have rarely shown much of a correlation'. He reported correlations of .33 (in engineering), and .17 (in social sciences) between the three best A-level results and the final degree, and went on further to suggest the possibility that factors such as personality and motivation have 'as much or more influence on success in higher education'.

Bourner and Hamed (1987) found even lower correlations in their investigation. They studied the relationship between A-level attainment and degree results for nearly 12,000 students who had studied in the public sector of higher education (29 polytechnics and 60 colleges of higher education) in England between 1983 and 1987. The data was divided into 8 separate subject groups. The highest correlation

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[6] Fishman, J. A. and Pasanella, A. K. (1960). College Admission Selection Studies. Review of Educational Research, Vol 30, 298-310.

of .26 was found for the language subject group, and the lowest correlation was .08 for the health-related group.

In a part of their study on personality and academic performance Holder and Wankowski (1980) calculated the correlation between A-level grades and degree performance for more than 2,300 students in seven separate groups of courses in the University of Birmingham. They found different results for dissimilar course groups. A maximum correlation of .39 was found for physical sciences and applied sciences (male students), and a minimum of .02 for arts. Other course groups fell around .20 in the middle of the range.

In a more specific study Davies (1983) applied regression analysis to study the relationship between entry qualification and degree performance of 85 students in a department of Economics. He concluded that there were 'large random errors and the main characteristic is of a weak relationship'. Davies suggested that other guides to student suitability should be given equal, if not more, weight.

Using data of 1979 graduates from universities in Britain, Sear (1983) tested the extent to which degree classes correlated with the best three A-level results. The data was broken down into nine subject groups, e.g. education, medicine, architecture etc. The groups included from around 300 to 12,000 graduates. He reported that: 'the strength of association is invariably small'. Sear found that the proportion of variation in degree classes associated with A-level scores was 'never much above 10% and for some subject groups it was even less than that'. The relationship was strongest for science and engineering, .35 and .34 respectively; and lowest for social studies and architecture, .24 and .17 respectively.

Ghafar (1994), investigated the relationship between A-level and first year results of 156 Malaysian science students. Apart from a correlation of .30 between A-level physics and first year university physics all other results were very poor.

For their meta-analysis of the relationship between secondary education and university achievement Peers and Johnson (1994) included data from 60 correlational analyses from 20 separate studies in universities and polytechnics. Out of the 60 analyses only 21 had returned a correlation of above .30; the average was .25 with a standard deviation of .13. We will deal with this study in more detail in the following chapter.

1.2.8. Predictive Validity of the Second Threshold

A ten year research project in Britain in the 1960s and 1970s studied the possible benefits of the application of university entrance tests similar to the American Scholastic Aptitude Test (Choppin, 1979). The British version, or the Test of Academic Aptitude (TAA), was applied to a large number of samples. In 1967 alone, over 27,000 final year students from a random sample of 619 high schools were tested. In the subsequent follow-up over 7,000 of the students who had entered university were traced and their academic progress was recorded. Similar procedures were also repeated twice in the following years. The predictive powers of the tests were examined against first year university performance and final degree results. Choppin said that the correlations were 'disappointingly low', and generally much smaller than those of A-level grades. The mean correlation of the mathematical part of the tests with first year performance in seventeen courses was .12, and that of the verbal part was .11. The combination of the test results with A-level results had made very trivial improvements to the predictive correlations for the majority of courses.

Choppin also reported that in the early 1960s the Scottish Council for Research in Education administered experimentally a modified version of the SAT to Scottish school students. The ability of the SAT in Scotland to predict achievement in higher education was found to be lower than that obtainable with the results of the Scottish School Leaving Certificate Examination.

Choppin also stated his scepticism about the results of some American studies which had reported high correlations between scores on the Scholastic Aptitude Test and subsequent college performance. He cautioned that many of such high correlations were products of 'statistical chicanery such as attenuation', and referred to Agnoff's research[7], which on the basis of a large number of American studies, had reported that simple correlations between SAT scores and college performance typically ranged between .20 and .40.

Research was carried out by a team of 'distinguished' Dutch psychologists to study the ability of two aptitude tests, one questionnaire, and a measure of high school

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[7] Agnoff, W.H. (1971). The College Board Admission Testing Program: A technical report on research and development activities relating to Scholastic Aptitude Test and Achievement Tests. New York: College Entrance Examination Board.

performance to predict first year performance of students who had entered Delft Technical University in two consecutive years (Hofstee, 1979).

The results of the study showed that the best predictor was the high school grade point average (or GPA) in mathematics and sciences which correlated .44 and .62 with the performance measure. The second predictor, namely the Study Habit Questionnaire, returned correlations of .39 and .45. But the other two criteria namely Maths Aptitude Test and General Intelligence Test showed very low relationships. Correlations for the Maths test were .19 and .10, and those of the Intelligence Test were .21 and .22. Hofstee also reported several other related studies (e.g. on students at Edinhoven Technical University) which returned more or less similar results.

Wedman (1979), reported on the Swedish experience of testing for admission to universities. In the Swedish admission system, apart from the conventional paths from secondary education to higher education, provision was made for applicants who were 25 or more years old and had some basic knowledge of Swedish and English, in addition to four years of work experience related to the course for which they were applying. This group of applicants was required to take an entrance test. Wedman calculated the correlations between the tests scores and first degree performance for more than 470 students in three separate higher education institutions (two technological, and one teacher training). She found a correlation of .41 in the teacher training, and .32 and .40 in the technological institutions.

Three decades after the 1960s and 1970s studies on the application of aptitude tests for admission to British universities, the subject came to the attention of the public, media, and experts in the year 2000. Debate on the application of the tests erupted shortly after the publication of that year's admission results. The Sutton Trust's Executive Summary of the results in the 13 highest ranking universities in the UK drew attention to the over-representation of students from independent schools and higher social classes in the universities mentioned. This and other related issues raised the debate on university access. There were some claims that student selection based on a system similar to the American SAT[8] would be a fairer way of admission to university, and that British higher education needed to adopt such a method. In response to the need for relevant evidence, and commissioned

[8] SAT originally stood for Scholastic Aptitude Test. It was renamed Scholastic Assessment Test in 1994.

by the Sutton Trust, the National Foundation for Educational Research (NFER) undertook two tasks: one, a pilot study on the relationship between SAT scores and A-level results; and two, a literature review on the SAT and other aptitude tests used for university entrance (McDonald et al, 2001b).

The pilot study which was carried out on samples of between 101 and 630 students from independent, low-, and high-achieving schools returned correlations of .33, .50, and .45 respectively. Thus, the researchers concluded that the test and A-levels 'assess somewhat distinct constructs'. Therefore, they cautiously implied that 'the SAT, or a test like it, *may be* of value in predicting university performance' (McDonald et al, 2001a, p36) (Italics added).

In the absence of inclusive sources, the review is a valuable contribution. As regards clarification of the issue of whether the SAT would improve on British student selection procedures, however, the review did not render an unequivocal result. In fact, the differing results of the reviewed literature (which had adopted dissimilar approaches, techniques, and data) seem to be among the main reasons which precluded reaching a firm conclusion in favour of or against the application of the test.

The review (McDonald et al, 2001b) includes a number of studies which were carried out mainly in the United States. Some of the studies tended to address the issues of predictive ability in relation to social, ethnic, or gender bias.

One of the studies reflected in the review was carried out by the 'College Board' in 2000 to investigate the ability of the SAT to predict freshman GPA. The study[9] covered data on 48,000 students from 23 colleges. A correlation of .35 was reported across all colleges studied. Noticeable fluctuations existed, however, when the correlations were calculated for separate colleges, gender or ethnic groups. The result for individual colleges ranged from a maximum of .72 to a minimum of .37.

Like Choppin (1979), the NFER researchers cautioned against the size of the latter correlations because of the statistical adjustments which were applied artificially to the original data/results.

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[9] Bridgeman, B., McCamley-Jenkis, L., and Ervin, N. (2000). Prediction of Freshman Grade-Point Average from the Revised and Recentered SAT I: Reasoning Test. (College Board Research Report No. 2000-1/ETS). New York: College Board.

Yet, the results above are in contrast with the findings of Baron and Norman (1992) who carried out a similar study covering two consecutive undergraduate classes of more than 3,800 students in the University of Pennsylvania. Baron and Norman found that the SAT scores correlated .26 with freshman GPA, and .20 with college GPA. These correlations were lower than those of achievement tests, and high school class rank. The former returned corresponding correlations of .26 and .32; and the latter .30 and .34. Further analyses showed that for the majority of individual courses, the SAT had a very low incremental predictive value when measures of high school performance or achievement test results were available.

McDonald et al (2001b) also demonstrated that according to independent studies the predictive ability of the SAT has shown a slowly decreasing trend over time. This may be due to the intervention of one or more factors such as: inclusion of non-traditional students, introduction of remedial teaching programmes, growth in the coaching industry, etc.

Altogether, the review concluded that 'the SAT has been found to account for a modest amount of variance in performance, after the information regularly available on students has been taken into account.' For instance, the College Board's study (mentioned above) showed that for white male students the inclusion of the SAT results accounted for a 5 per cent additional variation in freshman GPA compared with what the high school GPA would do alone.

1.2.9. The Implication of the Studies

To summarise, the examples above from the literature on predictive relevance of student selection measures indicate that, on average, the correlation between the first, or second, selective threshold with higher education achievement is in the order of .30 (the first threshold correlating slightly higher than the second). Yet, if we rely on the more optimistic findings of around .40, this accounts for less than 20 per cent of the variance common between the predictor and achievement variables. That is why a number of researchers have emphasised the importance of other (non-academic, or non-intellective) factors for success in higher education (e.g. Lavin, 1965; Bonte, 1979; Peers and Johnston, 1994; Sternberg, 1997).

In view of the fact that conventional selective tests rely mainly on verbal and mathematical abilities, it might be questioned as to how suitable such selective tools, on their own, are for the purpose of student selection for architecture courses.

Most architecture courses are design-centred; and it is known that, in addition to verbal and mathematical abilities, other abilities and modes of thinking are crucial to designing (Cross, 1995). This may be one of the reasons why, usually, low relationships between entrance abilities and course performance have been found for architecture (and design) courses when different course subjects are studied separately (e.g. Sear, 1983; Bourner and Hamed, 1987; and Peers and Johnston, 1994).

We leave the specific investigation of the relationship between prior abilities (and characteristics) and course performance among the students of architecture to the following chapter. The section below highlights a series of problems which affect both student selection procedures, and also the studies which are intended to examine such procedures.

1.3. Selection Procedures: Complexities and Shortcomings

This section includes two sub-sections. The first sub-section deals with the complexities in the design and application of the selective tests, and the second involves the unavoidable shortcomings in the study of such tests or examinations, in terms of their predictive validity.

1.3.1. Complexities in Testing for Selection

Final school leaving examinations and/or entrance tests are used as a basic criteria for admission to higher education. Since the specific cases under study in the present thesis involve separate entrance examinations which are dominantly in multiple-choice test format we limit this piece of discussion to entrance tests. Generally, entrance tests are regarded as enjoying more administrative convenience, and objectivity[1] than other kinds of student selection instruments.

It has become very common to see that large groups of candidates are assessed through entrance tests, and that, from the highest score gained downwards, a number of candidates are admitted to the course and others are rejected. In other words, the results of the tests are used as indicators to determine which individuals are more academically *meritorious*, or *suitable* for studying higher education courses.

Despite the inevitable application of selective admissions, such procedures undeniably have the potential to seriously affect the future life of those about whom selective decisions are made; yet they are often followed unquestioningly by both selectors and examinees. But if a given selective admission system proves inefficient, it is causing harm through the dissipation of resources and/or doing injustice to human beings.

It should be noted, however, that the ostensibly simple link between the entrance test and admission to the course (represented by broken arrow in Figure 1.3) is only the foreground of a multi-staged policy making process which relies on demanding assumptions.

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[1] As Rowntree (1994, pp149-150) emphasises: 'the description 'objective' should not be allowed here to refer to anything but the decision as to whether or not the student has chosen the approved answer'.

Unspoken Assumptions in Selective Testing

In reality, the *merit* or *suitability* concept needs to be defined first. What is the answer if one asks what is meant by a candidate's suitability?

In general a candidate's suitability is interpreted in terms of his/her capability to complete the course successfully (the first clockwise arrow in Figure 1.3). In an educational setting, the mere capability of a candidate to complete the course may be regarded as the sole requirement for him/her to be deemed suitable for admission[2]. In another setting the interpretation of suitability may require the prospective students not only to be able to complete the course but also to satisfy additional requirements, or achieve a certain quality. But how can this capability be defined operationally? What would be the answer to: who is the capable candidate? Conventionally, the answer to this question is: someone who has certain (sets of) abilities. Then, the new question would be: what are the indicators of the required abilities? There seems to be no other choice here except for externalising some evidence of the abilities. Entrance tests pretend to take on this responsibility.

In practice, the design and application of an entrance test relies on critical reductions to the concept of merit (or suitability), shown by outer clockwise arrows in Figure 1.3.

Although, normally, test results are regarded as the sign of candidates' suitability (the broken arrow in Figure 1.3), in reality, the logical succession is what is shown in the same figure by the counter-clockwise arrows. From Entrance Tests to Merit, each stage is regarded as the indicator of its preceding stage.

Therefore, the application of an entrance test to the candidates must have relied on the following assumptions.

1. There is a correspondence between the abilities which the test items require and the abilities needed for a reasonable performance in the course.
2. The test adequately covers the 'critical' abilities needed in the course.

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[2] This was emphatically proposed by Fulton, O. and Ellwood, S. (1989) to improve the student selection policies after their research on the pattern of admissions policies and practices in a number of UK higher education institutions. Among their recommendations they maintained that: 'the ability to complete a course, not the highest possible entry grade, should be the basic criterion for admission'; and that '[d]epartments should aim to identify the minimum point at which a student could be expected to cope with a course, and make their selection above that point on other criteria.'

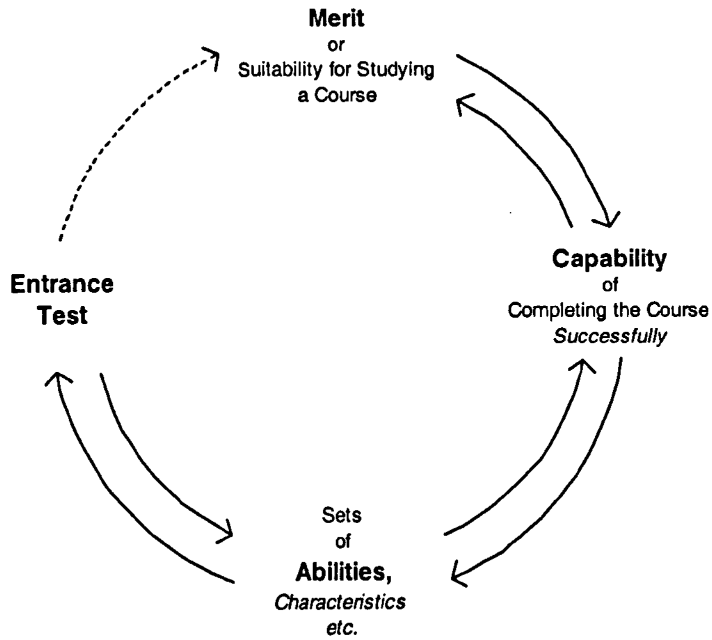

Figure 1.3. Reduction of 'merit' to performance in the tests.

3. A candidate's performance in the test is an indictor of his/her future performance in the course. In other words, candidates' relative ranks at entrance will remain rather consistent.

The above points are expanded on below.

Inherent Complexities

We saw that the design and application of entrance tests rely on the reduction of the concept of 'capability' to sets of abilities which are not self evident. Firstly, there exists evidence that, apart from the intellectual and academic abilities, other factors such as affective and environmental factors exist that influence a student's academic performance. Even if completely identified, most of these factors are not easy to monitor and measure. Secondly, the patterns of interaction, and the respective weight of these factors are not known clearly. There is also the likelihood that the strength of one kind of intellectual or non-intellectual factor may compensate for the lack of the other.

Moreover, given that the essential abilities are identified, how can we be sure that the test items in use do, in fact, assess those abilities. Figure 1.4 attempts to illustrate this issue. Let us suppose that the small letters inside the left hand side box represent different abilities that an entrance test assesses and the capital letters inside the right hand side box, those abilities that are essential for achievement in the course. Let us also suppose that the size of the inner frames inside each box accounts for the respective share of each ability. (Surely the borders of the abilities would not be very distinctive and so would overlap, but here these borders are separated for the sake of simplification.)

There is the possibility that parts of the tests are directly related to the abilities required in the course (Figure 1.4; 'b', 'c', and 'B', 'C' respectively). However, the other possibility is that one or more parts of the tests may exist that do not correspond to any course abilities (see 'F' in Figure 1.4). Also, one or more critical abilities may be needed in the course for which no corresponding item exists in the test (like 'A' and 'D' in the same figure).

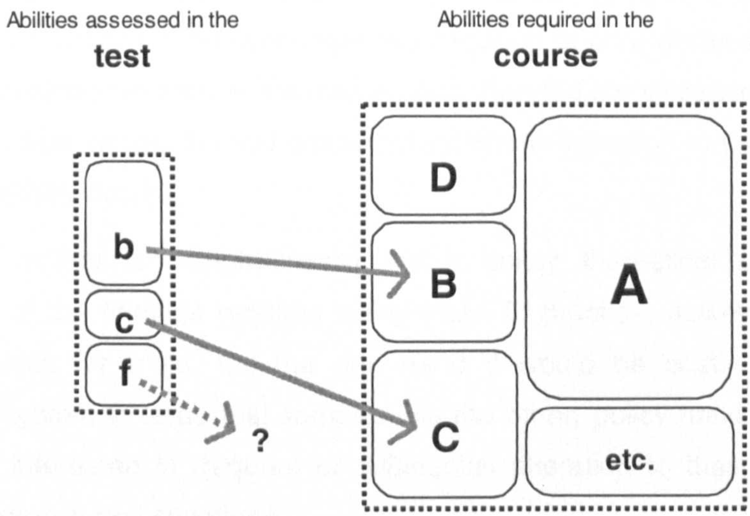

Figure 1.4.
Correspondence of entrance test to abilities required in the course

Rowntree (1994, p156; 163) highlights a similar point in his critical study on educational assessment, where he emphatically warns against 'making the measurable important rather than the important measurable'. He maintains that '[i]t is fatally easy to assess related but different objectives as well as or even instead of those you really care about - especially when those related objectives lend themselves more easily to measurement'.

Hence, if the essential abilities required for the course and their respective weights are identified with much uncertainty, and this tentativeness also applies to the tests, then in practice our entrance test becomes a classificatory instrument that perhaps enjoys some *reliability*, but that would be at the expense of *validity*. This is a disadvantage which tends to nullify the advantage of the objectivity of the entrance tests.

Undoubtedly, a large proportion of (intellectual and non-intellectual) factors that influence a students performance during the course defy clear monitoring and measurement. That is why we can not expect a perfect prediction of the future performance of the candidates, let alone the different patterns and paces of each student's development. This calls seriously into question the unspoken assumption that good performers in the tests will also be future good performers in the course.

Therefore, it seems that the most promising undertaking for improvement of a selective system would be the systematic identification of core abilities (and maybe other characteristics) required in the course, and then the identification of their best indicators[3]; in other words, the two critical points where reduction to the concepts of *merit* and *capability* occurs.

This will be neither a straightforward nor a solely theoretical process. The corroboration of the findings requires many trials. In practice, however, there are few opportunities for trials. On the one hand it would be costly to apply an experimental system to large trial samples, on the other, policy making authorities do not seem interested in frequent or substantial alteration to their conventional selection systems in real situations.

Therefore, as was hinted in the preface, circumstances which provide the chance of controlled comparative study[4] of two or more systems are valuable opportunities for investigation of the difference between the outcomes of the systems in order to find clues to further rectification.

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[3] Literature on educational assessment, and history of intelligence testing bear illuminating points related to this matter. See, for example, Gardner et al (1996); Gipps and Stobart (1993); and Gipps (1994) for the old assumptions of Intelligence testing and their influence on education and assessment. Also see the two latter sources and Rowentree (1994) for diverse aspects of assessment, especially the 'norm-referenced' and 'criterion-referenced' concepts in assessment.

[4] Evidently, it is not feasible to arrange an 'experimental' study for the comparison of the results of two selective methods. However, if we wish, for example, to compare the predictive ability of two or more selective methods, the influence of uncontrolled intervening factors should be kept to as much a minimum as possible.

The Influence of the Method

One more point seems worth highlighting here. That is the importance of the assessment *method* which can facilitate or obstruct the appraisal of various abilities or characteristics. For instance, one of the classifications of assessment methods is 'divergent-convergent'. Objective multiple-choice tests are regarded as the ultimate example of convergent assessment.

The two terms are borrowed from the field of psychology. Convergent thinking refers to the mental condition where one focuses rationally on a clearly defined task with a single (or limited) correct answer(s). On the other hand, divergent thinking involves an open-ended task/problem which has no single correct answer and demands trying many alternatives. The two assessment methods refer to situations in which the above modes of thinking find room for manoeuvre.

Considering the fact that most real life situations call for both modes, relying on only one of the methods leads to missing much otherwise valuable information/evidence for selection decisions. This is especially true for a design-centred course such as architecture which involves ill-defined problems and depends on both convergent and divergent thinking abilities.

1.3.2. Unavoidable Technical Shortcomings in the Study of Selective Tests/Exams

Two major problems exist in the study of the relationship between student selection criteria and academic performance.

1. The lack of an absolute standard for the size of relationship.
2. The shortcomings of the 'particular but exhaustive' vs 'general but partial' approaches to the study.

Lack of Absolute Standard

For any single study of the predictive ability of a selection method, there is no absolute standard against which the method can be examined.

It was mentioned previously that the size of the relationship between student selection criteria and academic performance is often indicated by a correlation coefficient. The interpretation of, for example, a correlation of .30 varies among different researchers, however. One may regard it as a poor correlation while another believes it is a medium (or even higher) correlation. The problem is the lack of any objective and definite frame of reference. Some researchers tend to compare the correlation outcome with those obtained in previous studies and thus may consider a correlation of .30 to be a reasonably strong correlation. Others may focus on the absolute value of the correlation, and particularly its second power (i.e. .09), and declare a correlation of .30 to be a poor correlation (because of the small common variation that can be accounted for). It is not known in what order the size of an optimum correlation between the predictor and performance measure is.

The expectation of a perfect correlation between the students' abilities at entrance, and their performance during the course is an unrealistic expectation, because this necessitates the identification of all influential factors and the mapping of their pattern of interaction. Moreover, such a perfect correlation would imply that no changes should have occurred between the students' rank in ability at entrance and over the course. All of these are far from reality. On the other hand, comparison of the obtained correlation with a general average found through other studies does not seem adequate. This may provide a tentative view. However, if background conditions, such as course content, methods of delivery, etc are not uniform, the comparison would not be practically useful.

Contrarily, if there are chances of comparison of two different student selection methods for identical circumstances (e.g. course content, regulations, etc) then it would be possible to decide about the superiority of one system over another without the need for an external absolute standard. Our specific case studies conformed to the latter condition. Details of this are given in Chapter 4.

A parenthetical point should be made here. Despite dissimilar views among researchers regarding the interpretation of the size of a certain correlation, they often use qualitative terms (such as small, moderate, etc), for ease of communication of their findings. After consulting several statistical sources which have suggested specific descriptors for certain ranges of correlation, the present author arranged his set of descriptors for use throughout the thesis when interpreting his calculated correlation results in common language. For more details see Appendix 1.

Particular but Exhaustive vs General but Partial Approaches

Another technical issue which involves such studies is that the study is either conducted in depth on a small sample or on a large sample but with limited depth[5].

The problem with the first type is that its results are usually context-specific and difficult to generalise; and the second type of study tends to conceal parts of otherwise important differences that exist among various segments of the study samples. For example, some studies have pooled data from high school exams of thousands of students from different schools and have studied the relationship of that data with subsequent grades of the same students at different universities. While such studies may enjoy statistical advantages (in terms of the sample size), they rely on questionable assumptions. They must have assumed, at least, that corresponding exams in different places (or times) have required the same abilities, and identical standards have been applied for grading in different high schools and universities (or over long periods of time).

All previous studies in this field have been engaged with the above issues to a lesser or greater degree, and no ideal solution can be prescribed to overcome such problems.

In a totally different context, Broadbent (1973, p135) criticised the then environmental psychology studies because of their marked reliance on statistical tools, and apparent disregard of the facts that should have been noted otherwise. He regarded them to be misleadingly involved in the 'fine analysis of coarse information'. One may similarly criticise many of the studies in our field. However, as long as there is a lack of more appropriate tools and better methods, we have no other choice but to apply what is available. What is important is to be aware of their limitations and shortcomings in order to be able to 'make the best job possible[6]' of our study.

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[5] These approaches are, sometimes, referred to as 'idiographic', and 'nomothetic' respectively, in the fields of psychology and sociology (see de Vaus, 1996, under the section 'Scope of the research', or Rowntree 1994, p158).

[6] To borrow Gipps and Stobart's (1993) phrase, cited above.

1.3.3. An Alternative interpretation of the Concept of Relevance

It was said earlier that the common method of assessment of the relevance of a selective examination is to consider its relation to the academic performance of the students. Therefore, the higher the predictive ability of the examination the more relevant it is considered to be (although it is known that these correlations are not a sign of causality).

In practice, however, on the one hand:

> many studies (e.g. Choppin, 1979; Bourner and Hamed, 1987) have found small correlations between entry scores and future performance,

on the other:

> some researchers (such as Klitgaard, 1985) have technically ascribed the cause of some weak correlations to limited variation in variables (i.e. in cases where admission is highly selective and entry scores are high).

This causes limitations to the study of *relevance* through the observation of correlations, unless the results are interpreted in the light of supplementary information. Therefore, despite the fact that high correlations are usually considered to demonstrate the 'fairness' of examination in recognition of candidates' merit (for entrance to university) one may take an alternative approach to examine the usefulness of entrance examinations. Particularly on the grounds of accountability, government authorities may prioritise the 'outcome quality' over the 'fairness' dimension and regard the former as an indicator of fairness towards the tax payers (who outnumber the candidates).

For example, think of two types of entrance examinations, *one* and *two* (for studying the same course); the former returning (relatively consistently) a correlation of .30 with the academic performance of its selected students and the latter a correlation of .20. However, the average academic performance of the students who were selected through examination *one* is C and the same measure for the students selected through examination *two* is B. In this situation the preference of one examination over the other is a value judgement and is dependent on our perspective of this matter. Here, one concerned with 'fairness' prefers examination *one*, whereas one with a pragmatic tendency and concern for the 'economic' outcome of the examination would prefer examination *two*.

Nevertheless, an ideal situation could exist to satisfy both dimensions. That is when an entrance examination:

1. displays a higher correlation with students' performance in comparison with alternative examinations, and
2. selects students whose performance is collectively higher than that of students selected by alternative examinations.

The relevance of selection procedures will be investigated with regard to both 'fairness' and 'economy' aspects where case studies of this research are discussed.

CHAPTER 2

Review of Previous Studies

Chapter 2

Review of Previous Studies

Introduction

The aim of this chapter is to gain knowledge of factors that can influence students' academic performance in architecture or similar courses. Since knowledge of past experience and previous research can make a reliable starting point and should be undertaken in the initial stages of research (Moser et al 1971; deVaus 1996; Bouma and Atkinson 1995) a series of relevant sources are reviewed below.

Two objectives are pursued through this review.

I. To discuss and compare the results of the related studies in order to broaden our knowledge of the subject and the factors involved, and also to enrich the findings of the present research.

II. To identify possible sources and methods of data collection and also the analytical tools of the previous studies. This should help to the selection of a suitable method and tool for the empirical part of our study.

This chapter deals with two kinds of studies which focused on the students of architecture or design.

- The first kind includes the studies which had a similar focus to that of our research. These either dealt with admission requirements for studying architecture, or investigated the relationship of one or more predictive factor(s) and the subsequent academic performance of the students of architecture or design.

An extensive literature search showed that only a very limited number of such studies was available. Therefore, the review was extended to include also studies which could indirectly contribute to our work.

- The latter kind consists of the studies which adopted a psychological approach. Such studies investigated the relationship of personality characteristics to academic performance, or studied the differences between the students of architecture (or design) and other students/people, or examined different thinking modes involved in a design situation.

Some points should be made here before turning to the reviews.

- While some of the *findings* of the previous studies are very likely to be context-specific, the *subject matter* of the findings is less likely to be so, and knowledge of it can develop insight and draw our attention to the latent relationships in our research.

For example, think of a study in which certain gender differences were discovered. Although the pattern of corresponding differences may be totally different in the context of a subsequent research, the benefit of the former study to the latter study is the bringing to light of a *subject* (gender differences) which otherwise could have remained untouched, and might have concealed potential patterns which hold for one gender but not the other.

- In view of the lack of studies directly related to students of architecture, it was decided to benefit from the generic similarities between architecture and cognate design courses, such as product design, and include a number of studies which investigated the topics of our interest among the students of the latter courses.

- Due to the absence of any similar available review of what the present chapter undertakes, our review will not be limited, as is often the case, to simple narrative reports of the findings of previous studies. More details will be given for two reasons. One, to provide a closer acquaintance with the studies and their methods for the prospective reader; and two, to prepare the ground for a critical examination (and rectification of some) of the findings.

- In order to avoid remote and confusing backtracks, criticism of the questionable points/findings are not given in a separate section. Any arguable finding will be examined on the spot.

Except for one major study, all studies belong to one of the two mentioned kinds of research, and form two separate sections in this chapter. The major study, however, contributes to both kinds. In order to avoid fragmentation, and owing to the breadth and precedence of that study, the first section below will be allocated to its review.

The review of the studies of a psychological approach will be given in the second section, followed by the review of the admission/predictive studies in the third section. At the end of each of the two latter sections a table will give a summary of the reviewed pieces of research (Table 2.13, page 91; and Table 2.15, page 113).

A final summary and conclusion closes this chapter.

2.1. The Bartlett study

Among the published research on selection and the subsequent academic performance of students of architecture, the study by the Architectural Education Research Unit at the Bartlett School of Architecture UCL in the 1960s, seems to be the most inclusive and elaborate study. It was the product of a one-decade effort of a team which included a well-known educationist, and also a psychologist. The study is regarded as the only major study of its kind by authors of subsequent pieces of related work. However, because of the large number of details, tables, and subtle findings, the outcome of the quantitative part of the study is rather confusing, despite its uniqueness. While in terms of the breadth of investigation the study is a milestone among similar works, neither a synopsis nor a critical review of it is available. Therefore, a relatively detailed account of the study will be given below. Firstly, a brief account of the history of the study is presented. Then the procedure of selection, selection criteria, and performance criteria are described. Afterwards, major findings are presented and discussed.

The Architectural Education Research Unit at the Bartlett School of Architecture was established in 1963 and bore three main outcomes, two books in 1969 and 1977, and a paper in 1972. While the second book (Abercrombie 1972), with a pedagogical stance, deals with the history of the study and its background events, the first book (Abercrombie et al 1969), gives a thorough account of the admissions procedure and its outcomes in the Bartlett School from 1960 to 1966. However, the main focus falls on two particular groups of cohorts. The first group is composed of the students who entered the school from 1960 to 1964 and did not withdraw (n=106). During those years, the admissions procedure/criteria were not exactly the same and slight variations are reported. The second group consists of British male students who entered the school during the period 1964-1966 (n=79). The latter cohorts are reported to have undergone very similar admissions procedures, but it should be noted that alterations were gradually made to the curriculum and syllabi over the same period. The unit also studied the 1967 and 1968 entrants, however, the latter pieces of study were not disseminated or made available to outsiders. The first source, Abercrombie et al (1969), consists of two main parts. The first part gives a thorough account of the selection procedures, criteria, and candidates' personal and academic details. The second part deals mainly with the performance of the selected students during their Bachelor's Degree course and its relation to the selection criteria. For the first group, i.e. cohorts 1960-64, the academic performance criteria comprise all marks or grades that the students gained during their Bachelor's Degree course, while for the cohorts 1964-66 only first year performance is considered. The complementary paper, Abercrombie et al (1972), mainly focuses on the second group, i.e. cohorts 1964-66, and gives the supplementary details of the students' academic performance during their course and respective relations with the selection criteria.

One of the advantages of this old but unique study is the administration of some psychological intelligence and personality tests along with the school's admissions procedure. Psychological tests were not intended to be taken into account for selection, rather, such tests were employed as an exploratory tool to find out whether specific attributes/characteristics were associated with particular groups of students (e.g. accepted vs rejected, or good performers vs poor performers).

2.1.1. Technical Background

Selection Procedure

Apart from a few exceptional cases concerning overseas applicants, it was the policy of the school not to offer places without interview. However, reportedly, due to the increasing number of candidates it was not possible to interview them all, and therefore, some screening mechanism was necessary. From 1960 to 1962 inclusive, candidates were selected for interview on the basis of their UCL application form. In the UCL application form, not only did the candidates give their academic qualifications but they also had to write about their reasons for choosing architecture and give a description of their interests. The Bartlett also requested headmaster's/headmistress' reports from the candidates' schools.

In 1960, the head of the school interviewed selected candidates and decided on the entrants. In 1961, 62, and 1963 a board of three members of teaching staff interviewed the candidates.

In 1963 and thereafter, all candidates had to apply through UCCA (Universities Central Council of Admissions). In order to select candidates for interview, their Academic Record, Referee's Report, and only in 1963 Candidate's Statement were taken into account. The authors claimed that each of the submitted documents was 'graded on a scale of desirability', but they did not explain in detail how the grading was carried out in practice. However, they said: '[t]he assessments were subjective, but we found that there was good agreement between us'.

In 1964, 65 and 66, screening for interview was based on the candidates' Academic Record and Referee's Report. Only those who were selected for interview were asked to send a Candidate's Statement. A series of three individual interviews replaced the board interview. Psychological tests were also administered, but not used for selection.

In 1967 and 68, selection for interview was as before, however, for admission to the school, interview was given a lighter weight, because previous evidence had shown that interviews were not of a reliable predictive value. Most interviewees had only one interview and in exceptional cases a second interview was done. This part of the study was not published.

Selection Criteria

Paper Qualifications

To apply to the Bartlett School, candidates had to obtain GCE passes either in five subjects, two of which had to be at A-level, or in four subjects, three of which had to be at A-level. From 1960, however, an A-level pass in Mathematics was set as a prerequisite. The school was adopting a more scientific approach towards architectural education and the selectors assumed that mathematical aptitude was correlated with and represented the necessary 'scientific, objective, and logical' ways of thinking. Moreover, because of the design of some new courses, A-level mathematical knowledge was considered to be necessary for their understanding. In the three pieces of information available before interview, i.e. Academic Record, Referee's Report, and Candidate's Statement, the following details were sought and assessed.

In Academic Record (mainly O-Level performance), number of subjects passed, grades obtained, repeated failures, ages at the time of examinations, number of subjects taken at a sitting, range of subjects, kind of school, and family background were sought. Academic Records were graded from A to E and included categories: very good (with signs of distinction), good, average, weak, and very weak.

In the Referee's Report, 'warmth of support for the candidate and confidence in his future as a student' were examined, 'bearing in mind how well the referee seemed to know the candidate, and to understand the requirements of architectural training.' Grading scale consisted of a five category A to E scale.

Candidate's Statement was expected to cover each candidate's main interests and activities, and reasons for choosing architecture and applying to the Bartlett School. In the Statement, issues such as 'wide interests, a flexible outlook, and a generally energetic and productive way of life' and kind of school attended were sought. Grading scale was the same as previous items.

Interviews

Interviews had two major aims: (1) to assess the potentiality of a candidate as an architect; and (2) to find out how suitable each candidate as a member of Bartlett would be.

Not only were the interviewees asked to bring portfolios of their drawings, models, photographs, sculpture, etc but also they were asked questions of their reason for wishing to become an architect, books read, hobbies, buildings seen, etc.

The following aspects were to be identified and evaluated in interviews.

1. Sensitivity to environment
2. Range of interest; appetite
3. Ability to organise material conceptually
4. Ability to organise material concretely
5. Personal likeability
6. Global grade

Item 5, personal likeability, was deliberately included to check its possible influence on the other grades, in other words, to see whether interviewers were able to disentangle their subjective feelings for a candidate as a person, from their assessment of the candidate's relevant characteristics.

Weighting of Selection Criteria

Selection criteria were not given identical weights in different years. In the early years, Academic Report was given the most weight in choosing candidates for interview, however, the interviewers' judgement had the dominant role in deciding the entrants. They made their decisions 'without deliberately considering the other grades, though all the material was available' (Abercrombie et al 1969; p 25). Interim studies showed the 'precarious' predictive value of interviews and therefore, interview lost the hitherto decisive role later. From 1967, the sum of the grades given for the paper qualifications and the interview grades were applied to decide the acceptability rank of the interviewees.

Psychological Tests

From 1964 to 1968, a total of 15 different psychological tests were given to the interviewees, however, only two of them were administered throughout, and the published pieces of research just reflect the results of those two tests, namely AH5 and DPI. AH5 was known as a 'high grade intelligence (general reasoning ability)' test which comprised two parts. The first part dealt with verbal and numerical problems, referred to as verbal and mathematical reasoning, or intelligence. The second part embodied problems in diagrammatic form, hence tending to check some non-verbal propensities.

DPI or Dynamic Personality Inventory was a 325 item test intended to explore an individual's 'personality traits, tendencies and defence mechanisms'. A more detailed account of this test is given later in this section. Other tests were also either about personality or spatial ability.

Performance Criteria

To study the predictive value of the selection criteria, different performance criteria were applied in the Bartlett School. In some cases, written examinations mean marks, shown in percentage ranges, were used. In order to classify students' final performance Honours Degree Classes were applied, and in other cases, in order to indicate the quality of performance during the Bachelor's degree in the Bartlett, a measure called 'Bartlett categories' was used. In the 'Bartlett categories', students' performance was classified into five groups called 'OK', 'Chequered', 'Limping', 'Lost', and 'Withdrew'.

The 'OK' students were those who had completed the Bachelor's Degree in the minimum three year time without any failure in written examinations and having been 'satisfactory in studio work.'

'Chequered' students had completed the degree in three years and were satisfactory in studio work as well, however, they had to repeat some examination while continuing the course.

'Limping' students were not able to complete the course in three years time and it took longer for them to complete the First Degree, because they had to repeat a year or retake some examinations after spending one or more years out of school.

'Lost' students, having failed in examinations and/or studio work, had left the School without getting any degree.

'Withdrew' students, being very few, changed their mind very early in order to study another course.

Data Treatment and Statistical Tools

Both in the main study and in its follow up, the researchers gave brief descriptions of the processes of data treatment and statistical methods applied. They claimed that in order 'to facilitate the derivation of averaged and composite scores', all variables, predictors and criteria were normalised and transformed into standard scores (Abercrombie et al 1969 p108; 1972 p77). For the analysis of the cohorts' 1960-64 data, and in search of respective group differences, Chi square[1] tests were mainly applied. However, as regards cohorts 1964-66, product moment correlation, and one-way analysis of variance[2] were additional statistical tools. In some limited cases, Spearman's rho correlation were also applied.

Despite the fact that the researchers made a manifest attempt to examine and report every minute detail, there exist cases where the use of particular analytical methods or the interpretation of the results seems questionable. A series of outstanding findings which were claimed by the original authors are reported below, and each questionable finding is tackled immediately afterwards.

Because of differences between the admission procedures employed before and after 1964, and also differences in the statistical methods applied, such findings are reported in separate parts (i.e. 1960-64 and 1964-66).

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[1] Chi square test is a statistical tool for testing 'the difference between *observed* frequencies and *expected* or theoretical frequencies' (Cohen and Holliday, 1982, p133). The null hypothesis in using Chi square is that neither association nor difference exists between the (two) variables under study.

[2] Analysis of Variance is a statistical tool to test 'differences between the means of several (>2) groups of scores' (Cohen and Holliday, 1982, p206). It is used to test whether the samples under study represent the same population in terms of their means.

2.1.2. Findings

2.1.2.1. Cohorts 1960-64 (inclusive)

By the use of cross-tabulations and Chi square tests the authors examined the relation between predictors and performance criteria of 1960-64 cohorts (n_{max}=106). No differentiation was made in this part of the study between the students in terms of their gender or origin.

Table 2.1 renders an abridgement of what the Bartlett researchers used and reported on relations between different selection and performance criteria during the period 1960-64. The first and second cells in each row show the pair of criteria the relation between which was studied. In the third and fourth cells of the same row, different classes of the first and second criteria are shown respectively. Colons in the third and fourth columns show the cut-off points of individual or combined classes of each criterion as used in Chi square test tabulations. The last column displays the significance level of the test results.

Best Predictors, Cohorts 1960-64

Drawing upon the results illustrated in Table 2.1 and Table 2.2, the Bartlett researchers concluded that among the results of all students of cohorts 1960-64 'the best single predictor [was] Academic Record followed by Candidate's Statement' (Abercrombie et al 1969 p85).

With reference to Table 2.2, the authors (in the same place) claimed that the combination of any other predictors (selection criteria) with Academic Record raised the predictive value, and the best combination was Academic Record with Candidate's Statement. The combination of three or four predictors is reported not to have improved on the results. As shown in Table 2.1 and Table 2.2, Chi square test was the only statistical tool for the study of the relations of individual or combined selection criteria with certain measures of performance. However, it should be noted that, as Cohen and Holliday (1982), deVaus (1996), and Siegel and Castellan (1988) have clarified, Chi square test is intended to show class or group differences and in fact whether such differences are significant or not[3]. Chi square test is not intended to show the magnitude of association between variables.

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[3] To speak more precisely, the test shows how confidently the null hypothesis of no difference can be rejected.

Table 2.1. Relation between different criteria (selection and performance)
Cohorts 1960-64
Adapted from Abercrombie et al (1969)

Selection criterion	Performance criterion	Classes of selection criterion [a]	Classes of performance criterion [a]	n [b]	Level of significance [c]
Academic Record (Application)	Bartlett performance	A, B : C, D, E	OK : Ch : Lmp : Lst	106	p<.001
Academic Record (Entry)	Mean mark written examinations 3rd year	A, B : C, D	100-70, 69-60, 59-55 : 54-50, 49-40, 39-0	76	p<.01
Academic Record (Entry)	Class in studio work 3rd year	A, B : C, D	1, 2.1, 2.2 : 3, F	76	p<.02
Academic Record (Entry)	Bachelor's Degree results	A, B : C, D, E	1, 2.1 : 2.2, 3, F	76	p<.001
Referee's Report	Bartlett performance	A : B, C [d]	OK, Ch : Lmp, Lst	106	.05<p<.1 NS
Candidate's Statement	Bartlett performance	A : B, C [d]	OK : Ch : Lmp : Lst	106	p<.01
Interview Grade	Bartlett performance	A : B : C, D, E	OK : Ch : Lmp, Lst	83	NS

a: Colons in the third and fourth columns separate individual or combined classes as used for Chi square test tabulations. Abbreviations stand for OK, Chequered, Limping, and Lost.

b: Applicable number of students in the respective subject(s) of investigation. 106: All students of the four cohorts; 76: Students who took the degree in minimum time; 83: Students for whom grades on the three paper qualifications and interview were available.

c: Level of significance of Chi square tests.

d: No students were graded D or E amongst those who entered the School.

To convert raw Chi square results into correlation coefficients 'between 0 and 1', deVaus (1996, p166) mentions two of the Chi square based correlation coefficients, namely Phi or Carmer's V, and a number of other statistical tools to arrive at comparable measures of association. It should also be borne in mind that level of significance shows how many out of 100 samples by chance alone would show the particular relation we observe in our sample and has nothing to do with the magnitude of association. Moreover, in cases where the variables are of many classes, the grouping of classes, i.e. the location of cut-off points (which are somewhat arbitrary in this case), may affect the outcome substantially.

Table 2.2. Relative Prediction of single and combined Selection Criteria
83 Students (1961-64)
Adapted from Abercrombie et al (1969)

	Predictors used in Selection				Relation with Overall Performance [a]	Cells used in Chi square test [b]
	Academic Record	Referee's Report	Candidate's Statement	Interview	n= 83 1961-1964	
1	X				p < .05	A : B : C D E OK : Ch : Limp/Lost
2		X			NS	A : B C OK : Ch : Limp/Lost
3			X		p < .05	A : B C OK : Ch : Limp/Lost
4				X	NS	A : B : C D E OK : Ch : Limp/Lost
5				X	p < .02	A B C : D E OK : Ch : Limp/Lost
6	X	X			p < .02	No Cs : With Cs OK : Ch : Limp : Lost
7	X		X		p < .001	No Cs : With Cs OK : Ch : Limp : Lost
8	X			X	p < .01	No Cs : With Cs or low interview (D, E) OK : Ch : Limp : Lost
9	X	X	X		p < .001	No Cs : With Cs OK : Ch : Limp : Lost
10	X	X		X	p < .01	No Cs : With Cs or low interview (D, E) OK : Ch : Limp : Lost
11	X		X	X	p < .001	No Cs : With Cs or low interview (D, E) OK : Ch : Limp : Lost
12	X	X	X	X	p < .001	No Cs : With Cs or low interview (D, E) OK : Ch : Limp : Lost

a: Statistical significance of the Chi square test results.
b: Classes of selection and performance criteria (A, B, C, D, E; and OK, Chequered, Limping, Lost). Colons show cut-off points.

For instance, one type of grouping of the students' interview grades resulted in significant, and the other type in non-significant differences in their identical performance categories. As seen in Table 2.2 row 4, interview grades are divided into three groups: As; Bs; and a combined group of Cs, Ds and Es. In row 5, there are just two combined groups of interview grades. The first group comprises As, Bs and Cs; and the second group consists of Ds and Es. Grouping of performance categories is the same in the two rows. 'OK' and 'Chequered' are in individual cells, and 'Limping' and 'Lost' categories together form a third cell. As can be observed in Table 2.2, while the particular grouping of interview categories in row 5 results in significant differences between performance categories under study, another kind of grouping, e.g. in row 4, can result in a non-significant level.

Therefore, unlike correlational studies which look for 'the extent to which increments in one factor occur together with increments in the other' (Cohen and Holliday,1982 p86), the mentioned use of Chi square test and its related levels of significance, can neither render the magnitude nor a comparable measure of association between the predictors and performance criteria of the study. This implies that the above reported claims about the 'predictive' value of different selection criteria can be seriously called into question.

Relation Between Written Examination and Studio Work

In the same manner, the authors also reported on the relation between written examination and studio work of the cohorts 1960-64.

The data on third year examinations mean marks and studio grades of 1960-64 cohorts are given in Table 2.3. By applying the Chi square test, the authors concluded that 'performance in studio work and in written examinations in the Third Year are related', and 'the relationship is significant at $p<.05$.' (Abercrombie et al 1969 p67). However, it is the noticeable difference between the small segments of top and poor performers that must have led to the significant result, and the significance of the result does not tell us anything about the magnitude of the relationship.

By the use of the same data, the present author carried out 'ordinal by ordinal' correlation tests to see how strong the relationship was. It was found that, similar to the Chi square test, the correlation result was significant. However, in terms of magnitude (on both Spearman's rho and Kendall's tau) the size of correlation was .29 which means less than ten percent of the factors accounting for variability are common to both variables.

Table 2.3.
Relation of mean mark on written examinations to studio work grade in Third Year
Cohorts 1960-64

Adapted from Abercrombie et al (1969)

Rank of exams mean mark	Design work grade					Row total
	1	2.1	2.2	3	F	
1	2	3	2	0	0	7
2	6	9	12	4	0	31
3	2	0	3	10	0	15
4	2	2	4	3	0	11
5	0	2	0	4	3	9
6	0	0	0	2	1	3
Total	12	16	21	23	4	76

A similar examination was carried out of the data of those students who had gained 2.2 or higher in their design work (shaded part of the above table; nearly two thirds of the sample). A trivial correlation of only around .05 was found for this large segment of the 1960-64 students. This supports the claim that the significant difference was the effect of noticeable difference between two opposite extreme segments, and almost no relationship was observable for the majority of the sample. For more details about the ordinal by ordinal correlations see Appendix 2.1.

Interviews

Interviews were found to be pointless predictors. The applied Chi square tests are reflected in Table 2.1 and Table 2.2. Abercrombie et al (1969 p80) also reported that no marked differences were observed between the performance of those who were placed in the top three classes of the five interview grade classes. Moreover, to check the validity of statements made about interviewees at a board interview, the researchers matched those statements with statements made later by teachers about the abilities of those students (former interviewees) during the course. Despite the fact that in some cases the interviewer and the subsequent teacher were the same person, marked discrepancies were observed and the researchers concluded that 'there is little relationship between the statements made at a board interview about specific characteristics of candidates, and the opinion of teachers who become familiar with their work as students over three or four years.' (Abercrombie et al 1969 p85). Additionally, since the mean score of accepted candidates on the verbal part of the intelligence test (and not the diagrammatic part) was significantly higher than those of the rejected, the authors suspected that the verbal proficiency of the interviewees might have influenced the interviewers.

2.1.2.2. ***Cohorts 1964-66*** *(inclusive)*

At the time of disseminating their first work (Abercrombie et al 1969), the authors reported on the relation of selection criteria and psychological tests to only the first year performance of cohorts 1964-66. In spite of some changes in examination regulations and rearrangement of some courses, those groups of students are reported to have experienced 'a uniform method of selection and a fairly uniform first year of study' at the Bartlett. Another important point that should be made here is the fact that, according to the authors, these three cohorts were large enough to allow separate analysis for each cohort, and by more powerful statistical methods. It was also 'numerically feasible to omit female and overseas students from the samples on the grounds that differing developmental cultural and motivational characteristics may confound predictor-criteria relationships observable in the male British samples' (Abercormbie et al 1969 p107). In the interests of homogeneity, only male interviewees of ages 17 to 20 and educated in the UK were included in the study of cohorts 1964-66. Originally, 260 male candidates of ages between 17 and 20 were selected for interview from among 1002 candidates. Out of that 260 candidates 126 passed the interview and were offered a place, however, 79 decided to study at the Bartlett and entered the school. Drawing upon the second part of the first report (Abercormbie et al 1969) and the whole second report (Abercormbie et al 1972), the following parts of this section mainly report on the findings based on the mentioned 1964-66 data.

Intercorrelation of Predictors

For each cohort, the product moment correlations of 15 predictors, including both employed and potential predictors were calculated[4]. The available outcomes rendered 301 correlation coefficients the majority of which were very low and non-significant. As could be expected, measures of the same nature such as UCCA grading and Academic Record at entrance were consistently, highly and significantly correlated (min .82, max .88, $p < .01$), and almost the same was true for the correlation between the first and second part of the intelligence test and the total score of the test (min .60, max .85 $p < .01$). Apart from such anticipated correlations, however, the only significant and rather consistent correlation in the three cohorts was between interview 2 (range of interest, and appetite) and interview 6 (global grade). These correlation coefficients for cohorts 1964, 65, and 66 were .58, .83, and .59 respectively, all above one percent level of significance. Other than the mentioned correlations which were rather similar for the three consecutive years, there were no more cases of close and significant correlation in common by all three cohorts. Although 30 other significant correlations were observable in the total 301 cells, those 30 cases looked sporadic and very scattered throughout the table. Apart from failing to reach the accepted levels of significance, a considerable number of correlation coefficients were very low. For instance, the average of 41 possible correlations of the Referee Reports with the other criteria was just .14 (Std Dev .18) while only two of the cases were significant. Table 2.4 represents a part of 301 available correlations.

Relationship of Predictors to Studio and Examinations

No table was given to show correlations between predictors and separate subjects in detail in the follow up, however, the team claimed that such correlations were found to be very variable and no consistent pattern was detectable. Not only were the correlation coefficients very variable between different subjects, but also the same was true within the same subject from year to year and from cohort to cohort (Abercrombie et al 1972 p82). It was the same in the first report, where it

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[4] Predictors were Academic Record at application (mainly O Level grades); Academic Record at entrance (A Levels or equivalents); Referee Report; Candidate's Statement; Petch grading; UCCA grading; AH5 Intelligence Test (parts 1, 2, and total score); Interviews (1. Sensitivity to environment, 2. Range of interest, and appetite, 3. Ability to organise material conceptually, 4. Ability to organise material concretely, 5. Personal likeability, 6. Global grade).

demonstrated the relation between predictors and seven criteria of just first year performance for the three cohorts.

Table 2.4. Product moment correlations between predictors
Entrants 1964-66

Adapted from Abercrombie et al (1969)

Predictor*	Yr	AR ap	AR ent	RR	CS	AH5			Interview					
						I	II	Total	1	2	3	4	5	6
AR ap	1964	-	.33	$.67^{*}$	-.16	.01	$-.44^{+}$	-.28	.21	$.46^{+}$	.17	.22	-.05	$.52^{+}$
	1965	-	.32	$.46^{*}$	-.20	.12	$.36^{+}$	.27	.04	.11	-.14	.02	.04	.02
	1966	-	$.43^{*}$	.16	-.23	.26	.27	$.48^{+}$	.03	.02	-.22	/	-.26	-.26
AR ent	1964		-	.27	.24	-.20	-.08	-.23	$.62^{*}$	.32	-.02	.36	-.33	.30
	1965		-	.32	.20	.35	$.46^{*}$	$.47^{*}$	-.16	.10	.04	.14	.07	.05
	1966		-	.30	.27	.03	.28	.21	$.39^{+}$	.14	-.20	/	-.16	-.18
RR	1964			-	-.15	.20	-.26	-.06	.34	.14	-.26	.12	-.05	.38
	1965			-	.10	-.03	.26	.16	.10	.08	.02	.28	.04	.08
	1966			-	.05	.05	.14	.14	.26	.10	-.19	/	.10	.20
CS	1964				-	-.11	-.11	-.10	.23	-.32	-.06	-.03	.03	.02
	1965				-	.17	.15	.16	.07	.17	.13	.11	16	.29
	1966				-	.12	.19	.14	.16	-.10	.11	/	.08	-.12

*: Abbreviations: AR ap: Academic Record at application; AR ent: Academic Record at entrance; RR: Referee's Report; CS: Candidate's Statement; AH5-I: test of (verbal and numerical) intelligence; AH5-II: test of (diagrammatic) intelligence.

*: $p < .01$
+: $p < .05$

From different applied predictors, none showed a relatively consistent and significant correlation with a certain subject in any two consecutive cohorts of the three cohorts. However, taking into account all potential and applied predictors, there were cases of relatively consistent but low and non-significant correlations. For instance, Academic Record at entrance correlated with first year Overall Performance .33, .35, and .29 in 1964, 1965, and 1966 respectively (all non-significant). No other predictor rendered any higher consistent correlation with individual subjects or overall performance in the three First Years of the study. By calculating multiple correlation it was shown that the combination of predictors returned better correlations than single predictors. For example, the combination of Candidate's Statement with Academic Record improved the previously observed correlations of Academic Record with Overall Performance by between .14 and .28. However, the result of combining more than two predictors did not prove noticeably better. The researchers claimed it was 'apparent that little is to be gained from combining more than two predictors.' (Abercrombie et al 1969 p120). It should also be noted that no pattern of predictor combination worked optimally for all three cohorts.

Bearing in mind that the authors reported every minor issue that might have had an implication for selection, the brevity of their comment on the relationship between predictors and individual subjects is telling. They stated succinctly that '[t]here were no consistent relationships of performance in any specific subject at the Bartlett with any of the selection criteria.' (Abercrombie et al 1972, p 86).

Relation Between Written Examination and Studio Work

Contrary to the section about 1960-64 cohorts, researchers did not report on the relationship of design work to written examinations *mean* mark in the third year. However, some individual correlations were given for studio and other courses which seems more illuminating than those of aggregated mean marks. The results varied from cohort to cohort. While a few modest and significant correlations were found between studio and history or non-calculative technological courses such as construction, low and non-significant correlations were always observed between studio work and structure. Table 2.5 shows product moment correlations between studio work and structure examination for the first and third year of each cohort.

Table 2.5.
Correlation between design and structure marks*

		Structure	
	Cohort	1st year	3rd year
Design	1964	**0.35**	**0.09**
	1965	**0.24**	**0.1**
	1966	**0.07**	**0.35**

*: All product moment correlations non-significant
First year: n = 1964, 21; 1965, 31; 1966, 26
Third year: n = 1964, 16; 1965, 24; 1966, 24

Yearly Variation in the Same Subject

By calculating product moment correlations between successive parts of the same subject (e.g. History 1, 2, and 3), the authors demonstrated that 'performance in any one subject taken over two or three years varies from year to year'. However, performance in studio work turned out to be fairly consistent. In all three cohorts, performance in studio 1 and studio 2 correlated between .45 and .74, and at least above five percent level of significance. Studio 1 and 3 were also correlated positively between .36 and .56 but only in 1964 significantly. Apart from studios a moderate consistency was observable in structure courses but other subjects showed much variations (Abercrombie et al 1972,p81,82).

Interview

As with cohorts 1960-64, for cohorts 1964-66 the student selection interviews proved fruitless. For each cohort (1964-66), the correlation of interview grades with first year performance criteria was very low and not significant. The average of 21 possible correlation coefficients between 'Global' interview grades and seven different course and studio marks of first years was .16 (Std Dev: .09; min: .00, max: .31). The team concluded that 'in the study of first year performance of the 1964-66 cohorts, the interview was of little predictive value, and in particular, no consistent relationship was found between performance in studio work and the ratings given at the interview specifically intended to test "ability to organize material concretely".' (Abercrombie et al,1969 p80, p116).

The subsequent follow up (Abercrombie et al 1972), supported the previous findings about interviews. As shown in Table 2.6, not only did interview mean scores fall short of discerning any significant difference among groups, but also the rank orders of those scores (subscript figures to the left of the mean scores) were very distorted as compared to the performance ranks, i.e. performance categories. Weak performers were shown to have enjoyed the highest mean score (6.11) on the admissions interview. Good performers, however, similar to average performers were of the lowest mean score (5.45) on the same interviews.

Table 2.6.
Mean scores of cohorts 1964-66 on selection criteria, and intelligence test, by degree performance category *

Adapted from Abercrombie et al (1972)

Performance		n	Academic Record	Referee's Report	Candidate's Statement	Interview	AH5 I	AH5 II	AH5 Total
Categories [a]	1	27	$_{1}$ 7.03	$_{1}$ 7.63	$_{1}$ 7.07	$_{2}$ 5.96	$_{1}$ 19.63	$_{2}$ 24.85	$_{1}$ 44.48
	2	24	$_{4}$ 5.67	$_{5}$ 5.88	$_{3}$ 6.71	$_{4.5}$ 5.45	$_{4}$ 18.46	$_{1}$ 24.92	$_{3}$ 43.38
	3	11	$_{2}$ 6.36	$_{3}$ 6.82	$_{4}$ 6.45	$_{4.5}$ 5.45	$_{5}$ 17.09	$_{4}$ 23.27	$_{5}$ 40.36
	4	9	$_{5}$ 5.33	$_{2}$ 7.11	$_{2}$ 7.00	$_{1}$ 6.11	$_{2}$ 19.56	$_{3}$ 24.44	$_{2}$ 44.00
	5	8	$_{3}$ 6.00	$_{4}$ 6.62	$_{5}$ 5.50	$_{3}$ 5.62	$_{3}$ 18.62	$_{5}$ 21.75	$_{4}$ 40.37
Level of significance of mean score differences [b]			n.s.	p<.05	n.s.	n.s.	n.s.	n.s.	n.s.

*: Subscript figures to the left of the mean scores represent the rank of each group mean in the corresponding column.

a: Performance Categories: 1: Class 1 or 2.1 Honours Degree or excellent; 2: class 2.2 or good; 3: class 3 or average; 4: those who took more than three years to gain the degree or weak; 5: failed or drop-outs.

b: As measured by F test (one-way analysis of variance).

Referee's Report

Drawing on the data under *Referee's Report* in Table 2.6, the authors concluded that '[p]erformance at the Bartlett is significantly (p<.05) related to RR' (Abercrombie et al, 1972, p79).

Seemingly, the respective level of significance of the applied F test (p<.05) which was the only statistically significant result led the authors to that conclusion. However, the significance of difference between group means on RR does not necessarily imply any significant incremental relationship between the predictor and the criterion under study. As de Vaus (1996, p186) emphasises, '[w]hen we are comparing three or more means', similar to the cases in Table 2.6, 'all an F-test can tell us is that at least two means exhibit a real difference from one another.' Figure 2.1 is a graphical explanation of why the group means on RR rendered a significant difference.

The bold numbers (1 to 5) in the plot area of Figure 2.1 represent performance categories, the location of each bar on the horizontal axis shows the respective category's mean, and the height of each bar demonstrates the number of students in each category.

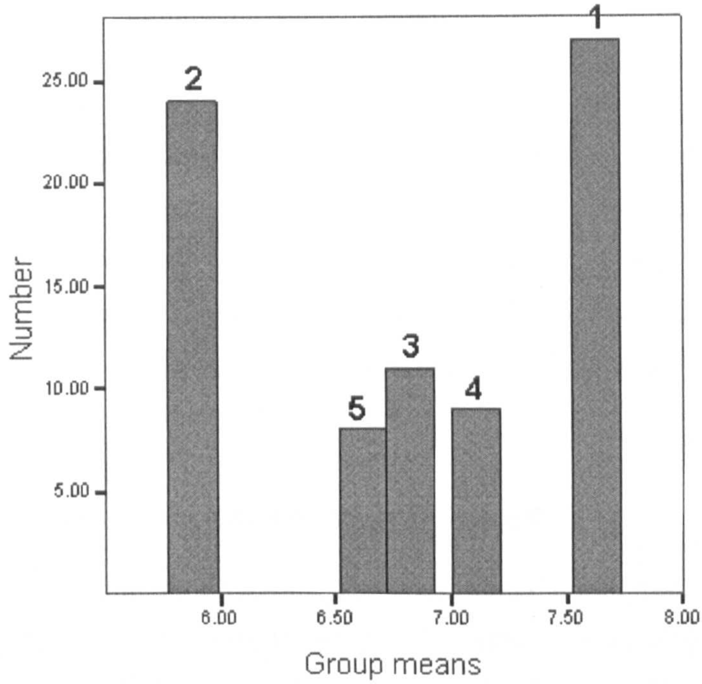

Figure 2.1. Difference between group means on Referee's Report
Cohorts 1964-66

As seen in the figure, three performance categories 3, 4, and 5 stand closely both in terms of their number of students and their group means as compared to categories 1 and 2. However, not only do categories 1 and 2 consist of larger numbers of students, but they also stand further apart (on the two extremes of the group means range), and thus cause a significant difference. Yet, as seen in Table 2.6 and Figure 2.1, there is a clear misplacement on the ranks of performance category means as compared to their respective ranks of means on RR. Category 2 or good performers, collectively, had the lowest mean score on Referee's Report, while Category 4 or weak performers were next after Category 1 on their Referee's Report mean score. Therefore, solely on the basis of a significant difference within the group means on RR, it is wrong to conclude that performance was significantly related to the Referees' Report. Contrary to the authors' claim, Table 2.6 suggests that mean scores on the diagrammatic part of the intelligence test (AH5-II), and then, mean scores on the Candidate's Statement show the best relationships with the Bartlett performance categories; and mean scores on interview , and then verbal and numerical part of the test followed by Referee's Report show the poorest corresponding relationships. More details are given in Appendix 2.2.

The point which seems worth mentioning here is that the authors stressed the lack of any significant correlation between Candidate's Statement and Academic Record, or Referee's Report predictors. Commenting on the six possible correlations for the three cohorts, the authors wrote: 'indeed four of the six correlations are negative. This is interesting in view of the fact that on the personality test, candidates given high grades on CS [i.e. Candidate's Statement] differ more strongly from those given low grades than is the case with the other paper qualifications' (Abercrombie et al 1972, p79).

2.1.2.3. DPI Psychological test and related findings

From a total of 15 different psychological tests given to the interviewees between 1964 and 1968, only the results of the Dynamic Personality Inventory were discussed thoroughly. While the authors wrote: '[t]he Dynamic Personality Inventory is not a well-known test nor widely used', the originator of the test (Grygier 1961) claimed that '[t]he test has been used extensively in Europe and America in research on personnel selection, studies of occupational success and failure, prediction of academic success,' and so on. Grygier (in the same place) also reported that most of the 32 scales of the test had satisfied the criteria of adequate reliability (split-half and test-retest), content validity[5], concurrent validity, and construct validity. Average split-half reliability of the scales was reported as .75 and average test-retest reliability as .80. While both the originator of the test and the Bartlett researchers stress that, in its construction, the test has followed a 'psychoanalytic approach to the theory of personality', the Bartlett team emphasise that in their study they have not looked for 'psychoanalytic interpretations of the DPI' and have not justified its use by such intentions. Rather, they claim that they interpreted the test 'simply in terms of the content of its items, and justified its use by its face validity and, after the event, by its power to pinpoint consistent and

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[5] Grygier (1961) describes the above validity indicators as follows.

Content validity: 'as reflected in the degree of correspondence between the content of the items of a scale and the theoretical formulations around which the scale is constructed'.

Concurrent validity: 'as indicated by statistically significant relationships between test scores and independent measures of corresponding personality traits'.

intelligible individual differences.' (Abercrombie et al 1969 p49). A list of all 32 scales of the test is displayed in Table 2.7.

Despite the awareness of the authors of the theoretical foundations of the test, some of the scales seem either adrift in an educational context, or need very painstaking interpretation. For instance, where in the Bartlett team's reports the scale 'Pf' reads 'Sensitivity and Imagination' which can be quite meaningful in any architectural education context, the same scale in Grygier (1961) is associated with 'Fascination by fire, winds, storms and explosions (sensual aspects of the Icarus complex): perceptiveness of sensual impressions, vivid imagination.' Moreover, the mathematical and statistical treatment of the data can be questioned in some cases which will be described below. Bearing in mind the above cautions about the test, the following are some of the most notable reported findings concerning the psychological test.

- Those candidates who were selected for interview (n=260) showed significant differences from the general population of students on whom the test norms were based. Out of a total of 32 scales, on 15 scales the significance of the difference between interviewees' mean scores and the norm (as measured by *t* test) was above one percent level and on three scales above five percent (Abercrombie et al 1969 p50). On the following scales, in the order of relative increase from the norm, interviewees' mean scores were found to be significantly higher.

  'Tactile and handicraft interests'
  'Sexuality, lack of sexual repression'
  'Creative and artistic interests'
  'Unconventionality'
  'Drive for achievement (active)'
  'Need for movement' and 'Masculinity'.

  And on the following scales, in the order of relative decrease from the norm, interviewees' mean scores were significantly lower.

  'Authoritarianism'
  'Hypocrisy, social conformity'
  'Orality'
  'Emotional dependence'
  'Submissiveness to authority'

Construct validity: 'as evaluated by the logical consistency of the empirical data and factor analysis with theoretical dynamic formulations'.

'Interest in children'
'Conservatism'
'Exhibitionism'
'Femininity'
'Hoarding'
'Liking for passivity'.

It is not known to what extent the above differences from the norm could be attributed to the screening system or the candidates themselves. What is known is that such characteristics were not mentioned among the reported details which were sought in the Academic Record or Referee's Report.

- There were significant differences between the mean scores of the accepted candidates and the rejected on some specific scales of the DPI. The accepted group were higher on 'creative and artistic interests' and 'feminine interests', and lower on 'conservatism' and 'authoritarianism' (all four cases p<.01 by t test), and also lower on 'attention to details' and 'ego-defensive persistence' (both cases p<.05) (Abercrombie et al 1969 p59, 1972 p82).
- As regards the (prior) Academic Records of the male candidates (n=260), the DPI mean scores failed to discern any significant difference between the high and low Academic Record groups.
- Concerning the relationship between DPI scores and overall performance in the first year for Bartlett entrants (1964-66), product moment correlations were calculated. For 1964 entrants only 'oral aggression' correlated significantly and negatively with overall performance (-.58 p<.01), for the 1965 cohort 'exhibitionism' and 'initiative' correlated positively (.46 and .47 respectively p<.01) and 'interest in exploration and adventure' correlated negatively with overall performance (-.36 p<.05). Regarding the 1966 cohort none of the scales rendered a significant correlation. Moreover, a considerable number of correlation coefficients were very low and no consistent pattern was observable over the three years of the study.
- As regards the relation of the psychological test to performance in degree at the Bartlett School, when DPI scores were related to degree classes (of all three cohorts together), the authors claimed that only one significant linear relationship appeared, namely between the 'initiative, self reliance and decisiveness' scale and degree class. However, the size of this relationship was not stated. There

also existed a number of non-linear U-shape relationships, 'in that First Class and Failures resembled each other: this was so for some of the scales that distinguished the candidates offered a place from those rejected after interview.' (Abercrombie et al 1972, p87). The first class students had very high mean scores on 'unconventionality', and the failing group being high on 'conservatism' and 'emotional dependence' scored on the opposite extreme to the first class. However, first class students and failing students both were reported to have gained high mean scores on 'masculine interests', 'verbal and intellectual aggression', 'orality', 'need for movement, change and independence', 'exhibitionism', 'interest in exploration and adventure', 'creative and artistic interest', and 'feminine interests'; and similarly low mean scores on 'tactile and handicraft interests' (Abercrombie et al 1972, p82).

- In order to study the relation of DPI to examinations and studio work (excluding degree class), all possible correlations were calculated. Since there were 54 sets of examinations and studio marks over the three successive courses of study (16, 16, and 22 for 1964, 1965 and 1966 cohorts respectively) and 32 scales of the psychological test, a total number of 1728 correlations between personality measures and the marks emerged. The authors reported that 11 per cent of possible correlations with studio marks, and 7 per cent of possible correlations with written examinations were significant at five per cent level. Without going into detail, they claimed that studio-design work showed 'clearest relationship between personality and performance, though only in the 1964 and 1966 cohorts.' (Abercrombie et al 1972, p83). Yet the successful studio performers of the two years tended to show some contrasting characteristics. For instance, while in 1964 top performers were high on 'conservatism', the 1966 top performers were high on 'unconventionality'.

Table 2.7 is a reproduction of one of the means through which the authors tried to comment on the relationship between the DPI and performance (examinations and studio excluding degree class). The table, in columns numbered 1, 2, and 3, summarises 'the numbers of positive and negative correlations (whether significant or not) of each DPI scale with each cohort's examinations and studio marks.' (Abercrombie et al 1972, p84). Totalled sums of the three cohorts are also given in column number 4. Looking at the difference between the positive and negative pair figures in column 4, the authors have decided the rank of tendency of DPI scores to correlate with performance (as shown in column 5). However, because of the disregard for the size of correlation coefficients and sole reliance on the algebraic summation of directions, i.e. positive or negative sign of correlation coefficients, the capability of the thus acquired values of representing real ranks of tendency to correlation are open to question.

Additionally, as the team themselves mentioned (in the same place), and as seen in Table 2.7, on many test items, 'scale's tendency as to positive or negative correlation reverses itself between the 1964 and 1965 cohorts.' A few of such instances are: 'Liking for seclusion, introspection', 'Unconventionality', 'Conservatism', 'Authoritarianism', and 'Exhibitionism'.

Bearing in mind that the size and level of significance of correlations were ignored, and the fact that the number of the course subjects was not the same in all three cohorts, the pooling of the three cohorts' data (Table 2.7, column 4) poses another problem: it may render a distorted and over-generalised picture of relationship between the personality scores and performance. Nevertheless, on the basis of top ranks and also the lowest ranks in Table 2.7, column 5, Abercrombie et al (1972 p84) concluded that there was a tendency for good performance to be related to high scores for 'initiative, self-reliance and decisiveness', 'creative and artistic interests', 'sexuality, freedom from sexual repression', 'unconventionality', and 'orality' (all highlighted in light grey in the table), and to low scores for 'insularity, reserve, mistrust and prejudice' and 'conservatism' (shown in dark grey in Table 2.7).

Likewise, in order to investigate the relation between the characteristics preferred at selection and performance over the course, ostensible ranks in column 5 (i.e. rank of tendency to correlate with performance) were compared with ranks of size of difference between mean scores of accepted and rejected candidates on different personality scales (shown in the adjacent sixth column).

The Spearman rank order correlation coefficient was reported .35 ($p<.025$ one tailed test) and thus the preferred characteristics at selection were claimed to have been associated with 'superior course performance'. Where pairs of ranks in columns 5 and 6 were high and quite close on particular personality scales, it was reported that seemingly preferred characteristics of that kind at selection also tended to be associated with superiority in course performance.

Table 2.7.
Relation of sum of positive and negative correlations of DPI scales with performance
(examinations and studio, excluding degree class), cohorts 1964-66

Adapted from Abercrombie et al (1972)

	[1]		[2]		[3]		[4]		[5]	[6]
	1964		1965		1966		1964-66			
	n=19		n=30		n=30		n=79			
DPI scales	+	-	+	-	+	-	+	-	Rank [a]	Rank [b]
Hypocrisy, social conformity	8	8	7	9	14	8	29	25	20	22
Liking for passivity, warmth, comfort	7	9	5	11	10	12	22	32	28	21
Liking for seclusion, introspection	13	3	3	13	14	8	30	24	16	23
Orality	9	7	10	6	18	4	37	17	4	5
Oral aggressiveness	1	15	9	7	12	10	22	32	28	8
Emotional dependence	5	11	7	9	9	13	21	33	30	23
Need for movement, change, independence	8	8	7	9	18	4	33	21	11	7
Verbal & intellectual aggressiveness	5	11	9	7	16	6	30	24	16	14
Impulsiveness & spontaneity	7	9	13	3	15	7	35	19	7	10
Unconventionality	4	12	16	0	17	5	37	17	4	3
Hoarding	10	6	9	7	13	9	32	22	13	28
Attention to details	12	4	5	11	13	9	30	24	16	30
Conservatism	12	4	2	14	3	19	17	37	31	32
Submissiveness to authority	10	6	3	13	12	10	25	29	22	26
Authoritarianism	13	3	3	13	14	8	30	24	16	31
Insularity, reserve, mistrust & prejudice	13	3	1	15	2	20	16	38	32	23
Phallic symbols	14	2	6	10	15	7	35	19	7	13
Narcissism	4	12	7	9	14	8	25	29	22	12
Exhibitionism	1	15	15	1	17	5	33	21	11	9
Active drive for achievement	11	5	2	14	12	10	25	29	22	18
Passive drive for Achievement	10	6	10	6	16	6	36	18	6	17
Sensitivity and imagination	8	8	1	15	15	7	24	30	25	14
Interest in exploration & adventure	14	2	2	14	15	7	31	23	14	19
Sexuality, lack of sexual repression	5	11	13	3	21	1	39	15	3	4
Tactile & handicraft interests	7	9	5	11	15	7	27	27	21	11
Creative & artistic interests	6	10	14	2	20	2	40	14	2	1
Masculine interests	11	5	7	9	16	6	34	20	9	27
Feminine interests	2	14	10	6	22	0	34	20	9	2
Interest in social activities	3	13	9	7	19	3	31	23	14	14
Interest in children	4	12	7	9	12	10	23	31	26	20
Ego-defensive persistence	3	13	8	8	12	10	23	31	26	29
Initiative, self reliance, decisiveness	12	4	13	3	19	3	44	10	1	6

a: Rank of tendency to correlate with performance.
b: Rank of size of difference between mean scores of accepted and rejected candidates.

'Creative and artistic interests', 'Unconventionality', and 'Sexuality' are a number of such instances. And where pairs of ranks were low but close on specific scales, those characteristics were reported to have been negatively associated with good performance. There were also a few scales on which 'the correlation between preferred candidates and successful students breaks markedly.' (Abercrombie et al 1972 p84). As seen in Table 2.7, scales such as 'Oral aggressiveness' and 'Masculine interests' are examples of the mentioned breaks.

This latter part, however, should be dealt with great caution, not only because of the previously mentioned technical problems, but also because of what the researchers themselves reported elsewhere about the failure of interviews in showing any relationship to the subsequent academic performance of the selected students.

2.1.3. Interim Summary of Findings: the Bartlett study

The two disseminated sources on the Bartlett study scrutinised a wide range of subjects from which some of the most important topics were reported and discussed above. Eventual findings under the two categories of Selection Criteria and Psychological Test are as follows.

Selection Criteria

- It was shown that a number of findings, especially those about the prediction of the performance of the 1960-64 cohorts, were questionable.
- The most indisputable finding was the inability of the conducted selection interviews to predict the subsequent academic performance of the candidates. In particular, despite the application of more powerful statistical tools for the analysis of the cohorts' 1960-64 data, no consistent relationship between interview grades and measures of subsequent performance was found.
- The intercorrelation of predictors (particularly those of different natures) were mainly insignificant and inconsistent. It was almost the same for the relationship of predictors to studio and examinations. However, it was shown that the combination of two predictors returned better predictions than those of a single predictor.
- Only in Studio, and to a smaller degree in Structure, was a relative consistency observed in students' performance over the years. Yet, Studio and Structure showed non-significant and low correlations, at best.
- Modest evidence was found that Candidate's Statement had a better capability than interview and other paper qualifications to distinguish between the good and poor performers.

Psychological Test

- The test failed to differentiate between the groups with high or low prior academic qualifications.

- Candidates who were selected for interview showed significant differences from the norm. Those differences did not seem attributable to their Academic Records or Referee's Report on the bases of which interviewees were selected.

- Likewise, those who were accepted (after interviews) showed significant differences from the rejected candidates in their psychological test (being higher on 'creative and artistic interests', for example).

- Evidence was found for the existence of local relationships between the psychological test scores and performance during the course. No decisive conclusion, however, could be made in that regard because of both large variation in different cohorts' results, and also methodological deficiencies.

- On the whole, Studio grades tended more than written examination marks to correlate with the psychological test scores.

- 'Initiative, self reliance, and decisiveness' was the only scale of the psychological test on which invariably positive correlations with overall performance were observed for all three studied cohorts.

- Two of the Bartlett study findings tend to highlight the importance of non-academic qualifications to a design-centred course. First, the fact that Candidate's Statement showed better relation than those of other selection criteria with 'performance classes', and also its combination with Academic Record rendered better predictions of performance. And the other, the fact that Studio Work more than Written Examinations tended to show correlations with the psychological test, while the latter failed to differentiate between the high and low groups on their prior Academic Records.

- Despite the emergence of some local relationships between the predictors and performance measures, the overall outcome of the study tends to indicate the lack of selection criteria of any consistent or statistically significant bearing on the subsequent performance of the majority of the students. There is a likelihood that the reported alterations to the selection procedures or curriculum (in the Bartlett) were responsible for the observed inconsistency in relationships. However, the study does not reveal whether the meagreness of the relationships should only be attributed to the alterations, or it is a common phenomenon to similar design-centred disciplines. Some of the studies in section three (below) help to clarify the issue.

2.2. Psychological Investigations

Having gained acquaintance with the Bartlett study, this section reviews five individual pieces of research. Four of them investigate the psychological, or cognitive differences between the students of design and other students or the general public. The fifth study makes an attempt to test a hypothesis about different thinking modes involved in a design situation. Table 2.13 (page 91) is compiled to show the basic parts of each study in order to give an overall view about them. A summary of each paper can be obtained from each separate row and a comparison between papers can be made through the columns.

2.2.1. Self-images of Students

Stringer (1970) showed that two samples of students of architecture and engineering had significantly different views about themselves. By applying a 50-item questionnaire, Stringer investigated the anticipated professional self-images of architectural and civil engineering students. The architectural students who were accounted for in the study were 262 students (from year1 to year5) from the schools of architecture in the universities of Edinburgh, Nottingham, and Wales. Their counterparts were 242 students (from year 1 to year 3) from the departments of engineering in the universities of Bristol, Edinburgh, and Nottingham.

The self-descriptive questionnaire included various statements on talents, interests, values, work habits, and points of view that an architect or engineer might have. The questionnaire was developed from a pool of items already used in the Institute of Personality Assessment & Research, University of California; and it was very similar to one of the questionnaires MacKinnon[6] used to test different groups of supposedly creative and non-creative architects. Students were asked to appoint the statements to five categories from those least characteristic of themselves to the most characteristic. Later, such categories were given values from 1 to 5 for the purpose of analysis.

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6 Mackinnon, D.W. (1963). Creativity and images of the self. In White, R.W. (ed). The study of lives. New York: Atherton press.

To study the possible significant differences between groups under study, different groups' means on each item were subjected to a conventional F test[7]. To compare the architectural and engineering students' self images, mean ratings of all year 1, 2, and 3 architectural students were matched against the same set of data for engineering students. Out of the overall 50 items of the questionnaire, significant differences emerged on 27 items (on 13 items $p < .001$; on 6 items $p < .01$; on 8 items $p < .05$).

In a subsequent Discriminant Function Analysis[8], Stringer (1970, p27) demonstrated that not only on single items, but also on all items as a whole a significant difference existed between architectural and engineering students. Differences between different years or schools of architecture were also observed. The contrast between the architectural and engineering students was more remarkable, however. Finally, by the use of Factor Analysis, Stringer grouped the significantly differing characteristics. Such characteristics were grouped according to their content under the five following titles.

1. *Aesthetic-creative motivation*

   - The students of architecture were more likely to see themselves as 'taking an aesthetic view and being more sensitive to matters of form and elegance in problems'; as being fluent at idea generation and creative in whatever they tried.

2. *Orientation toward other people*

   - The students of engineering were more likely to see themselves as 'seeking out the help and advice of other people'; as 'freely giving their time and ideas' to other people; as being more inclined to collaborate in a team than working alone.

3. *Mental habits*

   - The architectural students believed they had strong spatial visualisation abilities. They also enjoyed 'philosophical speculations'.

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[7] A statistical test which compares two or more groups means to find out how probable the observed differences are due to sampling errors. According to deVaus (1996, pp 184-5), the test is recommended when the dependent variable is in *interval* level, and the independent variable with only a few categories.

- The engineering students were more likely to see themselves as having an 'active, efficient, well organised mind'; as being 'neat and orderly in their habits and manner of work'.

4. *Purpose and responsibility*
   - The students of architecture were more likely to see their goals as being more social.
   - The students of engineering tended to see themselves as more responsible to the profession.

5. *Information*
   - The students of architecture were more likely to see themselves as 'keeping up with current publications and literature in their field'.

Comparing different groups of architectural students Stringer implied that, during the course, the self images of such students evolve from a rather idealistic (and somewhat stereotyped) image at entry to a more realistic perspective in the fifth year. Had he included the comparison of first-year-only students of the two disciplines in his work, much insight would have been gained as to whether initial personality and ability differences, or educational processes were responsible for the differing self images. Lee and Radcliffe's (1990) study which is reviewed below corroborates some of Stringer's findings.

2.2.2. Different Cognitive Strategies

In a more experimental approach Lawson (1984) compared the problem-solving behaviour of students of design vs. students of science in a design-like task. His intention was to understand how students of architecture (as designers) 'perceived the relations between variables' in a design problem, and the way they produced 'desired relations between the elements of their solutions'. He showed that the opposite groups employed different strategies.

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[8] 'This method of multivariate analysis enables one to test the null hypothesis that two or more groups are drawn from a common population with respect to their means overall on a set of variables. The correlation of variables is accounted for, so that shared variance between two items of similar content cannot contribute unduly to the overall difference between groups.' Stringer (1970, p27).

For his experimental purposes, Lawson required a controllable model of design activity which needed no specialist knowledge. Therefore, he devised a series of tasks, which required selection and arrangement of coloured blocks of different shapes, so as to try to maximise the amount of one particular colour showing around the outside faces of the blocks. Subjects were informed that some hidden rules were also in force which needed or limited the use of certain blocks. However, they were neither told what the rules were, nor were they instructed to discover the rules. But rather, the subject was required to produce a solution, and was allowed to ask if a combination of blocks that she/he had assembled was acceptable or not. An on-line computer was used by the subject to input his/her successive solutions and receive an instantaneous response as to whether each solution was accepted or not. In that way, it was possible to trace and compare the details of all interim solutions with correct solutions for further analyses.

The experiment included two phases: the first phase samples were made up of two matched groups of 18 architecture, and science students (all in their fifth year of study). In the second phase, the same number of first-year architectural students in their first term of study were compared with post A-level sixth-form school pupils eligible for university degree courses.

During the course of the experiment, two potential kinds of errors could have caused each subject to score less than a possible maximum score.

1. *Structural error* or failure to identify the hidden 'structural' rule which determined which blocks were necessary, or possible to use.
2. *Planning error* or failure to arrive at an optimal configuration when the structural rule was satisfied.

Lawson hypothesised that 'the more spatially able architects would make fewer planning errors than the scientists'. The analysis of the fifth-year students' results confirmed the hypothesis.

While the mean performance scores of the two first phase groups were similar, Lawson found them significantly different for different types of problem rules. The architects made fewer planning errors, but made more structural errors than the scientists. As compared to the first phase groups, the second phase groups, i.e. the sixth-form students and first-year architects, showed a poorer performance. The

difference between the two second phase groups was not statistically significant. However, similar to the first phase, the first-year architects made fewer planning errors and more structural errors than the sixth-form students.
Moreover, it was found that, during their problem solving steps, the science students had changed a significantly larger number of blocks than their architect counterparts; while blocks selected by fifth-year architects rendered significantly higher possible colour scores. In other words, the science students were more concerned with the trial of different blocks to discover the *structure* of the problem (i.e. the hidden rules), while the architecture students took on a sequence of high scoring solutions to arrive at an acceptable *solution*.

On the basis of the above observations, and reportedly further detailed examination of the protocols, Lawson concluded that fifth-year science students took a 'problem-focusing' strategy, while fifth-year architects showed a 'solution-focusing' strategy. More interestingly, he reports that retrospective interview with the students revealed that 'about half of each group could not conceive of any alternative to their methods.'

Lawson (1984; 1997) argued that the above differences cannot be attributed only to the educational experiences of each group. Because despite the undetectably significant (strategy) differences in the second phase, the sort of difference between the first-year architects and sixth-formers resembled well the difference between the fifth-year architects and scientists. Therefore, he claimed that educational methods must have 'merely reinforced an already existent difference in approach' between those who were attracted to one or the other course.

2.2.3. Interest Profile of Students

Mikellides (1989) studied the interest profiles of more than 700 first year architectural students collected over a period of 12 years from 1976 to 1988 in the then Oxford Polytechnic. The study makes a comparison between design-oriented students with some other professional groups of students. Mikellides showed that the interest profiles of Commerce, Art, Engineering, and Secretarial students were different. However, when he compared the Oxford Architectural students' profiles to the other fields' profiles, the Art students' and the Architectural students' profiles showed very close similarities.

He used the Rothwell-Miller Interest Blank (RIB 1968[9]) which is intended to give an 'assessment of vocational interests on the basis of an individual's attitude towards occupations based on his stereotyped ideas over time'. The profiles include the following twelve categories.

Outdoor	Persuasive	Social Services
Mechanical	Aesthetic	Clerical
Computational	Literary	Practical
Scientific	Musical	Medical

Both (Art and Architecture) groups showed quite similar levels of interest in Aesthetic and Outdoor activities; they also least liked Clerical and Computational activities. Data on seven isolated or consecutive years out of the 1972-87 period showed that the most liked category was invariably Aesthetic and the second and third preferred categories were either Literary or Outdoor activities. Concerning Scientific interest, as compared to Engineering students, not only were Architectural students not lower, but they also showed slightly higher levels of Scientific interest. While prospective engineers and architects were equally interested in Outdoor activities, their interest profiles fell furthest apart, first on Mechanical, and Aesthetic, then on Musical, Literary, and Computational interests.

Through the superimposition of four various line charts representing the interest profiles of four different architectural cohorts (obtained in 1973, 1976, 1980, and 1987), Mikellides showed that the line charts had stayed quite similar. While, for instance, some minor fluctuations on Mechanical, Persuasive, and Social services scales were observable, all four line charts intersected on the same points on each of the Aesthetic, and Computational scales, corresponding to the most and least liked categories respectively. Moreover, measures of interest in other categories such as Outdoor, Scientific, and Medical activities showed very close values.

The additional contributions of the Mikellides' study was the demonstration of differences between male and female students' profiles, and also cross-cultural differences.

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[9] Rothwell-Miller, Interest Blank (1968). National Foundation of Educational Research. Nelson Publishing Co.

Drawing upon the data of 1979 and 1980 female architectural entrants to the Oxford Polytechnic, he showed that not only were the female students more interested in Aesthetics than their male counterparts, but also the measures of females' interest in Aesthetics showed smaller variance than those of the males' interest measures. It should be noted, however, that the statistical significance of such differences was not reported. Moreover, the female group demonstrated stronger interests in Literary and Musical categories and lower interests in Outdoor and Mechanical activities.

As regards cross-cultural differences, Mikellides (1989) compared one of the Oxford architectural cohorts' interest profiles (combined genders' data) with a set of similarly acquired data in a Swedish school of architecture (Lund University). The recent data were classified separately by gender groups, however. As compared to the overall British sample, both male and female Swedish samples showed stronger interest in the Literary category; and higher levels of interests in Aesthetics, specially the Swedish female group. While some of the differences between the male and female groups of the Swedish school were similar to their British counterparts' differences, noticeable gaps were observable on Musical, Social services, and Practical categories among the two Swedish gender groups.

The presence of such distinctions, as can be anticipated, may reflect some possible cross-cultural differences. However, the role of idiosyncratic student selection procedures should not be overlooked. While some of the profile differences between Oxford and Lund can well be attributed to particular cultural backgrounds, some other distinctions may still be due to specific selection criteria. No more profiles from other British schools of architecture were reported on to see the possible similarities and differences among the schools of a similar culture, and the consistency or variations of the profile in each school over time.

It should be noted, however, that Mikellides' response to the author's questionnaire (analysed in the following chapter) testifies to the administration of a continual study and monitoring of the school entrants, both in terms of academic qualifications and some psychological characteristics. Thus, the similarity of the interest profiles of architecture students at the then Oxford Polytechnic is very likely to be the effect of employing what Mikellides (1989, p243) calls 'a fair cross section of architectural criteria' for student selection procedures.

2.2.4. Innate Design Abilities

Lee and Radcliffe (1990) studied the background and design abilities of several groups of first year engineering and industrial design students to find out if their prior experience and social contact had any effects on their performance in design. The authors intended: (1) to show that prior engineering experience improves design skills; and (2) to demonstrate that a clear difference exists in 'attitude to design between engineering and industrial design students'. While little support was found for the first claim, convincing evidence was found for the latter.

Both the analytical method and conclusions of the work are *partly* debatable. However, Lee and Radcliffe's research also includes some lateral outcomes which are by no means less important than the initially expected outcomes. Therefore, we will go into some details for two purposes: (1) to show a technical (analytical) problem and question its consequent findings, (2) to highlight the findings which have not received sufficient attention in the conclusion of the paper. First, a brief account of the work is given.

Two hundred and eleven first year students in four branches of engineering (civil, electrical/electronics, chemical, and mechanical) as well as 15 first-year students in industrial design comprised the sample of the research.

The researchers asked the students to design a folding picnic table (as a familiar and common item in the daily life) in a one week period of time. This task was undertaken at the beginning of the first year to ensure that students' performance reflected only their pre-tertiary experience and knowledge.

A chronological record of the design work, all sketches and rough work as well as the final design were submitted by the students. Each student was also asked to answer several questions after the design task in order to find out: their background, experience and personal contact with engineers/industrial designers; the information needed and gathered for the design; how their idea was generated and the main factors they considered in the design; and whether any formal design method had been adopted.

Students were divided into two overlapping sets which formed five groups in total. The first set included all engineering students who were classified into three groups according to their background and experience. These groups were: (1) those who had at least a one-month direct experience of engineering; (2) those who had relatives who worked as engineers; and (3) those who had no previous contact with engineering. The data of these groups were applied to prove that experience improves design skill. The other set was composed of two groups of mechanical engineering, and industrial design students. By means of the data of the latter groups the authors made an attempt to show that engineering and industrial design students are different in their attitude to design. Table 2.8 shows the size of each group and the codes by which they are represented in the following tables.

Table 2.8. Participating student groups

Group Code		n
	1st Set *All Engineering Students*	
E	With a direct experience (from 1 month to 3 years)	33
R	With a relative as an engineer	31
N	No previous contact with engineering	147
	2nd Set	
M	Mechanical engineering students	33
I	Industrial Design students	15

Seven facets of design were used to classify the data and also to measure design performance of students. The facets included: design methodology; design objectives; information needs; conceptualisation; evaluation of ideas; graphical communication; and technical quality of design. This implies that importance was given to both the processes and products of the designs.

Methodological flaw

Lee and Radcliffe illustrated their results in the format of percentage tables and bar charts. They made their conclusions by drawing on a number of cases in which apparent differences were observed among the group percentages. They did not report the application of any test to examine the statistical significance of the observed differences. Reliance on such differences, however, may end up in misleading conclusions. The present author undertook a series of statistical tests and found out that a number of the differences were not as meaningful as they initially appeared to be. Some examples are given below.

On the basis of the differences among the results of the three engineering groups (E, R, and N), Lee and Radcliffe concluded that 'experience obviously played a significant role in the design abilities revealed' in the study. The claim, however, needs further qualifications to see what 'significant' can mean in relation to the studied aspects.

Consider, for example, Table 2.9 which shows the percentage of students in each group by their method of idea conceptualisation. 'Innovation' category implies that the idea was original, 'not drawn from what was commercially available'. If the idea had new features, in addition to what was available in the market, it was classified as a 'development' of existing ideas. Some students had only made new combinations of what was commercially available. The latter method was thus categorised as 'combination'. Other methods are also shown in the table.

Table 2.9. Methods of conceptualising (percentage for each subject group)

Adapted from Lee and Radcliffe (1990)

	Subject groups				
	E	**R**	**N**	**M**	**I**
Conceptualisation method	(% of each group)				
Innovation	**36**	**23**	**27**	**28**	**73**
Development	45	74	69	69	20
Combination	12	0	3	3	0
Systematic analysis	3	0	0	0	7
Survey feedback	3	0	0	0	0
Discussion	0	3	0	0	0

Percentages in the 'innovation' row suggest that, among all engineering groups, innovative design was relatively more frequent in group 'E' whose students had some prior engineering experience. Since innovation is usually given a higher value than other mentioned methods of conceptualisation, this observation must have been among the evidence which lent support to the claim that 'experience played a significant role in the design abilities'. But the question is: how confident can we be in the accuracy of the observed differences to be able to draw conclusions upon them?

To answer the above question objectively, all categories other than 'innovation' can be collapsed into 'other' or non-innovative methods to render the observed differences amenable to an applicable statistical test. Because, firstly, apart from 'innovation' and 'development' other categories hold small percentage figures or otherwise very small number of students. The widespread occurrence of such small numbers may easily distort the results if all categories are directly applied in the test. Secondly, the table shows that out of the two categories, only on 'innovation' does group E show preponderance over other engineering groups. No claim is made about the superiority of group E in 'developmental' ideas.

Having the size of each group available, it was possible to convert percentages into the number of students who had either innovative or non-innovative ideas. Through the application of Chi square test the statistical significance of differences (i.e. p values) were calculated. The results of the calculations (presented in Figure 2.2) and the proportion of conceptualisation methods by each group (shown graphically in Figure 2.3) indicate that no significant difference existed between the engineering groups in terms of their innovativeness.

Figure 2.2. Statistical significance of differences between conceptualisation method of groups

Adapted from Lee and Radcliffe (1990)

	Subject groups				
	E	R	N	M	I
Conceptualisation method	(% of each group)				
Innovation	36	23	27	28	73
other	63	77	72	72	27

M : I p=.003

E : R p=.228

E : N p=.294

E : M p=.478

E : I p=.017

E : R : N
p=.440

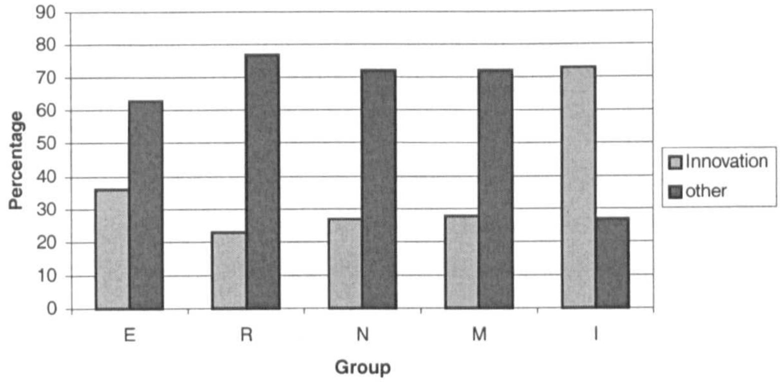

Figure 2.3. Graphical representation of conceptualisation methods by group

Technically speaking, 'p' values around the table in Figure 2.2 show the probability of arriving at similar results when no such differences hold between the populations from which the groups were drawn. To put it in a simpler way, the values can be regarded as the probability of the results to have occurred by chance. It should be added here that, commonly, maximum allowance for this sort of chance in similar studies is less than five percent [10]. That means when the probability of arriving at similar result (in samples from non-differing populations) is equal to or more than five percent, then the result is not regarded as 'significant'. A close examination of the percentages of groups E and R showed that, despite the apparent preponderance of innovative design in group E, there is a likelihood of nearly one-in-four that the observed result might have occurred by chance (p=.228). By the same token, the difference between the sample of experienced engineering students (group E) and mechanical engineering students[11] in their ability to think innovatively is not significant at all. Because the corresponding 'p' value is .478 which implies a very high probability for chance (nearly one-in-two). Likewise, simultaneous comparison of groups E, R, and N returns a 'p' value of .440 which rejects a 'significant' difference among the groups. Therefore, the 'p' values indicate that no statistically significant difference held between the engineering groups in their innovative conceptualisation abilities.

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[10] While in very rare cases the researcher may accept up to 10% likelihood of chance, more stringent studies do not allow more than one percent.

[11] If we suppose that students who had a prior engineering experience (i.e. group E) were evenly distributed among the different engineering disciplines, only 16% of mechanical engineering students have had such a prior experience.

However, the comparison of the results of industrial design students with those of mechanical engineering or experienced engineering students returns 'p' values of .003 or .017 respectively (see Figure 2.2 and Figure 2.3). From a statistical viewpoint, both of the values are small enough to be able to claim that innovative design was 'significantly' more frequent among the industrial design group than any of the engineering groups of students. The significance of this finding, which reflects an important difference between the engineering and design students in their designing attitudes, had escaped the notice of the original authors in their final conclusion.

From among other areas (or facets) under study, only in two areas did the differences between the students with engineering experience and those without reach a significant level. One, in sketching and graphical communication skills, and the other in their ability to propose alternative ideas.

Figure 2.4 shows the differences between the groups in their drawing skills. Originally, the authors had classified the skills into six categories (shown in the same figure below 'skill level' in small font). Consequently, some of the cells contained either zero or very small percentages. Combination of the adjacent original categories (as in Figure 2.4) would render the differences more amenable to testing. The results of the groups E, R, and N suggest that drawing skills of the students with engineering experience were significantly different from those of groups R and N, the former group performing much better.

Figure 2.4. Sketching/graphical communication skills

Adapted from Lee and Radcliffe (1990)

	Subject groups				
	E	R	N	M	I
Skill level	(% of each group)				
Competent (High or Good)	39	13	16	34	40
Sufficient (Acceptable or Adequate)	54	71	61	48	47
Insufficient (Poor or Illegible)	6	16	21	18	13

M–I: p=.876

E vs	R	N	M	I
	p=.041	p=.006	p=.298	p=.678

Despite the above differences which imply the positive influence of experience on the drawing skills of engineering students, no statistically significant difference was found between each pair of the E, M, and I groups in their drawing skills. It should be borne in mind that no particular prior experience was reported for the M and I groups. It is not known whether mechanical engineering and industrial design students had some sort of unidentified equivalent experience to those of students with engineering experience, or other factors (such as intrinsic interest in the task) could have motivated the former two groups towards efficient presentations of their design ideas. Alternatively, there is a likelihood that the groups R and N, which also included electronic and chemical engineering students, had been unfamiliar with necessary sketching skills, and the engineering experience of the group E had provided them with a sufficient threshold of graphical skills.

Figure 2.5 shows the difference of groups in their inclination towards the generation of alternative solutions. Among the engineering groups, the group with engineering experience had the largest proportion of more than one solution to the design problem. However, the only significant difference was found between the latter group and group R. Corresponding difference between groups E and N was slightly below a significant level. If all groups are taken into consideration, then industrial design students show the largest proportion of more than one idea. Yet the difference between each pair of the E, M and I groups fails to reach a significant level.

Figure 2.5. Idea generation

Adapted from Lee and Radcliffe (1990)

	Subject groups				
	E	R	N	M	I
	(% of each group)				
Developing only one idea	39	65	56	47	20
Developing more than one idea	61	35	44	53	80

M–I: p=.076

E–R: p=.038; E–N: p=.077; E–M: p=.515; E–I: p=.195

Apart from the 'conceptualisation' area in which the differences between the engineering groups were non-significant (p_{min}=.228; p_{max}=.478), corresponding differences in several other areas also failed to reach a significant level. Figure 2.6, Figure 2.7, and Table 2.10 represent some such examples.

Figure 2.6. Awareness of aesthetics

Adapted from Lee and Radcliffe (1990)

Awareness of Aesthetics	Subject groups E (% of each group)	R	N	M	I
Aware of	36	29	25	25	80
Not aware of	64	71	75	75	20

M–I: **p=.000**

E–R: p=.551; E–N: p=.198; E–M: p=.336; E–I: **p=.005**

Figure 2.7. Information seeking

Adapted from Lee and Radcliffe (1990)

Information seeking	Subject groups E (% of each group)	R	N	M	I
No information sought	36	39	37	31	0

M–I: **p=.015**

E–R: p=.804; E–N: p=.914; E–M: p=.669; E–I: **p=.007**

Table 2.10. Design objective adopted

Adapted from Lee and Radcliffe (1990)

Design objectives	Subject groups E (% of each group)	R	N	M	I
Functional					
Weight/portability	45	45	61	53	73
Compactness	30	23	31	47	47
Stable on ground	21	23	18	22	53
Durability					
Weatherproof	9	13	10	9	40
Durable	39	39	35	38	40
General performance					
Strength	52	45	51	56	67
Rigidity	9	0	4	3	47
Ease of manufacture	12	10	16	31	40
Safety					
Aesthetics					
Aware of	36	29	25	25	80
Not aware of	64	71	75	75	20
Cost					
Aware of	40	77	52	47	67
Not aware of	60	23	48	53	33

Altogether then, there is little evidence to support the original conclusion of the authors that prior engineering experience had played a significant role in the design abilities of the studied engineering groups. Only in the drawing abilities, and alternative idea generation were significant differences found between the (engineering) groups with engineering experience and those without. This is not sufficient evidence to generalise for design abilities. Concerning the second intention of the authors, i.e. to demonstrate the difference in attitude to design between engineering and industrial design students, their collected evidence seems tenable. The results of our revision qualify and support their claim.

The industrial design students showed significantly higher rates of response in the following aspects of design which together can be regarded as their particular attitude to designing.

1. Inclination towards innovative idea conceptualisation
2. Awareness of aesthetics
3. Inclination towards information seeking.

However, this does not imply that they had ignored other important requisites of designing. The industrial design students had not adopted, by any means, any poorer design objectives than those of the engineering students (Table 2.10). The former had shown similar engineering awareness in terms of functional, operational, etc objectives adopted in their designs.

The authors also reported that comparison between the mechanical engineering and industrial design students showed that the latter group were more conscientious about the project, did some research on the existing products in the market and paid more attention to the details and the main product concept. The mechanical engineering students, however, emphasised the practical rather that aesthetic aspects and tended to use standard component parts in their design.

2.2.5. Comparison of Psychological Types

Drawing on Jung's theory of psychological types, Durling (1998) compared the 'cognitive styles' of students of design, with those of both cognate and dissimilar professionals. He showed that differences existed between the 'underlying cognitive characteristics' of designer and non-designer samples, and emphasised the necessity for harmony between teaching and the learning styles of the learners.

Durling employed the Meyer-Briggs Type Indicator (MBTI) to compare his sample of students of design with several other previously studied samples. The MBTI inventory, which is predicated upon Jung's theory of psychological types, is a self-reported questionnaire arranged around four pairs of dichotomised scales as follows.

- Extraversion-Introversion
- Sensing-Intuition
- Thinking-Feeling
- Judgement-Perception.

As Durling (1998) says, the MBTI is meant to measure 'preference strengths which reflect the kinds of perceptions and judgements individuals use in interacting with their environment'. The first two scales are reported to deal with the person's orientation towards the world, or the way one prefers to focus attention. The two succeeding pairs concern cognitive processes. The sensing-intuition pair has to do with the way a person takes in information. In 'sensing' one prefers facts, realities, and tangible information, whereas in 'intuition' one is inclined to involve in indirect perceptions and to seek possibilities. The third pair of scales, i.e. thinking-feeling, concerns the way a person makes decisions. One who falls in the 'thinking' range prefers objective and logical modes of reasoning, while in the other pole the person prefers not to be detached from his/her personal values, and is inclined to take a subjective mode of thought. The last two scales deal with the individual's attitudes. While a person with 'perception' propensity prefers experience and open options, is at ease with uncertainty, and shows flexibility; one with 'judgement' attitude prefers having things organised, decided and settled.

The MBTI inventory includes 16 combinations or types each of which is made out of four Jungian scales (one from each of the above dichotomies). A person may shift between the dichotomous modes to respond to different circumstances. However, according to Jung and Meyer-Briggs' theory, every person is believed to predominantly belong to one of the types, sharing many basic characteristics with other people of the same type[12].

The database of MBTI studies includes the records of many occupational groups. It has been shown that in many occupations, respondents tend to cluster in certain areas of the matrix of types.

Durling's sample included 71 first year undergraduate students who were studying one of the product design, interior design, graphic design, or furniture design courses. He displayed the results of his sample and previously studied samples in separate (four by four) matrixes of 'types'. The samples and their respective size are shown in the first two columns of Table 2.11. Durling showed the number and percentage of every type in the corresponding cells of each sample's matrix. Thus he showed that the clustering pattern of his sample of designers was quite similar to those of design-oriented samples (e.g. architects), but different from the way other samples clustered. He also drew on the frequency of some of the eight MBTI scales among each sample's results to show that cognitive preferences of design-oriented samples were different from those of other samples. For instance, Durling reported

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[12] For more details about the theory see: Hall, C. S., Nordby, V. J. (1974). *A primer of Jungian psychology.* New York: Taplinger publishing Co. And, Myers Briggs, I. & Myers, Peter B. (1995) Gifts differing: understanding personality type. Palo Alto, California: Davies-Black Publishing.

that his designers sample were 79 percent intuitive, while preference for intuition amounted to only 24 percent among the 'normal population' sample.

To illustrate sample differences, the present author compiled all scattered percentages of each MBTI scale (by sample) in a single table. Moreover, a further investigation was carried out to find out whether noticeable observed differences between the designer and non-designer samples were statistically significant[13].

Table 2.11 displays samples' inclinations on pairs of the dichotomised scales; and the following bar charts represent the same data graphically.

Table 2.11. Samples' inclinations on paired MBTI scales
Adapted from Durling (1998)

Sample	*n*	*Observed frequency on paired MBTI scales (%)*							
		Extraversion	Introversion	Sensing	Intuition	Thinking	Feeling	Judgement	Perception
Normal population	1105	40.4	59.6	75.8	24.2	50.4	49.6	66.2	33.8
Business managers	849	49.2	50.8	67.6	32.4	75.3	24.7	76.2	23.8
Mechanical engineers	77	46.8	53.2	58.5	41.5	70.5	29.5	62.7	37.3
Architects	124	29.6	70.4	17.7	82.3	56.4	43.6	58.8	41.2
MacKinnon's creative architects	41	33.9	66.1	0	100	51	49	38.8	61.2
Interior design majors	224	52.6	47.4	37.6	62.4	34.6	65.4	42.8	57.2
Durling's design students	71	73.1	26.9	21	79	59	41	32.2	67.8

As seen in the 'extraversion-introversion' column of the table and Figure 2.8 different designer samples showed dissimilar preferences for extraversion or introversion. Among both architect samples, the majority preferred 'introversion', but the majority of Dulring's sample preferred 'extroversion'. However, as reflected in 'sensing-intuition' column of Table 2.11 and Figure 2.9 all designer samples were invariably more 'intuitive' than other groups. Even the difference between the closest samples, namely mechanical engineers and interior designers, was highly significant. To be more precise technically, it was possible to reject the null hypothesis of no difference between the samples at a very highly significant level (.001).

[13] 2X2 Chi square tests were applied to study the differences between paired groups.

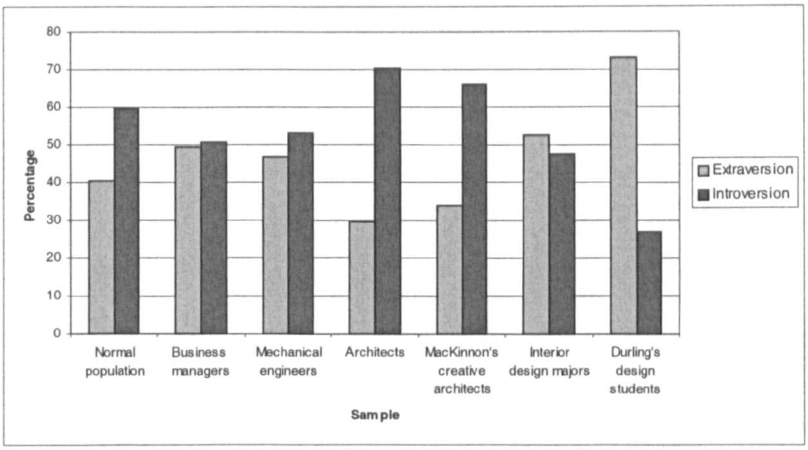

Figure 2.8. Comparison of samples on Introversion-Extroversion scales

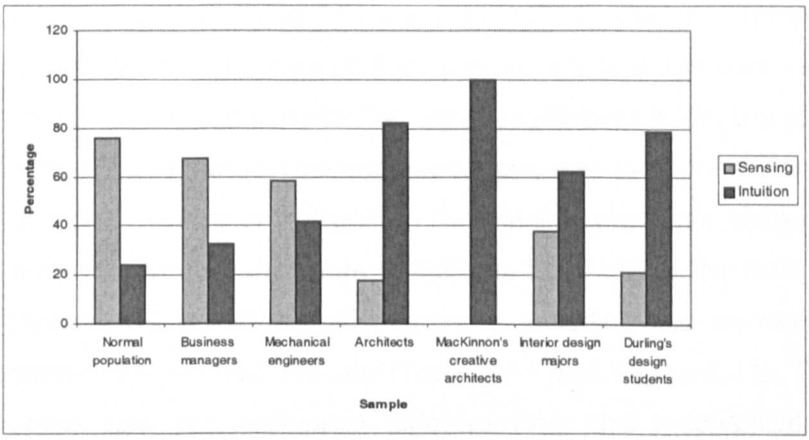

Figure 2.9. Comparison of samples on Sensing-Intuition scales

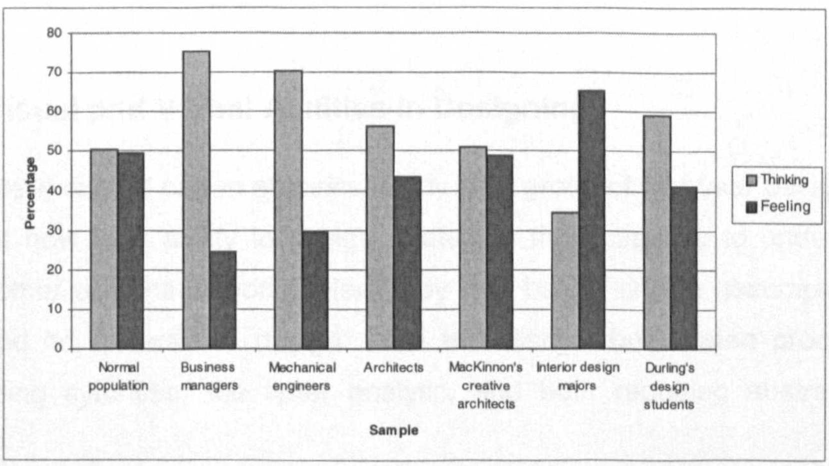

Figure 2.10. Comparison of samples on Thinking-Feeling scales

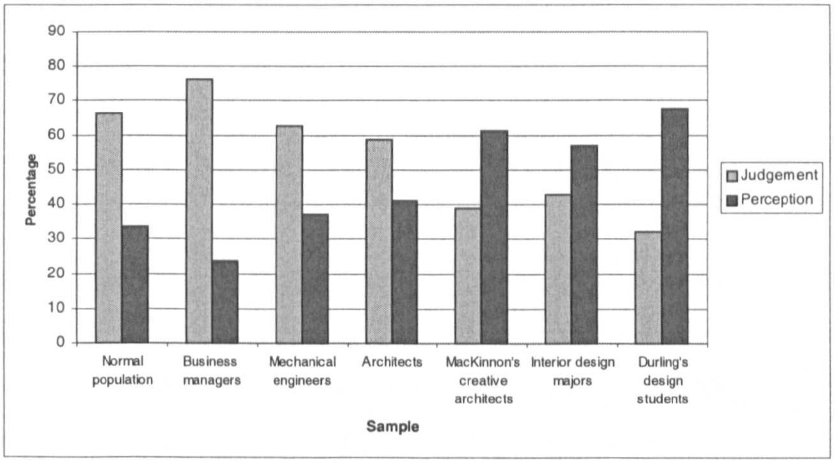

Figure 2.11. Comparison of samples on Judgement-Perception scales

On 'thinking-feeling' scales (Table 2.11 and Figure 2.10), designer samples showed different patterns, but the average of their preference patterns was very close to that of the normal population sample (i.e. equally distributed). On the same scales, business managers and mechanical engineers appeared to be mostly subscribed to objective and logical modes of reasoning. They mainly preferred 'thinking' (at least 70.5%). In terms of samples' measure of attitude, three of the four designer groups preferred 'perception'. However, other groups, including the normal population sample, showed a 'judgmental' attitude (Table 2.11 and Figure 2.11). The ordinary architects group was not noticeably different from the mechanical engineers. However, the difference between other designer groups and non-designer groups was highly significant (.003 or higher levels of significance).

2.2.6. Visual and Verbal Abilities in Designing

Ulusoy (1999) carried out an empirical study on a group of first-year design students to find out how their ability to design related to their capacity to understand and evaluate other designers' works. Her study was based on the assumption that 'to design' and 'to understand design' were two distinct but related processes, the former being synthetic, the latter analytic, and both requiring abstract thinking abilities.

Ulusoy hypothesises that while ability to design 'is related mostly with visual thinking', understanding and evaluation of others' design projects, which is an integral part of design education, 'is related with linguistic faculties'. A couple of questionable assumptions (briefly discussed below) are observed in the study. Nevertheless, what makes her study relevant to this section of our work, is her differentiation between (and the study of) students' visual and verbal abilities in design situations.

First a brief account is given of Ulusoy's study and her reported findings which, despite their positive directions, did not prove strong enough to substantiate her hypotheses. Afterwards, a couple of potential points, which did not receive adequate attention in the original text, are highlighted.

A series of projects were presented to a group of students of landscape and urban design[14] who were individually required to analyse and evaluate each project through:

I. diagrammatic graphical representations of the design idea;

II. a written criticism; and

III. an overall assessment (a letter grade from A to F).

Diagrams were evaluated on the basis of their 'representativeness of the design idea', and written criticisms on the basis of the 'articulation' and 'truthfulness' of the comments. The graphical representations and verbal expressions were taken as the measures of visual and verbal thinking abilities[15]. Correlation between the grades given by a student (for the series of projects) and the grades the jury gave to the same projects was regarded as a measure of the student's ability to evaluate a design correctly. A fourth measure was also employed in the study, the final grade each student received for his/her semester design project. This was considered to represent each student's ability to design.

Ulusoy calculated (Pearson) correlations between the above variables. Since the original text contained a detailed list of students' scores in all four variables, it was

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[14] Initially, thirty-two first-year students in the Department of Landscape Architecture and Urban Design, at Builkent University participated in the study. Due to incomplete responses, however, the applicable sample size decreased to twelve in practice.

[15] Ulusoy did not differentiate between the ability to analyse, and the ability to communicate the analysed matter. It seems to be evident that the production of diagrams or written critiques requires both the above abilities.

possible for the present author to calculate Spearman correlations[16] (figures between parentheses show corresponding Spearman correlations). The original and supplementary results are shown in Table 2.12.

Table 2.12. Correlation between measures of different abilities *

Adapted from Ulusoy (1999)

	Graphical representation		Ability to evaluate design		Ability to design	
Verbal expression	.20	(.28)	.24	(.11)	-.22	(-.27)
Graphical representation			.06	(.00)	.39	(.34)
Ability to evaluate design					.02	(-.21)

*: Figures between parentheses: Spearman rho correlations; other figures: Pearson correlations
All correlations non-significant

As shown in the table, It is acceptable that of the two 'verbal expression' and 'graphical representation' variables, the former correlated better with 'ability to evaluate design' and the latter with 'ability to design'. Moreover, 'verbal expression' returned a negative correlation with 'ability to design' and 'graphical representation' showed almost no relation with ability to evaluate design. This means that the direction of correlations supports the hypotheses. However, it must be noticed that such correlations were mainly low, and (partly due to the small size of the sample) all remained non-significant. Therefore, the observed correlations cannot be regarded as sufficient evidence to corroborate the hypotheses.

But two points remain to be brought to light. First, the fact that despite the lack of any noticeable correlation between 'ability to evaluate design' and 'verbal expression' and 'graphical representation' respectively, an array of high and significant correlations were reported between the grades the students and the jury gave to others' projects. All of the latter correlations were above .025 level of significance. They ranged between .58 and .95 with a mean of .81 and standard deviation of .12. This implies that the ability of the first-year students to evaluate

[16] Statistical sources recommend the use of 'Spearman rank order' or 'rho' correlation in cases where either one or both of the variables are in ordinal level of measurement (see for example: de Vaus 1996 p195-196). The nature of Ulusoy's variables implies that they cannot be regarded to be in other than ordinal level.

others' designs was noticeably in agreement with that of the experts of the field. Moreover, the lack of a discernible relationship between verbal and graphical representation abilities, and the noticeable ability of the students to 'evaluate design' may be an indication that the former abilities (contrary to Ulusoy's assumption) are composed of more than one ability. The students must have been good at analysis, because they eventually showed good evaluations, but they might have been poor at the communication of their analyses.

The second point is that not all the Pearson correlations appeared as poor as what Ulusoy reported. On the basis of the available data in the original text, the present author constructed a series of scatter graphs to examine how each pair of variables interacted. No clear pattern was identifiable in any of the scatter graphs except for one of them; the one which represented the relation between 'verbal expression' and 'ability to design', i.e. the final grade each student received from the jury for a semester project. Except for one student whose location was isolated (and close to the origin of the axes), points representing other students' locations shaped an obliquely stretched (descending) cloud. When the isolated case was excluded and the correlation of the same variables was calculated again, a significant correlation of -.61 emerged (-.66 for 'rank order' correlation[17]). This suggests the presence of a negative modest correlation between the 'verbal expression' and the design ability of the students. This latter finding together with the highest correlation of Table 2.12 tend to support one of Ulusoy's claims that 'those who are better designers can express themselves better visually than verbally.'

2.2.7. Interim Summary of Findings: Psychological Investigations

The findings of the above studies reveal the existence of psychological differences between students of design and students of other disciplines such as sciences or engineering. Researchers had employed one of the two generic methods to identify the group differences. While some of the differences were detected by means of self-descriptive tools, others were elicited from the products or behaviours of contrasting study samples during the tasks they were put to.

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[17] Pearson $r = -.61$ ($p < .05$); and Spearman's rho $= -.66$ ($p < .03$).

What is noticeable is that, despite the chronological gaps and isolation of the studies, various findings were in agreement and lent support to each other.

- Similar to the clear indications of 'creative and artistic interests' among both interviewees and the selected students of the Bartlett study, interest in aesthetic and matters of form and elegance were shown to hold significantly stronger among the students of design than was the case among other students. Not only was this claimed in studies which employed self-descriptive tools, but also it was demonstrated empirically.

- Various designer groups were shown to prefer an 'intuitive' cognitive style which matches the predominantly ill-defined nature of the problems they engage with. This may be one of the means through which students of design showed greater ability than students of engineering to conceptualise innovative ideas.

- As compared to students of engineering, students of architecture attached less importance to having well-organised mental habits, and computational activities were their least favourite activity. Likewise, it was found that students of architecture were more inclined to take a solution-focused approach to their problem, whereas, students of science strove after discovering the hidden rules of the game. Also, evidence was found that designers showed much more inclination than other groups towards a 'perceptive' attitude which manifests in preference for experience, openness to options, and being at ease with uncertainty.
- Not only did students of architecture see themselves as having good spatial visualisation ability, but also slight evidence was found that those who were better designers could express themselves better visually than verbally.
- On the whole, the findings imply that students of design are more interested in aesthetic, more in search of new information and experience, and more inclined to take intuitive and solution-focused approaches, than is the case with other studied groups.

Table 2.13. Synopsis of studies dealing with psychological aspects

Author; Year	Title	Main Question / Hypothesis	Subjects / Respondents	Data collection method / medium	Method of data analysis	Major findings
1. Abercrombie et al (1969) 2. Abercrombie et al (1972)	*1969:* Selection and academic performance of students in a university school of architecture. *1972:* Follow up of the selection procedure used at the Bartlett School 1964-66	Can psychological tests differentiate between particular groups of students (such as accepted vs. rejected or good performance vs. poor performance)?	All candidates who were selected for the interview for admission to the Bartlett School of Architecture (1964-66; n=260)	Psychological test / questionnaire: Dynamic Personality Inventory (DPI)	Correlation test One way analysis of variance	On some of the scales of the psychological test (e.g. 'creative and artistic interests') significant differences were found between the accepted and rejected groups in admission interviews. Indications were found of relation between some of the test scales and performance. Because of methodological problems, however, the relations seem inconclusive. On the whole, the DPI test scales tended to correlate more with studio design work than written examinations.
3. Stringer (1970)	The professional self-images of architecture and engineering students.	Is there a significant difference between the self images of the students of architecture and engineering?	A total of 262 students of architecture (year 1to 5) and 242 students of engineering (year 1to 3) in different universities	Psychological test / questionnaire: A self-descriptive questionnaire developed on the basis of Personality Assessment Test; University of California	F test Multivariate Analysis of Variance Factor Analysis	Significant differences were found between self images of students of architecture and engineering. Differences between different years and schools were also observed. Students of architecture saw themselves as having a more aesthetic view, sensitivity to form and elegance, strong spatial visualisation and tendency to philosophical speculation, etc.
4. Lawson (1984)	Cognitive strategies in architectural design	Discovering the cognitive differences between the students of design and science in (a design-like) problem solving situation	72 students: two pairs of each 2x18 students First pair: 5th-year architects vs 5th-year scientists. Second pair 1st-year architects vs 6th-form students.	Interactive online computer recording subject's questions, or their proposed solutions to a design-like task	t-test Mann Whitney U test Kruskal-Wallis analysis of variance	The fifth year students of science and architecture showed significantly different cognitive strategies; the former being more concerned about discovering the structure of problem and the latter taking a more solution focusing approach. The first year architects also showed similar results although their differences with the sixth form students were not significant.
5. Mikellides (1989)	Some questions concerning the interest profile of prospective architects	What is the interest profile of first-year students of architecture? Is it different from that of students studying other subjects?	700 first-year students of architecture who entered the Oxford Polytechnic over 12 years (1976-88), and a group of students in a Swedish school of architecture.	Psychological Test / questionnaire: Rothwell – Miller Interest Blank (RIB 1968: for assessment of vocational interests)	Line charts Simple comparison of means and frequencies Limited use of correlation	Clear differences were observed between the interest profiles of students of architecture and those of other fields such as commerce, secretarial studies, and especially engineering. Cross-cultural and gender differences were also found among the profiles of architecture students. Aesthetic, literary, and outdoor activities were the most liked categories by students of architecture.

Table 2-13. Synopsis of studies dealing with psychological aspects (continued)

Author; Year	Title	Main Question / Hypothesis	Subjects / Respondents	Data collection method / medium	Method of data analysis	Major findings
6. Lee & Radcliffe (1990)	Innate design abilities of first year engineering and industrial design students	The design skill development is predicated upon prior experience. A clear difference exists in attitude to design between engineering and industrial design students.	211 first-year students in four branches of engineering (with or without a prior experience) and 15 first year students in industrial design at the beginning of their course.	A design task and all its supplementary and chronological records. A questionnaire	Bar charts Simple comparison of group percentages (experienced, inexperienced, engineers, designers)	Prior engineering experience appeared to have significant influence on only limited areas of design skills (such as graphical communication). * Industrial design students were significantly different from their engineering counterparts in: (1) inclination towards innovative idea conceptualisation; (2) awareness of aesthetics; and (3) inclination towards information seeking. *
7. Durling (1998)	Creativity and Designer Personality	Is there any difference in cognitive styles between designers and other professional groups?	71 first-year students of design (graphic, furniture, interior, and product design)	Psychological Test / questionnaire: 'Meyer-Briggs Type Indicator'	Tabulations Simple comparison of frequencies	Designers were found significantly different from several non-designer groups and a normal population. Designers were more 'intuitive' and mostly took a 'perceptive' (as opposed to judgmental) attitude.
8. Ulusoy (1999)	To design versus to understand design	Ability to design is related with visual thinking, but understanding design is related with linguistic faculties.	12 first-year students of landscape architecture and urban design	Graphical representation and verbal expression tasks	Jury ratings Scatter graphs Correlation test	Despite the positive direction of results, the hypotheses were not statistically possible to prove. However, those who were better designers appeared to express themselves better visually than verbally. *

*: Findings which emerged after some rectification were applied by the present author.

2.3. Admission/Performance Investigations

In addition to the detailed review of the Bartlett study which was discussed in section one, this section reviews some other pieces of research which dealt with the subject of student selection and/or academic prediction. Domer and Johnson (1982); to a lesser extent Doan & Stiftel (1995); and Sheridan and Bowe (1996) present scopes directly related to the present research. Two studies carried out by Peers and Johnston (1994), and Hellner (1996) also investigate the relationship between prior qualifications and degree performance. Other pieces of research in this review are of a secondary relevance. The continual performance of students during the course was not the concern of the latter investigation but the issues they reflected can potentially serve for preparation of a better ground for our research.

Table 2.15 (page 113) is compiled to present the basic aspects of each study.

2.3.1. Spatial Ability and First Year Performance

Stringer (1971) studied the relationship between (psychological) test scores in spatial ability, previous experience, and first year performance of a group of architecture students. Stringer believed that since spatial ability was both a 'well-established and integral' concept to most psychological intelligence theories, and also 'central to nearly all architectural courses' it would render a useful testing ground which could benefit educational objectives.

His first investigation was designed to see if spatial test scores of a class of first year students of architecture were related to their previous experience of technical and architectural drawing. He also examined the extent to which training in a drawing course in first year studio would lead to improvement of spatial ability, and whether spatial ability was predictive of those parts of the course which were expected to involve more of this ability. No significant results were found regarding the first two questions, but positive indications were found in response to the last question.

Seven tests of spatial ability were given to 51 first year students of architecture in the then Portsmouth Polytechnic, first on the second day of their first term and second six weeks later. To answer the first question, the students were divided into three groups. Table 2.14, shows the configuration of the groups.

Table 2.14. Student groups

Group	description	n
1. **Drawing**	with prior academic or vocational education in technical or engineering drawing	13
(unnamed)	with a prior certificate in Building or a related subject	11
2. **Experienced**	the above groups together	24
3. **Inexperienced**	without the above qualifications	27

Tests were taken from the Kit of Reference Tests for Cognitive Factors[1] to show the 'spatial orientation' and 'visualisation' factors of spatial ability. The spatial orientation factors of the test deal with the individual's ability to comprehend the position and configuration of objects in space (usually with reference to one's position), and visualisation factors call for ability to mentally rotate, turn, fold, etc the images of objects.

The results of the first test showed that, on the whole, the 'drawing' group obtained higher scores than the 'inexperienced' group, and so did the 'experienced' group but with a smaller difference. None of the results were statistically significant, however. Those 11 experienced students who had no drawing qualifications showed no superiority of spatial ability, and in many cases scored lower than the 'inexperienced' group. The superiority of the 'drawing' group reduced in the retest, suggesting that the 'inexperienced' group had improved more in the interval.

An experimental training was set up to check the effects of training on improvement of spatial ability. Between weeks three and six of the first term the first year students were divided into two random groups. One of the groups followed a specially designed drawing course, while the other carried out a project combining analytical studies and a design exercise. Reportedly, the drawing exercise was very

[1] French, J.W. et al (1963). Kit of Reference Tests for Cognitive Factors. Princeton, Educational Testing Service.

much involved in a mathematical puzzle. At the end of their training the students completed the same seven spatial ability tests.

The results of the groups were compared through a 'multivariate analysis of covariance' which is intended to discount for initial differences in the test scores when looking for a differential change. Small differences emerged, on the whole. Only in one out of the seven tests (namely space relations[2]) did the group who had taken the drawing course gain significantly greater scores. The researcher, however, remained doubtful that the inadequate difference between the two training programmes might have not allowed the advantage of a drawing course to emerge.

Concerning the predictive ability of spatial tests for academic performance, Stringer cited a number of previous studies which had found correlations of from .37 to .68 between spatial ability tests and engineering drawing. He also observed similar correlations in his study, but tending towards the lower limit of the above range. Individual tests failed to show noticeable correlations with separate first year studio programmes. However, significant and positive correlations (around .35) emerged for some of the tests with an aggregate of first year design marks. Multiple correlation of all tests with aggregate design marks was reported to have reached .54, above the five percent level of significance. Similar multiple correlation was also observed for Construction Design. Moreover, some of the individual spatial tests correlated similarly or slightly better with technological examinations. However, no such correlations were found for more literary or verbal examinations of Design Theory, Philosophy, and History of Architecture.

2.3.2. Selective Admission and Academic Success

During the period 1969 to 1978, more than 1400 students began either the Bachelor of Environmental Design degree or the Bachelor of Science in Architectural Engineering degree at the University of Kansas. Domer and Johnson (1982), carried out research on a sample of 571 students[3] to study the relationship between a series of academic and non-academic characteristics and the students'

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[2] The 'space relations' test requires the person to 'imagine how a 'net' might be assembled to construct an irregular geometric object' (Stringer 1971 p25).

consecutive performance. On the basis of their findings, the researchers proposed that admission decisions should be made at the end of freshman year.

Domer and Johnson were not interested in detailed rankings or grades of performance, rather they were trying to arrive at a particular set of selection criteria which could better predict a given entrant's likelihood of being a future graduate, a voluntary withdrawer, or a dropout. They did not take into account the length of time for completion of the course. Domer and Johnson defined a voluntary withdrawer as a student who leaves the program with a GPA of equal to or more than 2.0 (out of 4.0).

Criteria and method of analysis

Predictor variables consisted of pre and post-matriculation data. Pre-matriculation variables included: overall high school GPA; high school rank-in-class; some of the sub-scores and composite score on the American College Test (ACT); some of the sub-scores and composite score on the Scholastic Aptitude Test (SAT); the number of high school semesters of mathematics, natural sciences, art, drafting, foreign language, and English. The student's age, size of high school class and the population of the home county also comprised the non-educational part of Pre-matriculation data.

Post-matriculation variables included: freshman GPA in design and engineering courses and overall grade point averages.

The sample members were not divided into subgroups (e.g. on the basis of entrance year cohorts, or gender etc.); all the data were studied together. A special regression technique, namely 'multiple discriminant analysis'[4], was used to see whether graduates, withdrawers, and dropouts could be statistically separated, and if equations could accurately predict group membership.

The analyses and findings

Domer and Johnson performed two analyses. In the first analysis, both academic and demographic parts of the pre-matriculation data were taken into account for

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[3] The availability of a complete and comparable data set for each individual student determined their inclusion in or exclusion from the sample. Transfer students and foreign students were not included in the sample.

[4] The authors describe the function of the technique as weighing and linearly combining the discriminating variables in a way that the groups under study are 'forced to be as statistically distinct as possible' (Domer and Johnson 1982 p23).

study. Out of an array of 19 variables, four appeared of discriminative value. The best single discriminator for group membership was the high school grade point average. In ranking order, the size of the graduating high school class, the number of semesters of foreign language courses taken, and the American College Test (ACT) composite score entered the equation after the high school GPA. Inclusion of more variables did not improve on the statistical distance among the graduates, withdrawers, and dropouts. To test the efficiency of the obtained results, Domer and Johnson employed a re-classification procedure through which the regression-based discriminant function was used to re-categorise the students into their original groups. All together, 52% of the students could be correctly identified in terms of their final status. Concerning the graduates, only 38.2% of them were correctly classified. For voluntary withdrawers and dropouts percentages of correct classification were 60.6 and 54.9 respectively.

In the second analysis, Domer and Johnson incorporated one additional variable, namely the freshman grade point average. The second procedure returned three variables of discriminative value. Freshman GPA, high school GPA, and high school class size were respectively the first to the third discriminant variables. The second re-classification procedure rendered 66.2% correct classifications. The accuracy of re-classification for the graduate, voluntary withdrawer, and dropout groups were 57.3%, 59.3%, and 85.8% respectively.

Figure 2.12 is an abridgement of the results of the two analyses.

Before going on to the conclusions Domer and Johnson made, it seems opportune to reflect on one of their incidental findings here. In their report, Domer and Johnson (1982 p27) presented the three performance groups' means on the four discriminant variables of the first analysis. The variables class size, number of semesters of foreign language, and ACT score were less able to distinguish between the performance groups as compared to high school GPA. However, only on the two former variables were the graduates' means higher than withdrawers' means. Regarding the mean high school grade point averages, voluntary withdrawers were first (3.27), followed by graduates (3.06) and then dropouts (2.76).

First Analysis

Step	Discriminant Variable
1	High school GPA
2	Class size
3	Foreign language
4	ACT composite score

Group	Percentage Correct Re-classification
Graduates (n = 178)	38.2%
Withdrawers (n = 231)	60.6%
Dropouts (n = 162)	54.9%
Overall (n = 571)	**52%**

Second Analysis

Step	Discriminant Variable
1	Freshman GPA
2	High school GPA
3	Class size

Group	Percentage Correct Re-classification
Graduates (n = 178)	57.3%
Withdrawers (n = 231)	59.3%
Dropouts (n = 162)	85.3%
Overall (n = 571)	**66.2%**

Figure 2.12. The results of the first and second analyses.
Adapted from Domer and Johnson (1982)
Discriminant variables (left boxes) and accuracy of respective re-classification (right boxes)

Comparing the results of the first and second analysis, Domer and Johnson claimed: '[s]electing probable architecture graduates from students just out of high school results in unacceptable error.' It was shown that in the first analysis, the chances of predicting graduate, voluntary withdrawer or dropout status were 52 in 100 which represented 19 percent improvement over a 1 in 3 subjective guess. Since the second analysis appeared to reveal a better discriminative ability the authors proposed the postponement of admission decision making until the end of freshman year. Despite possible theoretical similarities, Domer and Johnson also cautioned on the necessity for each individual school to develop their own guidelines for selective admissions. They suggested that such guidelines should 'reflect the particular characteristics of the students whose behaviour they seek to understand.'

Parenthetical Remarks

Despite the clarity of Domer and Johnson's study and its findings, there remain a couple of broad questions.

The first question concerns the homogeneity of their study sample. They stressed the exclusion of foreign and transfer students but the report was reticent about the demographic characteristics of the sample in terms of their age, gender, etc. The reliability of the observed discriminative (or predictive) patterns among such samples data, depends, among other factors, on the relative homogeneity of the sample. Because heterogeneity in a sample may lead to distorted results. It may either conceal pattern(s) which hold for one or more homogeneous sub-samples, or render a pattern which does not necessarily hold for individual sub-samples. Abercrombie et al (1969) showed that female applicants were of a higher level of academic qualifications as compared to the males in their study. Since they believed that differing developmental and motivational characteristics could confound the 'predictor-criteria relationship', they decided to limit their study to the male members of their sample.

Another similar question may address the aggregation of a ten-year-period data. This sort of aggregation of data implicitly builds upon the assumption that the school has adhered to a consistent educational process. Although the concern of the study was a broad prediction of entrants' subsequent performance (in terms of their likelihood of graduation, withdrawal or failure), it is very unlikely that the school repeated the same educational process for ten consecutive years. Retirement of the old educators and recruitment of new members, revision of programs, or at least, the development of original educators' experience, and consequent amendments to teaching methods are inevitable circumstances in any viable academic institution. It is true that a larger sample is more likely to be a better representative of its population than a small sample. However, because we can easily conceive of the aggregation of ten cohorts into a single large sample, it does not follow that such a large sample and its constituent smaller samples have undergone identical processes. By the same token, what holds for the larger sample may not hold for the smaller yearly sub-samples. There were several cases in the Bartlett study where the aggregation of the data from three cohorts would render modest correlations, while only trivial correlations were observed for any individual cohort.

The last point to be made here is the applicability of the outcome. Although in both analyses 'class size' emerged as a discriminant variable, and showed higher bearing on the discrimination of groups as compared to ACT score, it was not employed for selection. A part of the admissions web page of the school[5] where Domer acts as Associate Dean reads:

> *Applicants to the School of Architecture ...are evaluated on the basis of grades, high school class rank, and ACT scores. Kansas applicants must rank in the top half of their high school graduating classes with grade-point averages of at least 3.0 (A = 4.0) and ACT math score of 26 or higher for architecture .... Architecture applicants are encouraged to complete physics and precalculus mathematics in high school.*

Domer and Johnson (1982, p28) commented on the relevance of the number of semesters of foreign language courses. They claimed that '[t]he choice of language courses instead of high school drafting courses revealed the proclivity among graduates to choose intellectually challenging learning activities over the mechanical processes and regimentation of drafting.' However, no comment is given on the relevance of the 'class size' variable for which the statistical analyses had shown higher discriminative power. Nevertheless, none of the above variables, i.e. the number of semesters of foreign language and class size, appear applicable in practice. It seems that either the lack of external (concurrent) validation, or at least sole social unacceptability has prevented the inclusion of the two variables among the school's selection criteria.

2.3.3. Intakes of Different Admission Procedures

Gartshore and Mayfield (1988) carried out a questionnaire survey on the admissions procedures in UK schools of architecture to see if the schools could be differentiated according to their admissions policies and student intake. On the basis of the responses from 26 out of 36 schools, they found that schools requiring high points at A level (or the Scottish equivalent) were attracting students with strong Maths and Science backgrounds and schools which required low points were attracting students with strong Art backgrounds. The latter schools also attached a considerable importance to students' portfolios.

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[5] The University of Kansas , Undergraduate Catalogue [online].
Available: http://www.ukans.edu/~ucatalog/ugregulations/admission.html [9 Oct 1999].

Concerning their analysis, Gartshore and Mayfield firstly used Chi square and correlation tests, to identify the particular variables for which important differences existed in the data. Then, by applying Cluster Analysis to the corresponding data the authors demonstrated that the schools of architecture under their study could be significantly differentiated according to their admissions policies and student intake.

Through a secondary analysis, Gartshore and Mayfield showed that schools requiring high points could still be divided into two different sub-groups. One of the sub-groups included those schools which in addition to their requirement of high points were giving medium to considerable importance to portfolio, and, as a consequence, a high proportion of their intake had taken both science and art-related subjects.

The researchers showed that particular A-level subjects were not regarded as significant by most schools. One school had stipulated a minimum requirement of Art or Art History, three schools Maths or Physics, and two schools English Literature.

Gartshore and Mayfield, however, remained sceptical as to whether the schools which admit students with mainly Science A-levels 'do so directly or as a by-product of a high requirement'.

They also showed that the most frequently mentioned characteristics being sought in candidates at interview were: first, creativity, followed by self-motivation and analytical thought. The least favoured characteristics were idealism and assertiveness.

2.3.4. Coexistence of Mathematics-Science and Art backgrounds

Craven (1989) reported on the A-level qualifications of entrants to the school of architecture in Sheffield University over a ten-year period from 1979 to 1988. In a part of the study, the ranks of all the various A-level subjects, in order of their degree of representation among the entrants' A-level passes, were calculated for each year. It was shown that, despite changes in various years, the three top ranking A-level subjects during the period under consideration were Mathematics, Physics and Art. Craven claimed that no pass in a specific A-level subject was a mandatory requirement during that period, and that stipulations for combinations of subjects were kept to a minimum. However, he also added that candidates were somehow advised, through the prospectuses produced over the years, that 'A-level courses in Mathematics, Physics, and Art would be considered as most relevant'. Moreover, he mentioned that at interviews candidates were 'expected to present examples of work showing evidence of artistic ability.'

Despite the fact that mathematics had increased in representation and art had shown a decrease over the years under study, Craven concluded that for a significant part of entrants it could be claimed that 'a strong Mathematics and Science background does not appear to preclude the study of Art to A-level standard'.

2.3.5. Prediction of Performance in a Planning School

Doan and Stiftel (1995) investigated the relationship of admission qualifications to degree performance of 290 Master's students who enrolled in the department of Urban and Regional Planning in Florida State University between 1981 and 1990. While the program does not resemble an architectural program entirely, owing to some similarities in the curriculum and the methods of student selection, a brief description seems worthwhile here.

During the period of the study, requirements for admission to the program included: applicant's undergraduate GPA, accounts of extracurricular activities and work experience, and letters of recommendation. Moreover, all applicants were required to submit 'Graduate Record Examination' (GRE) scores. The GRE examination is given in various verbal, quantitative, and analytical fields and is used in determining admission to graduate study in the US. The analytical part was not widely used for admissions, though.

To study the effect of credentials on the graduation GPA (or last GPA for those who did not graduate) Doan and Stiftel applied multiple regression analyses. The independent variables they used to predict the final GPA consisted of Verbal, Quantitative, and Analytical scores of the GRE examination along with undergraduate GPA.

The full sample run revealed that the GRE Quantitative score was not significant and the mentioned independent variables together could account for 20% of variance in the final grade point average.

When the students were separated by gender, prediction became weaker for more than 30% of the sample population, i.e. women. No independent variable appeared to be significant in the expected direction and the regression equation only accounted for 11% of the variance. For men, however, there was a slight improvement, but this time, both GRE Analytical and GRE Quantitative proved insignificant.

Specifications of the model by citizenship or race did not improve on the results. Explanation of variance for American citizens was the same as that of the male proportion, whereas for non-US citizens it was just .10. For minorities (in terms of citizenship or race), all independent variables were shown to be either non-significant or acting in the opposite direction. Doan and Stiftel (1995) cautioned against 'manifest confidence' in GRE and undergraduate GPA. Concerning the relationship between credentials and performance they stressed that, contrary to their findings, 'faculty often are of the belief that this relationship is strong'. However, they showed that the credentials predicted a 'modest' portion of variation in the performance of only *white American male* students. The limited portion of such a variance and the faint relationship between the credentials and performance of other groups led the authors to ask for 'careful attention', and considering the inclusion of information that may reveal candidates' motivation for study in the profession.

2.3.6. Influence of Learning Context

Peers and Johnston (1994) examined the relationship between A-level attainment and degree performance in a number of disciplines including architecture. They emphasised that even though the A-level results serve as selection criteria for approximately 90% of universities in England and Wales, little attention has been paid to investigate their relevance to subsequent degree performance.

Drawing on a number of previous studies, they showed that there existed disagreement about the predictive ability of A-levels among the studies. Meanwhile, they reported that empirical studies in higher education, which have focused on the relationship between cognitive elements and contextual factors in the learning environment, have illustrated the presence of a contextual influence on learning approach. However, very occasionally the students' qualifications on admission to university were included in the latter studies.

Peers and Johnston took the hypothesis that the inconsistencies in the relationship between A-level attainments and degree performance (as found in the previous studies) may not be solely due to statistical artefact or sampling error (as was attributed in a number of earlier studies) but were in part because of 'systematic contextual effects acting upon prior knowledge and learning approaches.'

Peers and Johnston carried out a meta-analysis of 20 published studies to test their hypothesis. The studies comprised 60 independent univariate analyses, and, on the whole, included a total of 70,768 students who graduated from UK universities and polytechnics between 1954-1983.

Due to the limitation of available data, two very broad contextual factors, namely type of institution and discipline of study, and their influence on the relationship between A-level attainments and subsequent academic performance were examined during this research.

Technical details of a meta-analysis approach fall beyond the limits of the present work. Suffice is to say that it is a systematic way of reviewing, analysing and also synthesising results of independent studies which might have returned agreeing or disagreeing results. The method is meant to correct for statistical artefacts (e.g. sampling errors arisen from different sample sizes among the individual studies) and includes a number of statistical procedures and tests such as adjustment of correlations for sampling errors and tests of homogeneity.

Peers and Johnston tested three hypotheses to see: 1) whether the population correlation between A-level attainment and degree performance, corrected for sampling error, was significant; 2) if the universities and polytechnics could be regarded to have similar institutional influence on the mentioned correlation; and 3) whether population effect sizes (adjusted correlations) for seven disciplines in higher education were homogeneous.

The results showed that on the whole: 1) a 'small but positive' and significant correlation existed between the A-levels and degree performance, but 2) significant differences existed both between universities and colleges, and also among disciplines. Arriving at the best estimate population correlation of .276, the researchers concluded that it seemed that success in final degree examinations was related to success at A-level. However, through the identification of significant differences in effect size both for *institutions* and also for *disciplines of study*, they indicated that the relationship was also influenced by both the latter factors. Although Peers and Johnston accept that their study does not explain the way the latter factors influence the relationships, they parallel their findings with the recent views in educational psychology research which emphasise the importance of the agreement between students' approaches to learning and the learning environment.

The findings of the research confirmed the view that interaction between learning approach and environment mediates the relationship. For instance, in social science disciplines, where subject matter would be new and existing level of knowledge shows less importance than an appropriate learning approach, the corrected measures of relationships were low. Likewise, Architecture, which showed the lowest relationship, would demand a significant restructuring of the learning approach. Whereas, in medicine, in which acquisition of basic knowledge and the habit of accumulating factual information at A-level would form the basics of subsequent degree work, corresponding measures were high.

The findings of the research, therefore, indicate that A-levels function least reliably as predictors in contexts where a higher level learning approach based on personal understanding is encouraged. Like Doan and Stiftel (1995), Peers and Johnston also question the reliance of selection decisions on sole A-level attainments because they believe that A-level functions as a measure of attainment and does not distinguish between students on the basis of their potential for developing their learning approaches.

In conclusion Peers and Johnston propose that the assessment of psychological differences among students, and their learning goals and approaches would be useful ways of identifying subsets of students who might react similarly to experiences in higher education.

2.3.7. Outcomes of Contrasting Admission Policies

Hellner (1996) compared the correlations between the student selection criteria and the subsequent academic performance of students in two schools of design and architecture which applied different selection methods. Questioning the relevance of didactic qualifications, she was in particular interested in the relationship of the admission criteria to design studios. The first sample was drawn from students in the Faculty of Architecture, University of Manitoba where the students were selected solely on the basis of their high school grade point average (GPA). The academic performances of about 400 students who had entered the department of Environmental Studies or Interior Design between 1986 and 1991 were investigated separately. Grades from all design studios and also a number of theory subjects were compiled and analysed. The second sample was drawn from students in Toronto University's School of Architecture where selection was based on both records of prior academic achievement, and mainly candidate's performance in a series of assignments including:

- a deductive reading and drawing assignment;
- a writing assignment;
- a spatial cognition exercise;
- a directed composition exercise;
- a personal statement of interest in pursuing a design degree.

Overall entrance scores and undergraduate academic records of 62 students who had entered Toronto School of Architecture in 1989 were applied for the second part of the study.

The results of the first part of the study showed that there was no correlation between entry GPA and studio results for the first study samples. Corresponding correlations with the studied theory subjects were very low (for Environmental Study students: maximum $r=.10$, $p=.317$; and for Interior Design students: maximum $r=.18$, $p=.034$). In contrast highly significant correlations were found between studio 1 and the remaining studio courses (for Environmental Study students: minimum $r=.28$, $p=.002$; and for Interior Design students: minimum $r=.51$, $p=.000$).

Hellner reported that the results of the second sample showed better correlations than those of the first samples. For instance the correlation between the entry scores and design studio 1 was .49 (p=.004). She also found significant correlations between studio 1 and each of studios 2 and 3 (around .40).

2.3.8. Entry Qualifications and Degree Performance

Sheridan and Bowe (1996) investigated a wide range of potential relationships between entry qualifications and degree performance of the students in the University of Liverpool School of Architecture. The authors kindly made parts of their unpublished study available to the present author. The research findings indicated that no 'direct relationship' existed between A Level *grades* and degree performance, nor were the stipulation of specific A Level subjects justifiable for the purpose of student selection.

The study data included both entry and subsequent academic records of a pool of 319 students who had entered the school between 1988 and 1992. However, for the study of relationship between entry qualification and subsequent performance only the data of 194 students who had comparable A-level qualifications were applicable.

Compared with the rigour of the Bartlett School's student selection, the authors reported that '[t]he most important differences were the relative informality of the screening of applications, the lack of an interview and the specification in offers of A-level grades required.' Sheridan and Bowe mainly applied cross-tabulation and Chi square test, and where possible, correlation test to study the relationships. Due to the limited number of students under some degree classes, they categorised measures of degree performance as follows.

1 First and 2.1
2 2.2 and Third
3 Pass, Fail and Withdrawn.

Likewise, measures of yearly performance in different areas of Studio, Technology, and Contextual were banded into the three following categories.

1 40% or below
2 41-59%
3 60% or above.

Before reporting the findings which dealt with the relationship of prior qualifications to subsequent performance, two findings, which despite their tentativeness tend to reveal some gender differences, are first mentioned.

- As regards entry A Level subjects, the authors said that they found 'notable differences' between the female and male sub-groups. The female sub-group had shown a higher tendency than males towards Art, Biology, English, a Foreign Language, History, or Chemistry; and the male sub-group had been more inclined than females towards Maths, Graphical Communication, a Design subject, a second Maths subject or Economics.
- The highest proportion of female students who gained First class or Upper Second degrees were those who had taken Science and Maths along with Arts/Humanities A Levels. However, the highest proportion of similar male students were those who had 'Arts/Humanities only'.

Due to the latter finding, Sheridan and Bowe suggested that '[i]f it might be said that some combinations were more female or male it can be seen that the highest proportion of First / 2.1 graduates were women with a male combination and men with a female combination'.

Pre-A Level Passes

Concerning pre-A Level performance, in terms of number of passes, points scored for the 'Best 8' and 'Best 5' passes, or average points scored, no significant relationship was found with degree performance. The authors claimed '[i]ndeed some of the analyses demonstrated that weaker pre-A Level results were associated with strong degree performance.' However, a positive and significant association existed between a pass in pre-A Level Art and degree performance.

A Level Passes

As regards the relation between degree performance and having a pass in certain A Level subjects, significant associations were found for each Chemistry, Design, and General Studies. The relationship was positive for Design (i.e. those with an A Level pass in Design were more likely to perform better than those without), and negative for Chemistry. The majority of students who had a pass in General Studies mainly performed in the middle of the range, with 'very low rates of either loss or strong performance.' Having a pass in other subjects such as Maths, Physics, Biology, Geography, etc bore no significant relationship to degree results.

Having a fail or second attempt at A Level did not appear to impede the degree outcome. Not only did no negative and significant relationship emerge between fails or second attempts at A Level and degree performance, but it was also found that 'a higher proportion of students with fails gained First class or 2.1 degrees than those without failures, and a lower proportion gained only Passes or failed to complete the degree.'

A Level Grades

No direct relationship emerged between A Level *grades* and degree results. Moreover, very few statistically significant relationships were observed between A level *grades* and module marks. No clear or statistically significant relationships were observed between grades in Mathematics or Physics and module marks. Sheridan and Bowe (1996) also found that no strong association existed between successful completion of the degree and Maths unless it was 'in combination with an Art or Humanities subject and a Science subject.' However, students with grade A or B in Art were found to have performed more strongly in Studio and Technology, 'but only the relationship for third year Studio was statistically significant.' The authors reported that significant association was observed between degree performance and A Level results when '*points scores*' of only the Best 3 A Levels were taken into account. However, the size of the relationship was not reported.

Combinations of A Level Subjects

Concerning the effect of different combinations of A Level subjects, no significant relationships were found with studio work. Yet, the strongest performers in first year studio, were those who had 'Arts / Humanities + Science', and in third year were those who had 'Arts / Humanities only'. The weakest performers of both the years were those with 'Sciences + Maths' qualifications. It was almost the same for degree performance. While corresponding relationships remained non-significant, the weakest performers were found to be of a 'Sciences + Maths' background, and the strongest degree performer were found to be 'entrants with a combination of Arts/Humanities + Science + Maths, closely followed by entrants with Arts/Humanities only.'

On the basis of the above and other similar findings, the authors concluded that there existed little evidence to support the stipulation of particular A Level subjects for admission to the course. However, they suggested that prospective candidates proposing to take only Sciences and Maths be advised to 'consider expanding their workload to include General Studies, if not to include an Arts or Humanities subject.'

2.3.9. Interim Summary of Findings: Admission/Performance Investigations

- As far as mere student selection is concerned, evidence was found that the sole requirement of high or low academic qualifications was associated with the attraction of students with strong Maths/Science, or Art background respectively. However, it was also found that strong Math/Science and artistic backgrounds are not mutually exclusive. Being in the minority, schools which required both high academic qualifications and also gave importance to portfolio, were attracting entrants equipped with both Math/Science and Art backgrounds.

- Evidence was found that male and female sub-samples were of different academic inclinations. Likewise, it was found that different patterns of admission-performance relationship existed for male and female (or other differential) sub-samples. This may pose a problem to studies which have not differentiated between their potentially distinct sub-samples.

- Little evidence was found for the ability of solely bookish academic qualifications to predict performance in architecture or similar courses (especially in the design area). This subject will be taken up again in the next chapter which deals with the views and experiences of admissions tutors. It will be shown, correspondingly, that the majority of the tutors are suspicious of the relevance of solely academic qualifications, and disagreement between such student selection criteria and subsequent performance measures is believed to be higher in schools which apply no supplementary criterion for student selection.

- Comparison with other disciplines also showed that the relationship of prior academic qualification to degree performance is smallest in architecture. Yet in one of the detailed studies where high school GPA proved to be the best single variable to discriminate graduates, withdrawers, and dropouts, the mean high school GPA of withdrawers was larger than that of graduates, implying that the relationship is not linear.

- The inclusion of supplementary non-academic (or non-bookish academic) criteria or a measure of closely related academic performance (e.g. freshman GPA) were found to improve the prediction of subsequent performance. One of the studies had studied the effect of different combinations of entry A Level subjects. Indications were found that the strongest performers were those who had a combination of Arts/Humanities + Science + Maths, closely followed by entrants with Arts/Humanities only and then those who had Sciences + Maths background. It should be noted, however, that such an outcome might have been influenced by the ethos of the school.

- Students' performance in subsequent design studios appeared to be interrelated and more consistent than in other subjects. Moreover, evidence was found for the relationship of Spatial Ability tests first to the design and then technology parts of the course, but not with more literary subjects such as theory and history.

Table 2.15. Synopsis of studies dealing with selection or predictive aspects

Author; Year	Title	Main Question / Hypothesis	Subjects / Respondents	Data collection method / medium	Method of data analysis	Major findings
1. Abercrombie et al (1969) 2. Abercrombie et al (1972)	*1969:* Selection and academic performance of students in a university school of architecture. *1972:* Follow up of the selection procedure used at the Bartlett School 1964-66	Exploring the inter-relationship of entrance qualifications, and academic performance. Exploring the relation between selection criteria and subsequent academic performance.	106 students who entered the school between 1969-64, and 76 British male students who entered the school between 1964-66.	Prior Academic Records; Referee's Report; Candidate's Statement; Interview; Intelligence Test Academic performance records during and over the course	Chi square test Product moment correlation One way analysis of variance In some limited cases, Spearman's 'rho' correlation and regression analysis.	Selection interviews were not justifiable. Very low inter-correlations were observed between predictors of different nature. Combination of two predictors often improved the prediction, but no optimal pattern existed for all cohorts. Correlations between predictors and measures of performance were very variable and mainly low and non-significant. No consistent pattern was found for the same subject from year to year, and from cohort to cohort. Performance in studio (followed by structure courses) appeared to be fairly consistent. Candidate's Statement showed better relationship than Referee's Report and Academic Record to degree performance. *
3. Stringer (1971)	The role of spatial ability in a first year architecture course	Is spatial ability (as manifested in psychological paper and pencil tests) related to prior experiences of drawing? Is spatial ability predictive of those parts of the course which are expected to involve more of this ability?	51 first-year students of architecture in the Portsmouth Polytechnic.	Academic records and Psychological tests (seven sets of spatial ability tests from Educational Testing Service, Princeton; administered twice: on the second day of the first term and six weeks later)	Simple comparison of group means Multivariate analysis of covariance Correlation test	Those with prior drawing training showed non-significant superiority in spatial ability tests. Training in (a mathematically laden) drawing course did not exert substantial influence on spatial ability scores. Spatial ability scores showed low to modest prediction of design and technological subjects *but not other* (literary) subjects.
4. Domer and Johnson (1982)	Selective admissions and academic success: an admission model for architecture students	Which selection criteria (academic and non academic) can better predict graduation, withdrawal, or drop out of the students?	571 undergraduate students of Environmental Design, and Architectural Engineering (University of Kansas 1969-1978)	Pre-matriculation academic and non-academic records and post-matriculation academic records	Multiple Discriminant Analysis (a stepwise regression technique)	Best pre-matriculation predictors of academic performance (including high school GPA) were able to identify only 38% of the graduates correctly. The inclusion of 'freshman GPA' among the predictors improved the correct identification of graduates to 57%. Mean high school GPAs of the withdrawers (40% of the sample) was larger than that of graduates.
5. Gartshore and Mayfield (1988)	Admission procedures in UK schools of architecture	Can UK schools of architecture be differentiated according to their admissions policies and student intake?	Admissions tutors of 26 (out of 36) schools of architecture in the UK.	Questionnaire about admission policies and academic background of incoming students	Chi square and correlation tests Cluster analysis	UK schools of architecture could be significantly differentiated. Those requiring high points attract students with strong Maths and Science backgrounds and schools requiring low points attract students with strong Art backgrounds. schools requiring both high points and portfolio would attract students with both science and art-related subjects. Creativity, self motivation and analytical thought were characteristics most frequently sought in the interviews.

*: Findings which emerged after some rectification were applied by the present author.

Table 2-15. Synopsis of studies dealing with selection or predictive aspects (continued)

Author; Year	Title	Main Question / Hypothesis	Subjects / Respondents	Data collection method / medium	Method of data analysis	Major findings
6. Craven (1989)	Some observation of 'A' level qualifications of entrants to a university department of architecture	The pattern of 'A' level qualifications of entrants to the school of architecture in Sheffield University over a ten-year period	All students who entered the school of architecture, University of Sheffield with A-level qualifications between 1979 and 1988. (Total entrants: 410)	'A' level qualifications of student at entrance to the course.	Frequency and rank tables	Maths, Physics and Art were the most frequent 'A' level subjects among the entrants' qualifications over the ten year period under study. Strong maths and sciences background did not preclude the study of Art.
7. Peers & Johnston (1994)	Influence of learning context on the relationship between A-level attainment and final degree performance: a meta-analytic review	The relationship between A-level attainments and subsequent academic performance in higher education is influenced by discipline of study and type of institution.	A total of 70,768 students who graduated from UK universities and polytechnics over a period of 30 years; accounted for in 20 individual pieces of similar research (architecture students: n=564)	Literature review of the published studies which has studied the relationship between A-level attainments and degree performance of students graduated from UK universities or polytechnics.	Meta-analysis (including a number of statistical procedures and tests such as adjustment of correlations for sampling errors and tests of homogeneity)	A 'small but positive' and significant correlation was found between the A-levels and degree performance. However, significant differences in the size of correlations existed both between universities and colleges collectively, and also among disciplines. For architecture, the relationship was the lowest. Because the discipline requires a lot of restructuring of the learning approach in the academic process.
8. Doan and Stiftel (1995)	Predicting performance in planning school: an assessment of credentials with consideration of gender, *race and national origin*	How efficient are prior GPAs and standardised test scores in predicting graduate performance of students?	290 Master's degree students who enrolled in the department of Urban and Regional Planning in Florida State University between 1981 and 1990	Undergraduate GPA; GRE scores; Graduate GPA	Multiple regression analysis	Undergraduate GPA and GRE scores together explained for a modest portion of variation in the graduate GPA of the *white male American* students. For female and other origin students, however, the relationship was very poor.
9. Hellner (1996)	Design education and social relevance: rationale for an admissions policy for design and architectural faculties	Comparison of the relationship between selection criteria and academic performance in two university schools of design and architecture which applied different selection criteria	400 students from the University of Manitoba dept. of environmental studies and interior design + 62 students from the University of Toronto, School of Architecture and Landscape Architecture.	Entrance and subsequent academic records	Correlation test	No correlation was found between entry GPA and studio results in the school which only relied on prior academic GPA. Very low correlations were found for theory courses. Similar sets of correlations were higher in the school which employed supplementary criteria. Modest and significant correlations were observed between entry scores and design studio 1. In both schools studio design 1 showed modest and significant correlations with subsequent studio designs.
10. Sheridan and Bowe (1996)	Admission to Architecture and Degree Performance: A Study of Entrants to the BA Course at the University of Liverpool 1988-1992	What are the relationships between entry qualifications and degree performance in the school of architecture?	319 students entering the BA Architecture between 1988-1992. (The section which dealt with 194 students who had comparable A-level qualifications is reported in this review).	Data from UCCA application forms Direct entry forms Departmental examination records	*Chi-square test* Correlation tests	No direct relationship was found between A Level *grades* and degree outcomes; but there was a significant association between the latter and the *points totals* in 'Best 3 A Levels'. There were very few statistically significant relationships between A Level grades and module marks for the subjects studied. Relationship between different combinations of A Level subjects and degree outcome was not statistically significant. However, strongest performers were entrants with a combination of 'Arts/Humanities + Science + Maths', closely followed by entrants with 'Arts/Humanities only'. The weakest performers were those with 'Sciences + Maths'.

2.4. Summary and Conclusion

A number of more specific findings were earlier stated in 'interim summaries'. For the sake of brevity, what is given below is the general conclusion of this chapter and deals with the major findings.

It was mentioned at the beginning that the objective of this chapter was twofold.

1. To gain insight into the subject of student selection for studying architecture (or other design-centred courses), the involved factors, and previous findings through the investigation of a series of related studies.

2. To identify possible sources and methods of data collection, and the analytical tools which might be applicable to our case studies.

The available relevant studies were located and reviewed. The limited number of such studies along with their inevitable methodological constraints leave little room for definitive conclusions. Nevertheless, an attempt was made to make the best use of the previous pieces of research as stepping-stones to advance our study.

Some of the studies had adopted a psychological approach to study personality or cognitive characteristics of the students of design. Some others had predominantly dealt with academic data and investigated the relationship of prior qualifications to subsequent performance.

Despite the dispersion of the studies, in terms of time and subject, converging findings emerged.

As regards the first objective (above), the following conclusions can be drawn.

- Significant psychological or cognitive differences were observed between students of design and other courses (such as engineering, business, etc.).

Evidence was found that students of design, as compared to their non-designer counterparts, were more interested in matters of form and aesthetics, and more inclined towards 'intuitive' and 'perceptive' cognitive preferences which are manifest in less frequent personality types. Moreover, students of design were found to adopt prevalently 'solution-focused' strategies to tackle design problems ('solution-focused' strategies are in contrast with 'problem-focused' strategies which mainly seek formulae and governing rules).

- Concerning the prediction of subsequent performance, customarily employed academic predictors failed to show a defensible relevance.

On the whole, architecture, as a design-centred course, showed one of the smallest relationships between its selection criteria and measures of subsequent performance as compared to other courses. This was suggested to be the consequence of the nature of the course and its corresponding instruction methods which require considerable modifications to the prevalent learning approaches which are cultivated in secondary education.

- Indications were found for the relationship of certain psychological tests, or non-academic indicators (such as Candidate's Statement) to performance in the course, especially in the design area. These relationships were not as strong and incisive as to suggest the priority of non-academic measures over the academic selection criteria. However, they appeared to be convincing evidence for the importance of non-academic factors. The inclusion of supplementary selection criteria was shown to improve the prediction of future performance. Supplementary criteria may include a relevant non-academic indicator, or a measure of academic performance in a closely related area.

As regards the second objective (i.e. methodological issues), the findings are as follows.

- Corresponding studies appeared to be more similar in their data and data collection methods than in their methods of analysis.

Apart from students' academic records, three other means which were employed to collect data consisted of researcher-designed questionnaire, well-established psychological test, or experimental task. The latter means, however, was only used in the studies which adopted a psychological approach and focused on group differences. Studies of a similar nature had employed similar means of data collection, but different analytical tools. Percentage tables and cross-tabulations, Chi square test, correlation tests, and regression analysis were the most frequently used tools. The review of the past studies seems to provide some acquaintance with various analytical/statistical tools. However, the consultation of more specialised sources for the selection of proper tools is still necessary. While the assumptions (and data considerations) of different statistical tools are mentioned in reference sources, some of the studies did not appear to have paid sufficient attention to the guidelines. Some of the tools were shown to have been used inappropriately.

- Secondary findings showed the importance of the homogeneity of study sample(s). Evidence was found that the aggregation of heterogeneous samples data may conceal or exaggerate existing patterns.
- Self-descriptive tests were found capable of differentiating between contrasting groups. While the 'content validity' of these self-descriptive questionnaires is not easy to substantiate, they appeared to be effective tools for the identification of potential differences among dissimilar groups.

The findings of this chapter which dealt with a series of related past studies provided insight into the subject along with some methodological hints. Due to the paucity of directly related studies, the present author decided not to limit himself to the findings of the review above, in the hope that more information might be obtained. Therefore, an attempt was made to broaden our knowledge by drawing on the views of those experts who were involved in the selection of students to study architecture. What follows in the next chapter is an investigation into the present state of affairs in diverse (British and international) schools of architecture.

CHAPTER 3

Survey of Admissions Tutors

Chapter 3
Survey of Admissions Tutors

Introduction

This chapter reports on the views of architecture admissions tutors about student selection for the study of architecture and the consequences of different methods of selection. A number of admissions tutors, or other architectural educators who were in charge of new entrants, were asked to communicate their systematic findings or experiential views in that regard.

First, an account is given below of the objectives of this chapter. Then, the data collection tool, and our respondents are described. Afterwards, different sets of results are reported. Finally, a summary and conclusion is presented.

Aim and Objectives

A questionnaire was devised for sending to the admissions tutors in a number of (British and international) university schools of architecture.

The questionnaire included 12 questions through which the five following objectives were pursued.

1. To reveal the current procedures for student selection.
2. To identify the differences between (or similarities among) schools in their selection methods, and to see whether those differences/similarities could be ascribed to particular characteristics of the schools.
3. To explore the relevance of the applied selection criteria to subsequent performance.
4. To identify different attitudes towards the function of selection criteria.
5. To locate relevant and systematic pieces of research.

3.1. The Survey

3.1.1. Questionnaire

The questionnaire was so devised as to provide a range of both factual and subjective information on the student selection matter. Since the questionnaire was intended to address a wide range of both British and international schools which might employ diverse methods and criteria, the main questions were posed in an open-ended format to provide the opportunity to gather both anticipated and unanticipated information. Questions 1 and 11 (respectively in a Likert-type scale, and multiple choice format) are exceptions, however. The questionnaire and its inquiry letter are presented in Appendix 3.1 (page 340).

The first question aimed to identify where each admissions tutor would locate his/her school on an orientation scale ranging from 1 to 7, where 1 stood for the most technical and 7 for the most artistic orientation. It was thought that schools of the same orientation might show similar tendencies towards selection, and thus give similar responses to the questions. This could have led to the clustering of their data. In that case, the aggregation of the opposing schools' data could obscure any possible local pattern in the responses. Responses to the first question might be deemed subjective. Nevertheless, considering the constraints of such a piece of research, it seems the only possible way to gain an indication of the schools' orientation, and does not seem to be far from reality. Through questions 2 to 5 inclusive factual information about the schools' selection methods was sought. For instance, the schools were asked whether they screened their candidates before or during the course. Questions 6, 7, 8 and 11 dealt with the admissions tutors' views on the relationship of the student selection criteria to subsequent academic performance. Such views could have been formed systematically, or just anecdotally and impressionistically. Question 9 directly asked through which of these ways their views were formed. Details of any possible research on admission, carried out in the respondent's schools, were sought through question 10. Question 11 was intended to reveal the tutors' views about the optimum function that can be expected from selection procedures, and was the only question which was in a multiple choice format. The final question asked the respondents if they could suggest any relevant source on student selection (either in architecture or other courses) that could provide any further information.

3.1.2. Respondents

Two groups of schools were addressed; the majority of the British schools, and a number of international (mainly Asian) schools of architecture in developing countries. The reason for the selection of the British schools was their longer experience of formal architectural schooling as compared to schools in the developing countries. Moreover, apart from the ease of access and communication, the British schools appeared to be more likely to practice systematic monitoring of, and research into, their performance.

The university schools in the developing countries (especially the Middle Eastern and some Eastern schools) were believed to be experiencing some circumstances common to our case (in terms of the duration of their modern academic establishment, cultural issues, administrative procedures, etc.), hence the expectation of corresponding findings. The list of the schools is presented in Appendix 3.2.

Initially, all British university schools of architecture were nominated for correspondence. Concerning the international schools, priority was given first to Middle Eastern and particularly to neighbouring countries to Iran, then countries of Islamic culture, and then a small number of other developing countries.

An attempt was made in advance to identify each school's admissions tutor (or the most experienced tutor in the matter of student selection) in order to be able to address them directly, because this would increase the likelihood of receiving more careful and committed responses. Apart from the commonly available means, such as schools' web pages, prospectuses, schools' general offices, and embassies, the assistance of the international PhD students (in the same department as the present author) was very helpful to locate the right addressees in international schools. Finally, questionnaires were sent to those schools for which, within the set time limit, the admissions tutor (or an experienced tutor in that regard) was identified and available. The covering letters of the questionnaires were addressed directly to such persons.

16 out of 31 questionnaires sent to the British schools, and 12 out of 26 questionnaires sent to the international schools were replied to.

3.1.3. Data Analysis

The data reduction process was carried out by means of summary sheets and coding. The codes thus acquired were cast in a main table for further cross tabulations. Chi square test was applied to examine the significance of the differences between contrasting groups of schools. Before presenting the overall results, two sets of secondary results are briefly reported. First, a comparison is made between the two groups of schools which showed either artistic or technological inclination to reveal their noticeable differences, and then, main differences between the British and international schools are examined. Before going to the results it seems necessary to describe the intended meaning of two expressions which are used below, namely academic, and non-academic selection criteria.

In the context of this chapter, academic selection criteria refer to those criteria which deal with candidates' records of performance in: (1) upper secondary education; and/or (2) a final certificate examination at the end of secondary education; (3) and/or non-certificate university entrance examination(s), and rely on the assessments of candidates' performance in different subject areas of a formal curriculum.

Non-academic selection criteria concern the sort of information which is usually elicited from sources such as Record of Achievement, Personal Statement, Referee's Report, interview, portfolio, self-descriptive questionnaire, or psychological tests. Personal characteristics and background, and an individual's fields of interest and achievements are among the data thus acquired.

3.2. Results

3.2.1. Artistic and Technical Trends

In terms of orientation, the schools under study clustered mainly around the middle of the range. 14 out of 28 schools (50%) claimed that they were located exactly in the middle of the range, thus giving equal importance to both artistic and technical aspects of architecture. Five schools (2 British and 3 international) ticked point 3 on the scale claiming that they were slightly inclined to the technical side. Seven schools (2 international and 5 British) ticked point 5 stating a slight tendency towards the artistic side of the scale. Only one British school chose 6 representing a considerable artistic tendency. Due to the small number of schools in each category, and also the inclusion of both British and international schools in the artistic/technical categorisation, every inference seems precarious. The responses show that 4 out of 5 technically oriented schools rely solely on academic results for student selection, while 7 out of 8 schools of artistic tendency take both academic and non-academic evidence into consideration for the purpose of admission. In response to question 7, about opinion of the best criteria in terms of the prediction of subsequent academic performance, three artistically oriented schools gave priority to non-academic criteria, and three of them believed that the inclusion of non-academic criteria enhances predictive ability. Two out of five technically oriented schools support the inclusion of the non-academic criteria (although, only one of them employs such criteria in effect), and the rest returned no responses to this question. Responses to other questions were more dispersed and no noticeable difference between the two groups can be detected.

3.2.2. Trends in British and International Schools

When schools are categorised into the British and international locations (n=16 and 12 respectively), no significant contrast emerges in terms of the schools' orientation. However, a significant difference is observed between their decision making authorities, i.e. the bodies which decide on respective admission policies. All 16 British schools of our study claim that their admission policies/criteria are at the discretion of their schools, whereas only one third of the international schools set their criteria themselves. 8 out of 12 international schools select their students through national entrance examinations the decisions on which are made by external bodies.

The presence or absence of routine procedures of familiarisation before final selection is another contrasting point. 7 out of 12 international schools have no familiarisation session with the course, and the remaining 5 offer preparatory courses (three of which are optional courses for which students must pay); whereas, 15 out of 16 British schools, through one or more routines such as open days, studio workshops, interviews, etc., try to familiarise the students with the course before final selection.

As regards the overall mechanisms of student selection, the majority of the British schools (14 out of 16) employ both academic and non-academic evidence, while 6 of the international schools solely rely on academic evidence, and the other 6 require additional architecturally-related examinations.

Despite the mentioned contrasts, both international and British schools in our study appear quite unanimous about the predictive ability of their respective selection criteria. In each group, nearly one fifth of the respondents claim that their selection results are in harmony with the subsequent performance of their entrants. However, nearly three fifths of each group claim inconsistency, and the remaining schools (except for one British school claiming consistency only in the first year) say the issue is not clear for them (n=6).

Responses to question 7, asking which (part) of the selection criteria the schools find most relevant, are diverse. Yet, the British and international schools appear to have contrasting views overall. In spite of the diversity of the responses, they can be classified into three distinct categories. First, those who solely give importance to academic criteria; second, those who either solely value non-academic criteria, or assert the necessity of the inclusion of non-academic criteria for selection purposes; and third, those who have no clear idea.

The majority of the British respondents (62.5%) believe that the taking into consideration of non-academic criteria leads to better predictions. Only about 17 per cent of the international respondents favour the consideration of non-academic criteria. Contrarily, whereas nearly 19 per cent of the British schools solely support academic criteria, 33 per cent of the international schools hold that view. 19 per cent of the British and 50 per cent of the international schools returned no clear idea on this issue.

No other noticeable difference is detectable between the British and international schools in their responses to the other questions in the questionnaire.

3.2.3. Overall Findings

When all responses are taken together, the following results emerge.

As regards the time of their main screening process, 23 out of 28 schools (82%) claim that they screen their candidates before the course; 2 schools state during; 2 schools say both before and during; and one school does not give any answer to this question. In educational literature, however, screening the candidates *during* the course implies that every candidate is permitted to enter the course in the first place, but may or may not be able to continue the course according to their subsequent performance. The responses of the schools which claimed that they screen their candidates during the course to other questions indicates that they do apply some selection criteria at the outset. However, such criteria do not seem to be as strict as those applied in other schools.

Concerning the selection criteria, 50 per cent of the schools take into consideration both academic and non-academic evidence for student selection purposes. 29 per cent of the schools in our study select their entrants just on the basis of academic results (either reflected in high school grades, or general university entrance examination results). 21 per cent of the schools (all from the international group) draw upon both academic results and some additional architectural examination results.

Regarding the relevance of selection criteria, in terms of their predictive ability of subsequent performance, 57 per cent of the schools believe that selection criteria are inconsistent with subsequent performance. 18 per cent claim consistency and 25 per cent have no clear view (Figure 3.1). The differences are statistically significant (χ^2=7.36; df=2; p=.025).

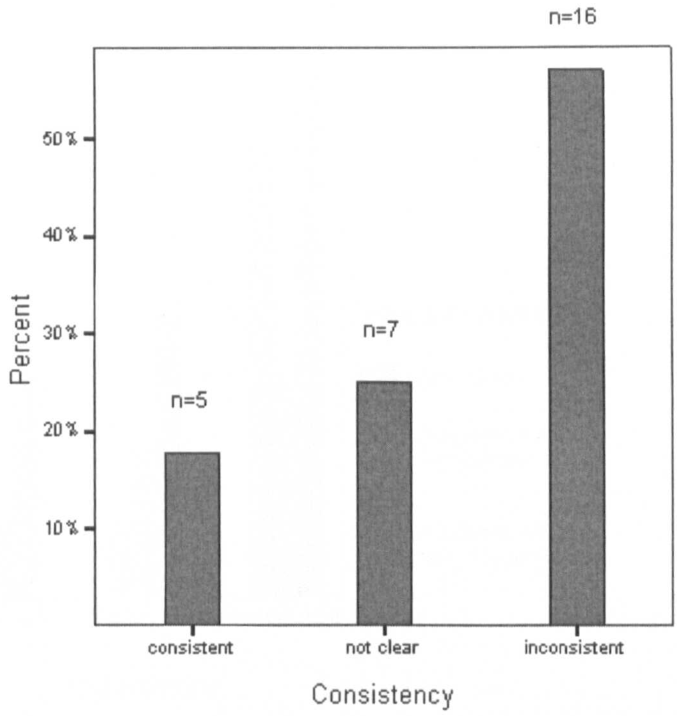

Figure 3.1. Consistency of selection criteria with subsequent performance (overall responses)

As shown in Figure 3.2, while only one out of 8 schools which apply only academic selection criteria claimed consistency (12.5%), four out of twenty of the schools which apply extra criteria do so (20%). The differences, however, are not statistically significant.

Figure 3.3 illustrates a further breakdown of the three categories (of the consistency axis) according to schools' locations.

As shown in Figure 3.4, concerning the usefulness of the different parts of the selection procedures, 43 per cent of the respondents state that either the non-academic part of their criteria alone, or the inclusion of non-academic to academic evidence renders the best prediction. 25 per cent of respondents give priority to academic criteria, and 32 per cent of the respondents either did not answer this part or indicated that they had no clear view.

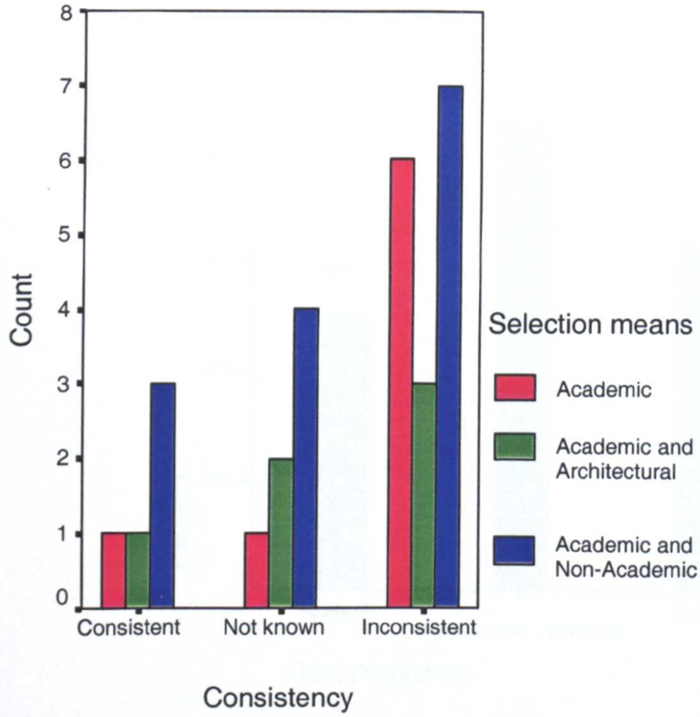

Figure 3.2. Consistency by selection means

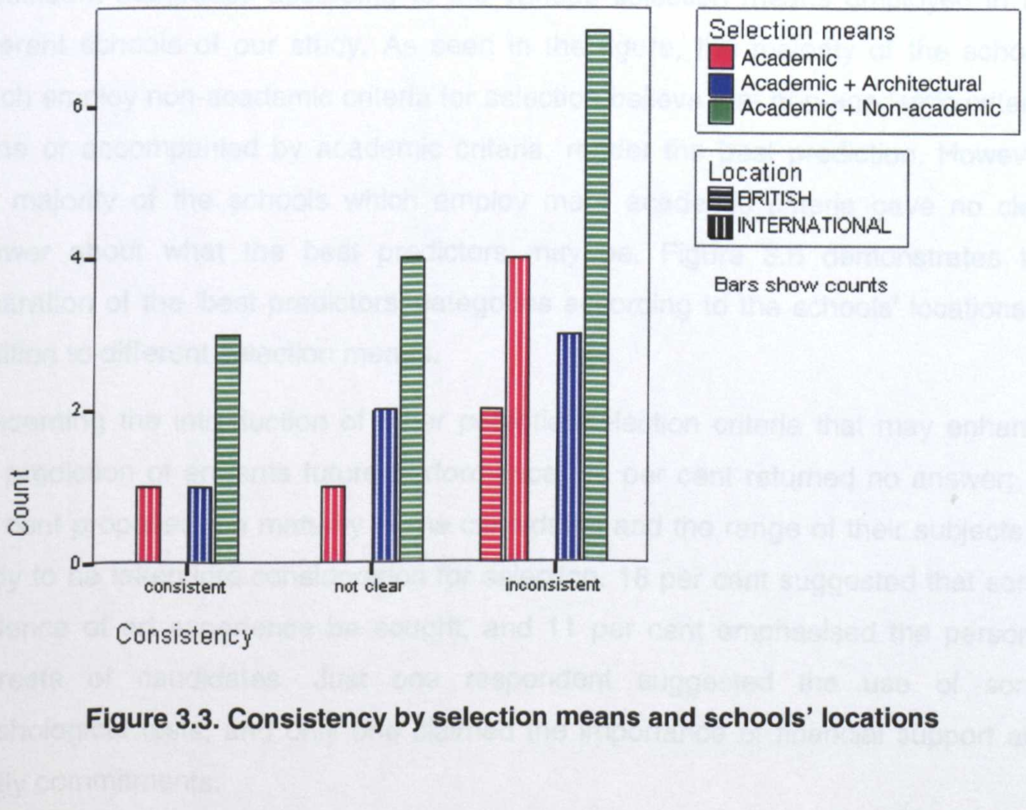

Figure 3.3. Consistency by selection means and schools' locations

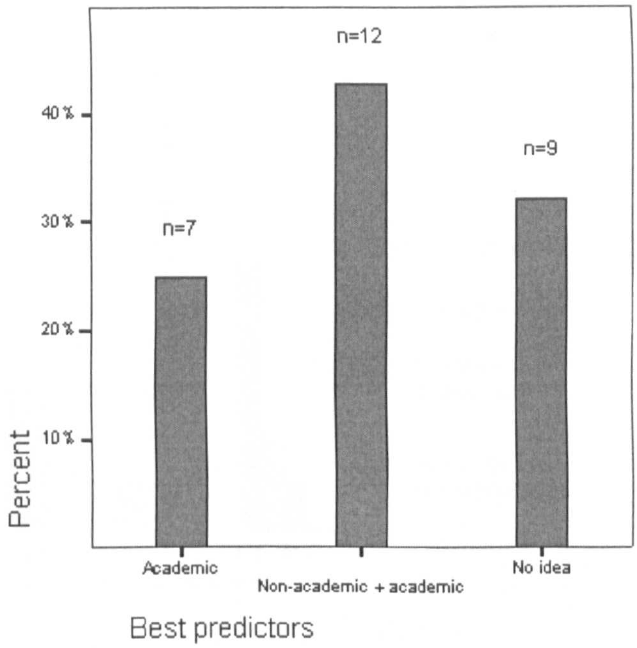

Figure 3.4. Best predictors (overall responses)

Figure 3.5 illustrates a breakdown of the former three categories into their constituent subgroups according to the various selection means employed in the different schools of our study. As seen in the figure, the majority of the schools which employ non-academic criteria for selection believe that non-academic criteria, alone or accompanied by academic criteria, render the best prediction. However, the majority of the schools which employ mere academic criteria gave no clear answer about what the best predictors may be. Figure 3.6 demonstrates the separation of the 'best predictors' categories according to the schools' locations in addition to different selection means.

Concerning the introduction of other potential selection criteria that may enhance the prediction of entrants future performance, 46 per cent returned no answer; 18 per cent proposed the maturity of the candidates and the range of their subjects of study to be taken into consideration for selection. 18 per cent suggested that some evidence of art experience be sought, and 11 per cent emphasised the personal interests of candidates. Just one respondent suggested the use of some psychological tests, and only one claimed the importance of financial support and family commitments.

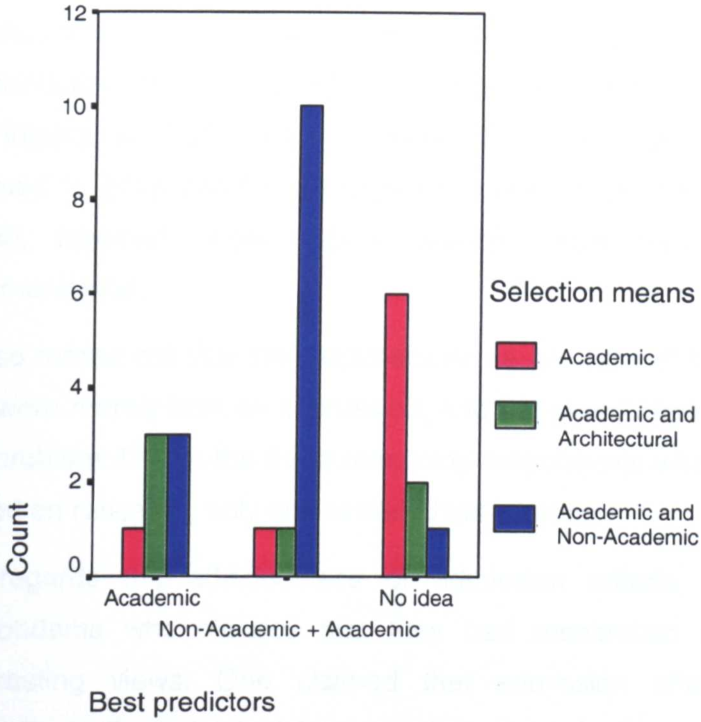

Figure 3.5. Best predictors by different selection means

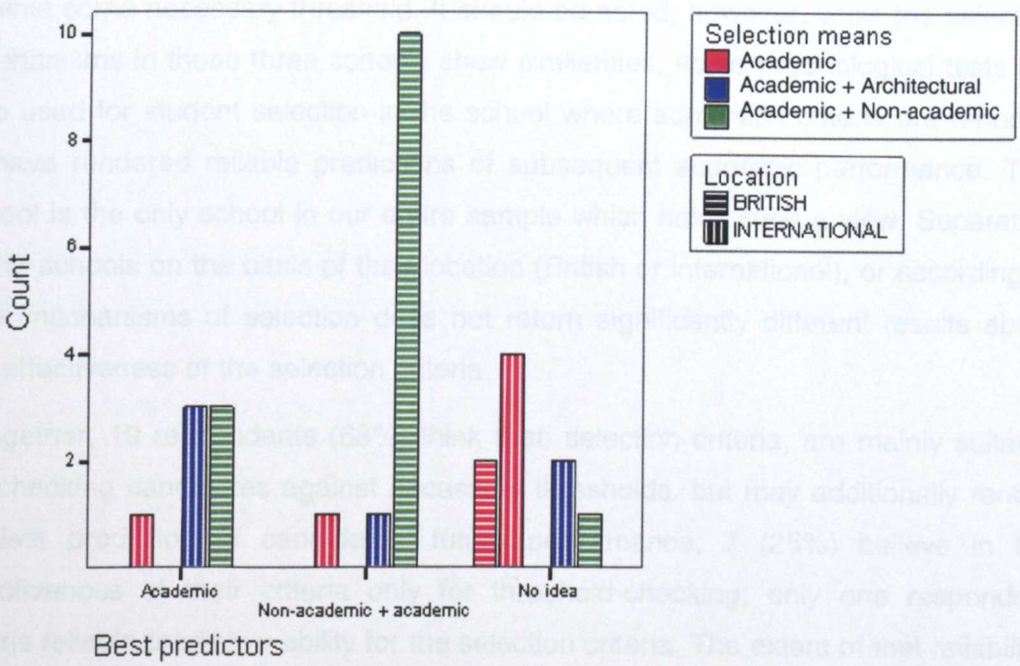

Figure 3.6. Best predictors by selection means and location

In response to the question as to whether any research on this matter has been conducted in the addressed schools, 89 per cent of the replies were negative. Two respondents claimed that they were involved in such investigations at the time of this inquiry, but had not arrived at any conclusions by then. Only one respondent claimed to have carried out continual research on the subject, the outcomes of which, however, were mainly applied within their school and were not communicated.

It also turned out that the responses of 89 per cent of the respondents (25 out of 28) were merely built on impression, and not on sources of empirical research into the problem. Out of the three remaining respondents who claimed their views were based on research, only one revealed his sources.

As regards the effectiveness of admission criteria, the only three (British) respondents who claimed that they had researched into the subject showed contrasting views. One claimed that admission criteria can render *reliable predictions* of candidates' future performance. Another believed that the selection criteria were mainly suitable for checking candidates against necessary thresholds but they *might additionally* render *modest* predictions as well. The other respondent held the view that admission criteria *at best* could have the function of checking against some necessary threshold. It should be noted, however, while the selection mechanisms in those three schools show similarities, some psychological tests are also used for student selection in the school where admission criteria are reported to have rendered reliable predictions of subsequent academic performance. This school is the only school in our entire sample which holds such a view. Separation of the schools on the basis of their location (British or international), or according to their mechanisms of selection does not return significantly different results about the effectiveness of the selection criteria.

Altogether, 19 respondents (68%) think that: selection criteria, are mainly suitable for checking candidates against necessary thresholds, but may additionally render modest prediction of candidates' future performance; 7 (25%) believe in the effectiveness of their criteria only for threshold-checking; only one respondent claims reliable predictive ability for the selection criteria. The extent of that reliability, in terms of some comparable measure, is not communicated, however. One respondent did not return any answer to this part.

In response to the last question, concerning the introduction of possible relevant clues to the problem, one of the respondents, who had conducted research on a related subject, took the trouble to introduce and send his paper. Apart from that, only three respondents alluded to two broad clues, the sources of which had been already identified and consulted.

3.3. Summary and Conclusion

To summarise, the results are categorised so as to correspond to the objectives of the questionnaire. The most important findings are given under similar topics to the initial objectives.

Current procedures for student selection; and the differences among the schools

- The technically oriented schools of our study mainly rely solely on academic results, while the artistically oriented schools seek additional non-academic evidence as well.
- Almost all the British schools of the study employ some routine familiarisation procedures before the final selection; a small minority of the international schools practice such procedures.
- While a considerable majority of the British schools take into consideration both academic and non-academic evidence for selection, half of the international schools rely solely on academic evidence and half of them require some architectural examination in addition to academic qualifications.
- While the British schools decide on their admission policies themselves, the majority of our international schools follow some external bodies' decisions.

The relevance of the applied selection criteria

- A significant majority of the British respondents believe in the relevance of non-academic criteria (on their own, or together with other criteria) in terms of their prediction of future performance. Our international respondents' views are divergent, only a small minority of them believe in the suitability of non-academic criteria.
- In the overall sample, a significantly larger proportion of respondents claimed that their selection criteria were not in harmony with the further academic

performance of their entrants. Nearly three fifths of each group of the British and international schools claimed that their selection criteria proved inconsistent with the subsequent academic performance of their entrants, whereas slightly less than one fifth in the same groups claimed consistency. When responses are classified according to the schools' selection mechanisms (e.g. only academic or including other criteria), evidence of inconsistency is more conspicuous among the schools which selected just on the basis of academic criteria. The latter differences are not statistically significant, however.

Different attitudes towards the function of selection criteria.

- Only one of our respondents believed that their selection criteria could render reliable predictions of their candidates' future performance. Apart from that unique view and a missing response, the remainder subscribed to two different views. While they were in agreement about the usefulness of selection criteria for checking candidates against some necessary thresholds, three fourths were additionally optimistic about the possibility of returning modest predictions of candidates' future performances. The other one forth, however, believed that checking against necessary thresholds was the ultimate function of the selection criteria.
- The main body of the respondents' answers to our qualitative questions are built on impressions and very few responses rely on empirical study. This also shows the lack of evidential work on the subject.

New pieces of systematic research.

- Only one unidentified study, which was indirectly but usefully related to the subject of our research, was introduced by one of the respondents.

In this and previous chapters, an attempt was made to gather relevant information (including published studies or experts views) to prepare the ground for an empirical investigation of the specific questions of our research.
The next chapter will describe the contextual conditions in which our cases occur.

CHAPTER 4
Local Background

Chapter 4

Local Background

Introduction

Through previous chapters knowledge was gained of related systematic studies, and anecdotal views on student selection for studying architecture. The next step is an empirical approach to the subject by means of a systematic comparison of the two selection methods in Iran. In this regard, during this preliminary chapter the contextual academic conditions of our cases are described. An attempt is made to provide background information related to both university and pre-university circumstances, and it will be shown that:

> the local prior[1] education is still akin to a traditional system, and does not seem to provide the necessary background for those who wish to study architecture.
>
> Iranian architectural education, despite its peculiar features, follows a conventional balance between lecture courses and design studios, but the latter is regarded as having the central role.
>
> The student selection system does not appear to fit architecture courses, and needs more objective study.

A brief description follows (in Section 4.1) of prior education in Iran in order to highlight some characteristics of the education that students experience before entering a higher education course. Section 4.2 then represents a short history of Iranian architectural schooling, and the main characteristics of its curriculum. Section 4.3 describes the link between the above bodies, i.e. the method of student selection for the study of a higher education course, in particular architecture. The implications of the issues described in the previous sections are discussed in Section 4.4, before the conclusion of this chapter.

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[1] By prior education, all public/general education before higher education is meant. However, our main emphasis is on secondary stages (including lower and higher secondary).

Before dealing with the mentioned sections, two points should be made here.

I. As it is the case with any country's educational systems, ongoing alterations have been made and are in progress in the Iranian systems. What is reported below is particularly true for the 1980s to late '90s during which our study samples carried out their prior and higher education. Undoubtedly, this does not mean that the present circumstances are essentially different from what is reported below, because fundamental educational changes rely on their requisite cultural attitudes which sometimes take generations to settle.

II. What is presented below about 'prior education' is not meant to portray a comprehensive perspective or a proportional outline of prior education in the country. The state of affairs is the resultant of a multitude of factors, and is associated with mixed positive and negative aspects. After giving a broad outline of general education, an attempt will be made to highlight some of the aspects which, in particular, appear to affect the design-centred courses of higher education including architecture. Unavoidably, some aspects of the prior education system which are brought to light appear negative. To avoid a biased impression, however, two brief instances of more positive aspects will be reported at the end of the corresponding section.

4.1. Prior Education

This chapter's descriptions of prior education are divided into two parts. First, an account is given of the overall structure of general education, then those features of the system which seem to bear relevance to our work will be described.

4.1.1. Structure of General Education

Figure 4.1 shows the major stages of general prior education in Iran. Children benefit from 12 years of education, often starting at the age of six. Pre-primary education is optional but is gaining increasing attention and importance.

The twelve-year length of general education has been maintained over time. However, modifications have been applied to the length of the constituent stages.

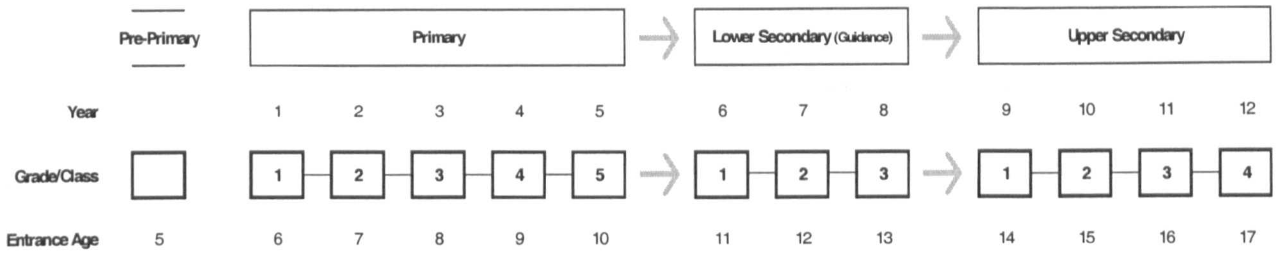

Figure 4.1
Overall stages of prior education in Iran

Before 1966, general education was composed of a six-year primary, a three-year lower secondary, and another three years of upper secondary. In effect, however, the latter two stages formed six years of secondary education because they were barely differentiable in terms of their educational methods, and approaches to teaching and learning.

The structure shown in Figure 4.1 was implemented in 1966 to introduce the key intervening Guidance stage which was expected to have a marked impact on the subsequent stages of education and also the labour market's need for semi-skilled workers (Safi, 1986). In theory, one of the major aims of the Lower Secondary (or Guidance) stage has been to help students identify their tendencies and capabilities for the purpose of proper selection of subsequent education or vocational training. The authorities, however, agree that the aim has not been completely fulfilled in practice because of a host of background problems along with the content-centred approach to education which has hampered the aims of the then newly-introduced stage[2].

Upper secondary education consists of two major divisions, namely Vocational, and Theoretical; and each division includes several branches. The former is meant to produce skilled workers to serve in different sectors of industry, agriculture, and services; and the latter, which accommodates the far larger part of the student population, takes a dominantly academic mode. Also referred to as comprehensive, this division is commonly regarded as the main path to the majority of higher education courses. The completion of a vocational secondary education, however, does not preclude one from having access to higher education. The Theoretical division is composed of four branches of Socio-Economy; Culture-Literature; Sciences; and Mathematics-Physics (Figure 4.2). The names represent the dominant themes of the branches, although slight overlaps exist among them.

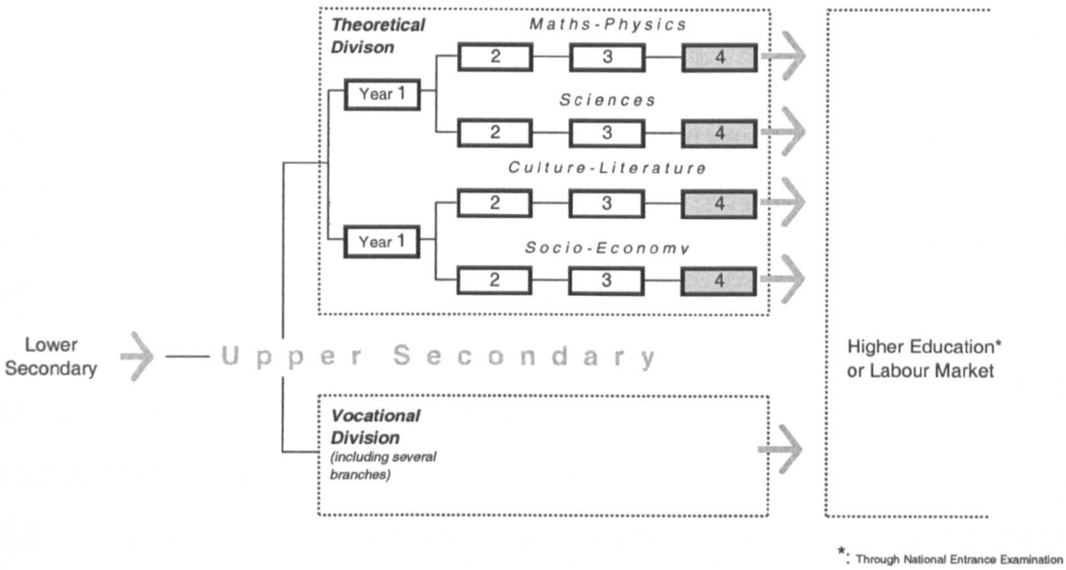

Figure 4.2.
Branches of academic division of Upper Secondary Education

For instance, the Sciences, and Mathematics-Physics branches have some general and specialised subjects in common (e.g. Persian literature, and chemistry respectively), but the former mainly covers the subjects which converge on the earth and life topics, and the latter, centred on mathematics and similar subjects, prepares the ground for studying engineering or pure sciences.

It is opportune to mention here that, with little exception, entrants to architecture come from the Mathematics-Physics branch, although little stipulation has been in force as regards the applicants' type of secondary education.

Apart from each grade's individual examinations, unified regional or national examinations are administered at the end of each stage. The certificate of

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2 See for example: Minister of Education and Reform in the Educational System in: *Name-ye Farhang: Quarterly Journal on Cultural and Social Research.* (1996). 5(20), 45-59.

completion of secondary education (Secondary Diploma) is obtained when a student successfully passes the final examinations of the twelfth grade[3].

General education is provided by several types of schools. Apart from a limited number of governmental schools for students with special educational needs, and other schools for gifted students, the great majority of the country's schools are ordinary governmental schools which provide free education. Since the mid-1980s, new types of semi-private and private schools also have begun to be established. Private schools, for which expensive tuition fees should be paid, are increasingly growing in number. However, ordinary governmental schools still heavily outnumber them. On average, far better educational environments (and extra-curricular activities) are provided in the semi-private and private schools.

4.1.2. Features of General Education

4.1.2.1. Uniformity

One of the features of Iranian prior education is the uniformity of each grades' curriculum, subjects, and textbooks throughout the country. Students have an almost free choice in the selection of their upper secondary study branch. However, they are required to study all the curricular subjects of the grade they are studying in (about 16 subjects in lower, and 9 in upper secondary in each grade). The unified textbooks, which in the majority of schools are the main sources, have been subject to gradual but continual amendments.

Marking is on the basis of a 0 to 20 scale, where 10 is the minimum pass mark. Every academic year is composed of three semesters[4] and the last semester marks are given a double weight. Overall average of the marks is the dominant measure of performance. Those who fail to gain a pass mark in a subject are allowed to resit shortly before the commencement of the new academic year.

[3] Since 1999, general secondary education terminates at the end of 11th grade, and the twelfth grade constitutes a pre-university grade (shaded boxes in Figure 4.2). Those who successfully complete the latter grade are allowed to apply for the National Examinations for entrance to the universities.

[4] Two-semester academic year has been introduced recently in some schools.

4.1.2.2. Content-Centredness and Memorising

The conspicuous characteristic of the country's prior education is its content-centredness and its associated methods of assessment which strongly encourage memorising and rely on this skill. It should not be ignored that since the early 1990s, Iranian students have frequently gained remarkable ranks in the International Olympiads. However, because of the limited number of competitors from each country, this may not be a representative indicator of the state of affairs.

The Third International Mathematics and Science Study (TIMSS)[5] and TIMSS 1999 (also known as TIMSS-Repeat or TIMSS-R)[6] portray another perspective. The study, with more than 40 participating countries, is known as the largest international study of students' achievement. Along with the inferential findings a number of tables show the comparative ranks of countries as measured by a series of achievement tests. Each country's collected data include a sample of some 3500 students (and the teachers and head-teachers involved) from 150 randomly selected schools. The study also enjoys the co-operation of several internationally established institutes to maintain the standards of both the data collection and analysis parts of the study. The TIMSS focuses on three stages of general education, namely 4th, 8th , and 12th grades. On the whole more wealthy countries appeared more likely to fall in the upper half of the league table[7]. However, no such relationship is observed in clusters of closely performing countries. For instance, the Iranian sample performed better than several neighbouring samples from countries of higher GDP per capita, and at the same time, lower than several other samples from countries of lower GDP per capita.

The 1999 study reports that the data show 'higher mathematics achievement when teachers emphasize reasoning and problem solving activities'. Likewise it claims that 'higher science achievement was related to the emphasis that teachers place on experiments or practical investigations.'[8]

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[5] For more details see: Third International Mathematics and Science Study - 1995 [online]. Available: http://www.timss.org/timss1995.html [21 June 2000].

[6] For more details see: TIMSS 1999 [online]. Available: http://www.timss.org/timss1999.html [21 June 2000].

[7] This matter was not covered in the original TIMSS study. The present author compared the GDP (Gross Domestic Product) per capita of a number of participating countries.

[8] TIMSS 1999 Benchmarking News; Highlights of the Results [online]. Available: http://www.timss.org/timss1999b/news.html [23 June 2000].

Concerning the Iranian secondary students, the data from 8^{th} grade students is available. The results show that the Iranian sample fell in the bottom quartile of the range in both the original 1995 and also 1999 studies. Considering the findings of the TIMSS studies (cited above), the latter results suggest that there must have been a noticeable discrepancy between the efficient methods of education, and the common educational methods in the country.

While part of the problem of content-centredness and over-reliance on 'convergent' assessment methods is undeniably related to the financial constraints, the socio-culturally intervening factors should not be overlooked. Lewin (1993) pointed out that educational studies in developing countries have repeatedly shown the resistance of the established traditions of teaching and learning to change to newer learner-centred modes. In a newer piece of research in a Middle Eastern context, Al-Bashaireh (1998) evaluated the consequences of implementation of a new learner-centred curriculum in Jordanian secondary schools. Among his findings, he enumerated a series of interrelated financial, technical, and also social problems which corroborates what Lewin had earlier mentioned[9].

Recently, the exercise of traditional methods of teaching and assessment is coming under increasing criticism by the country's specialists in the field. Shariatmadari and Afrooz, two academics who also have high-rank administrative experience in education in the country, criticised the prevalently traditional methods of education for: not providing the learner with the opportunities of self-actualisation; over-encouraging conformity; and excessive emphasis on the product at the expense of the process of learning (Name-ye Farhang, 1996b). Even senior authorities, who are habitually more inclined to highlight the strengths than weaknesses of their area of responsibility, feel it necessary to bring the problem to light. In the same manner in a formal speech, the Head of Educational Planning and Research Organisation censured the rigidity the educational system shows against reform and innovation (Hamshahri Daily; 4 Dec 1999). He is reported to have said that the educational system's lack of flexibility 'causes a grave damage and delays the establishment of scientific manners and development'; and that 'our educational system is like a

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9 Some of the problems identified by Al-Bashaireh (1998) included the adherence of the teachers to habitual lecture methods; not giving due importance to the development of higher thinking skills such as formulating hypotheses, designing experimental procedures, and applying experimental techniques to new problems; and also adherence to the traditional assessment methods.

moulding machine, it replaces creation-granted varieties with predetermined dimensions ... uniformity seems to be more valued than innovation and creativity.'

4.1.2.3. Lack of Art and Design Components

Apart from the problem of inefficiency of the applied methods, one of the serious predicaments of the educational system is the lack of practical attention paid to art and design. The 1992 Directives of the Educational Reform Council[10], under section 'Principles for Artistic[11] Activities' strongly supports the exercise of such activities and emphasises necessary considerations for different educational stages (or age groups). The considerations, however, do not seem to be fulfilled in practice. While the subject of art (in effect, an hour of drawing per week) is provided for in the primary curricula, it is left to the school and respective teacher's choice of how to handle the subject. Lower Secondary is the only section for which art education is provided. The principal medium for this education is each grade's art textbook which mainly deals with the subjects of history of art and calligraphy, and partly with graphic arts. In practice the course is allocated one hour per week and consists of theoretical study of the textbook and practical exercises of drawing and calligraphy. Accordingly, half of the examination consists of a written part (answers to bookish questions) and the other half includes a piece of drawing and a calligraphy task. The provision of art education may be sufficient in private schools where, in return for high tuition fees, qualified teachers, a proper studio and materials for the subject are fairly available. However, this is not the case in the vast majority of other schools. According to the Iranian Education Census Book (1993, and 1994), when our corresponding study samples completed their secondary education in 1993 or 1994, respectively 4.3 and 6.6 percent of the secondary schools were private schools. In terms of student population in the same years, 1.7 and 2.3 per cent of the students were studying in private high schools. The same source did not provide the exact student to teacher ratio for qualified teachers in art- or design-related subjects. However, comparison of the data for other curricular subjects and teachers' qualifications reveals that the most optimistic ratio had not been smaller than 1900 students to one qualified-in-art teacher (i.e. one teacher for more than sixty students if any qualified art teacher taught 30 hours a week).

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[10] Educational Reform Council. (1992). Directives of the Educational Reform Council. Tehran: Ministry of Education.

[11] In the Iranian context, words 'art' and 'artistic' usually take wider meanings than limited to beautiful expressive works. Art activities may also include design works with a technological focus.

Since the problem posed by the lack of sufficiently provided art and design programmes seems to bear direct relevance to our research, this problem will be tackled in more detail at the end of this chapter.

Parenthetical note

As mentioned earlier, what was given above did not mean to depict an inclusive view of general education in the country; there was no room to reflect instances from the positive side. In order not to have caused a biased impression and also not to lose the thread of chapter topics, suffice it to say that according to EFA/2000 UNESCO document[12], Iranian state schools (with a partial financial assistance from UNESCO) are the educational host of over 100,000 refugee students from neighbouring countries - reportedly one of the largest such cases. In the same circumstances the Iranian Literacy Movement Organisation was one the five winners of UNESCO's 1999 literacy prizes[13].

4.2. Architectural Education

This section includes two parts. First, a brief account will be given of historical backgrounds of the Iranian architectural education. Second, the key characteristics of its programme and the configuration of its curriculum will be dealt with in more detail. The share of the design area of the Iranian programme will be compared with those of a number of international schools at the end of the latter part.

4.2.1. Historical Background

Modern academic education of architecture in Iran dates back to the fourth decade of the twentieth century. Historical evidence testifies to the existence and performance of internationally renowned (equivalents to the present) universities in

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[12] Education in Situations of Emergency and Crisis. In Education in Crisis and Post-Conflict Situation. Assessment EFA/2000 – Thematic Study [online].
Available: http://www.unesco.org/education/emergency/unesco/situations.shtm#11[24 June 2000].

[13] Other winners were institutions from India, Niger, Peru, and the United Kingdom. See the following for more details: UNESCO names winners of its 1999 literacy prizes [online].
Available: http://www.unesco.org/education/educnews/99_08_06/litprizes.htm [24 June 2000].

the past eras of the history of Iran[14]. However, it was in 1934 that the first modern university was inaugurated in the capital Tehran.

The first academic architectural education was provided by the School of Fine Arts of the University of Tehran which was established in 1940. Andre Godard, a French archaeologist and architect, was the planner of the programme and also the first head of the school. As the background of the originator and the name of the school imply, and also as a result of preferences of the then educational policy makers of the country, the school tended to follow unquestioningly in the footsteps of the French Ecole Des Beaux-Arts.

For 20 years, the School of Fine Arts was the only school providing an architectural programme in a higher educational setting. In 1960, the second school of architecture was established in Shahid Behesti University[15] in the capital. Later, in 1968, the third school of architecture started operating in the Iranian University of Science and Technology. The third school also, like its antecedents, was located in Tehran.

Following the late 1960s changes in European universities including the Ecole des Beaux-Arts, curricular and pedagogical changes were also implemented in the Iranian schools of architecture. Later on, as Nadimi (1996, p81) mentions, '[s]pecial features of each school would be a function of the pedagogical conventions of the countries from which the majority of the teachers had graduated'. While having elements in common, each school had its own curriculum and particular orientations. Thus, after the introduction of modern higher education until 1990, when a number of new schools of architecture began to be established, those three

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[14] Academy of Jundishapur, known as the educational achievement of the Sassanid dynasty (AD 224–651), and the network of the Nizamiyah schools (mosque colleges) established in the early centuries of the Islamic period of the country's history, are telling instances. Such institutions accommodated a wide range of disciplines from philosophy to astronomy and medicine. The richness and diversity of their academic activities are regarded to have had a pivotal role in the accumulation and transfer of the intellectual heritage of the previous and the then scholars to the following civilisations (Nakosteen, 1964; Makdisi, 1981). Despite major historical fluctuations, the country witnessed the concomitance of social needs with commensurate technological developments, and the maintenance of an overall pace of scientific progress until around the 18th century.

During the reign of the Qajar dynasty (1779-1925), and especially in its second half, the country severely failed to maintain the pace of scientific/technological advancement of the time. Amid that stagnant period, Amir Kabir, the capable and insightful prime minister of Naser od-Din Shah (reigned 1848-96) established the first modern higher education institution (namely 'Dar ol-Fonun', meaning school of technology) after the then European universities in 1850 in Tehran. The prime minister, however, became the victim of his undiscerning king later, and the institution could not sustain its initial credit after a few decades.

While a small number of other higher education institutions were founded, it was not until 1934 that the first university of the country, namely the University of Tehran was inaugurated. Thus, the modern style of higher education was re-introduced on a larger scale than before, and the model (though on different scales) was multiplied in the major cities of the country afterwards.

[15] Formerly called: Iran National University.

schools were the only schools which offered architectural courses leading mainly to Master's degrees with a smaller number of students graduating with Bachelor's degrees. The number of schools of architecture has reached a total of 26 recently (in 18 state and 8 non-state universities[16] in 2001).

4.2.1.1. National Educational Reform

A short while after the Islamic Revolution, the evaluation of the high ranking educational authorities was that a reform was (particularly) necessary in higher education to adjust the educational programmes of universities to better meet the values and/or the needs of the society. The problem stemmed from the fact that some of educational programmes were shallow reproductions of the originally foreign sources. Neither was the interconnectedness of the adopted educational programmes with their original supporting backgrounds scrutinised, nor were proper amendments applied to adapt the programmes to meet the needs of the country. Concerning the architectural programme, for instance, while in the leading university (in the seventies) four semesters of compulsory courses of 'History of Architecture' predominantly focused on Western architecture, only one elective course about the history of Iranian Architecture was occasionally presented. This should be seen alongside the fact that only a small minority of the students could travel abroad during their entire course of study, and virtually none could gain a meaningful experience of Western life and the numerous factors which shape architecture in that context.

In 1980, a number of hierarchical councils and committees were established to plan the necessary measures for the reform[17].

Among the programmes of other courses, the new educational programme of Architecture was released in 1982 to be implemented *uniformly* in all schools of architecture thereafter[18].

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[16] A chain of non-governmental (Azad) universities were founded in 1982. These universities, which are required to follow the programmes and educational regulations of the state universities, rely on students' tuition fees financially. Separate (but similar to state-run universities') entrance examinations are administered for admission to these universities.

[17] To decide on new educational and cultural directions and principles in accordance with the values and needs of the post-revolutionary society, key issues in the educational and cultural sectors were assigned by Imam Khomeini, the leader of the revolution, to an appointed council of eminent scholars. The Supreme Council for Higher Education Planning, as a sub-division of the former council, was established afterwards. The revision of university curricula was one of the council's duties which was accomplished through the employment of a number of specialised Planning Committees/Groups for different disciplines/courses. While higher levels of the hierarchy were responsible for general and inter-disciplinary decisions, specific decisions on the details and contents of the syllabus were made in the

4.2.2. The New Architecture Programme

In its principles, the new programme is very similar to a generic model of architectural education. Dominant teaching methods include studio-based projects (relying on sequential reflections and crits) and also lectures. Educational material is arranged around the three axes of design; sciences and technology; and humanities – developing in complexity during the course. Educational material is divided into segments of two to six credit-unit courses. The share of each area and the appropriated times will be described below.

In terms of contents, however, the post-reform programme and its subsequent revisions tend to be more attentive and responsive to the regional actualities as compared to the pre-reform Iranian programmes of architecture. This is reflected in several newly introduced courses and also in the priority given to local architectural issues in design projects.

Peculiarities of the post-reform Iranian architectural education are as follows.

I. Uniformity of the programme in all schools.

II. Degree and overall length of the course.

III. Inclusion of compulsory General courses in the curriculum.

IV. Three-semester length of the preparatory courses.

V. Newly introduced courses of 'Human, Nature and Architecture', 'Islamic Architecture', and 'Rural Architectural Studies/Design'.

VI. Individual graduation.

The above items are described in more detail below. Generally, they are meant to portray a broad picture of the programme. However, items I and VI also have direct methodological bearing on the subsequent parts of our study.

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specialised Groups. The Planning Group for Architecture was composed of a number of architecture, urban design, and engineering academics.

[18] At first the curriculum and syllabi were intended to be exactly followed in all schools. However, from 1989, in the case of particular standards of academic level, universities were permitted to conduct partial alterations to the syllabus. In effect though, minor changes were implemented.

4.2.2.1. Uniformity of the Programme

Only a minor part of the programme is at the discretion of the well-established schools to be replaced with what any such school prefers; this does not include smaller university schools. Even in well-established university schools, the alterations have been too small to affect the main theme and structure of the programme. This uniformity of the official curriculum and syllabus may be debatable from some points of view. However, it facilitates our sampling methodologically, and our findings are more likely to be applicable for similar schools covering a larger student population. More details will be given in the following chapter about our sampling from three university schools.

4.2.2.2. Level of Degree and Length of Course

Mainstream architectural education in Iran (studied in this research) was a common continuous Master's degree programme[19]. According to the curriculum document[20], the diversity of the areas directly relevant to architecture, the necessity of gaining reasonable awareness of those areas, and the need for the development of creative integration skills in design circumstances were the reasons behind the continuity of the course to Master's level. However, in terms of educational regulations and possible termination, the first four-year part of the programme is considered (and referred to) as the BArch section of the course. Graduation at BArch level is a secondary stream permitting students to leave their architectural education before the March level. The interim graduation can be due to personal circumstances, educational circumstances, or a decision to study a cognate Master's degree such as Urban Design or Renovation of Historical Buildings.

In 1999, however, the latest programmes were released which affect only those who enter the schools thereafter. The 1999 programmes include an identical four-year BArch degree course and several discontinuous MArch degrees which can be applied for after completing the BArch course and sitting particular entrance examinations. The main reasons for the change included the following.

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[19] There also exists a two-year programme for training architectural *technicians* offered by a number of lesser higher education institutions.

[20] The revised edition of the Curriculum and Syllabi of the continuous Master's degree in Architecture (1995). The Supreme Council for Higher Education Planning: The Iranian Ministry of Culture and Higher Education.

One, to replace the common broad (or defocused) MArch with several specialised MArch courses. Two, the application of an additional (intervening) student selection process in the hope of securing a better outcome. It was also believed that the level of undergraduates' knowledge/skills would match with a range of construction sector needs for which less than a postgraduate's, but more than a technician's level of knowledge was needed.

The scope of the present work does not include the 1999 programmes, but it should be mentioned that 1999 BArch programme is very similar to the BArch part of the earlier continuous Master's programme which is the main reference in the present work (and was followed by our study samples)[21].

Apart from the concluding *Final Design Project*, it takes at least six years to complete all taught courses and design studios. Formally, under normal circumstances, students are allowed a maximum of 8.5 years to finish their course (including the Final Project). According to Nadimi (1996), however, a survey on the length of course completion in Shahid Behesti School of Architecture has shown an average of 8.48 years (for all graduates over a 32 year period). It should be noted that no period of formal practical experience is mandatory during the course. However, in accord with their levels of skills, students usually begin to find part time jobs in architectural firms after the completion of their second year of study.

4.2.2.3. Compulsory General Courses

The Bachelor's part of every discipline's curriculum which was released after the Educational Reform includes a series of compulsory General courses. These cross-disciplinary courses constitute a total of 20 credit units (requiring more than 20 contact hours per week), and include Persian Language, Foreign Languages, Islamic Studies, Physical training, etc.. Apart from Physical training other courses are theoretical. The General courses are usually scattered over the first three years of the course in decreasing order, and having a pass in each of the courses is necessary. However, students have the choice of when to take the courses.

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[21] The main difference is the inclusion of a Final Project into the new BArch programme. Previously the Final Project was carried out at the end of the Master's degree (on a larger scale). Since the then unified educational regulations required that Bachelor's courses be limited to 140 credit units, some of the technology and humanities subjects of the course were merged or constricted to provide room for the inclusion of the Final Project.

4.2.2.4. Preparatory Composition Courses

The curriculum includes three preparatory design studio courses (Composition[22] 1, 2, and 3) which officially require 16 contact hours weekly over three consecutive semesters. However, many additional working hours are usually needed to meet the deadlines for the exercises. The three-semester length of these studios is in response to the lack of sufficient preparation of design related skills (e.g. visual communication) in prior education. These studios start with freehand and technical drawings and continue to other graphical/architectural representation and communications skills in a broad sense. Through exercises in the analysis of physical aspects/elements of buildings or the built environment, students begin to reflect on those aspects/elements to build their personal schemata of architectural concepts. Involvement in simplified (and sometimes abstract) design problems, and small scale architectural design exercises are the complementary parts of the Compositions which prepare the ground for architectural design projects.

4.2.2.5. Newly Introduced Courses

Several courses of the new curriculum constitute its distinctive context-specific components. These courses are 'Human, Nature and Architecture', 'Islamic Architecture', and 'Rural Architectural Studies/Design'. Among other educational aims, each of these courses is also meant to familiarise the students with those socio-cultural values and circumstances of the country which are believed to have an important bearing on their future design decisions. 'Human, Nature, and Architecture' highlights the effect of value and belief system on architecture, 'Islamic Architecture' maintains links with the viable architecture of the past of the country, and 'Rural Architectural Studies/Design' brings the previously ignored subject of rural architecture into focus.

- According to the curriculum document, the aim of the first year courses of 'Human, Nature, and Architecture' subject is twofold. Mainly, to introduce the breadth of the subject of architecture, with particular emphasis on the combined influence of both natural and human-related factors; and secondly, to present preludes to a series of topics which will subsequently constitute the

[22] The Persian name of the course is 'Tarkib' which has several meanings in different contexts. Composition (and configuration) seem to be the closest English equivalents in this context. Other meanings of the word include: combination, synthesis, integration, and *gestalt.*

subject matters of diverse courses in the following semesters. The course tries to depict nature (or Creation) as an abundant source of architecturally related exemplars, and in tune with the beliefs of society, it tends to cultivate a respectful and inquisitive view of nature as a rich source of inspiration. At the same time, through the study of culturally dissimilar human settlements the course tends to demonstrate the influence of diverse human factors, including belief systems, on architecture. This course begins with a series of lectures (preferably) given by visiting specialists from diverse fields, and continues with a few short projects and/or studies carried out by students under the supervision of one or more tutors around the lectured topics.

- There is a widespread dissatisfaction among the architectural academics (and also country's intelligentsia) with the contemporary architecture of the country which is believed to suffer lack of identity (see for example Abadi's, special issue on Iranian architecture, 1996). Transplantation of non-indigenous (especially western) styles has failed to find supportive roots in the new context. Despite their rapid proliferation, evidence of evolution in styles/type or a clever adaptation to environment is very difficult to find. Nor have the viable dimensions of the traditional architecture been sufficiently and systematically identified to facilitate its evolution and applicability. It is believed that in the wake of the revival of the Islamic values, closer examination of country's traditional/Islamic architecture, which has proved to match the manners and values of the society, is necessary (but not sufficient) for finding workable solutions. Islamic Architecture courses are meant to provide students with proper situations for gaining acquaintance with such examples and exploring their explicit and implicit principles.

- Owing to the existence of widespread and numerous villages in the country and the ongoing need for their development, the Rural Architectural Studies/Design courses tend to familiarise students with the interacting factors in rural architecture. Through lectures and field trips, the first semester of the course is intended to draw the attention of students to a range of (geographical, cultural, economical, etc.) factors that shape the village. According to the curriculum document, it is anticipated that 'a general understanding of the relation between form and content is thus acquired'. In the following semester, the previous findings are employed to design an individual architectural project within the context of the same village. While almost all

Iranian students of architecture come from urban backgrounds, the Rural Architectural Studies/Design courses have been enthusiastically welcomed by students.

4.2.2.6. Individual Graduation

Final Design Project is the concluding component of the course in which each student is required to prove his/her competence in diverse areas of the discipline through an integrated design solution. The project also includes a dissertation which is intended to give a detailed account of all background aspects, rationale, and specifications of the designed project. Both project and dissertation parts are completed under the supervision of a tutor, and each student follows his/her individual timetable, hence there is no collective graduation. Through individual viva, in front of an audience of students and outsiders, each student is required to formally present his/her work to a jury (of often five, but varying academics) and answer their questions.

Similar to the case of the unified programmes, the exercise of individual graduation bears on our work methodologically, because the assessment of Final Projects, due to their difference in depth and breadth and also varying juries, is very unlikely to return comparable and applicable measures of performance.

4.2.2.7. General Configuration of the Programme

The initial curriculum included nearly 200 credit units demanding considerable number of assignments. It also led to students taking longer than anticipated to graduate, therefore, revisions were implemented to constrict the curriculum. The revised curriculum consists of 175 credit units which include 143 credit units for the Bachelor's part and 32 additional credit units for the Master's part of the programme (including the 6-credit Final Project). The course subjects can be categorised into four broad areas of Design, Technology, Humanities, and General subjects (examples of each are given below Table 4-1). Distribution of credit units in the four areas of study (over the BArch and MArch parts of the course) are as shown in Table 4-1. Figure 4.3 graphically represents the distribution of credit units, Figure 4.4 shows the percentages of the four areas over different parts of the course, and Figure 4.5 demonstrates contact hours for each area over the first part, second part, and the entire course.

Table 4.1.
Distribution of credits among the course areas

	Areas				Total
	Design [a]	Technology [b]	Humanities [c]	General [d]	
BArch credits	**46** (53)*	**46** (36)*	**31** (27)*	**20** (20)*	**143** (136+4)*
contact hours	2040	1291	850	340	4521
Master's credits (courses)	**18**	**4**	**4**		**26**
contact hours	816	136	68		1020
Master's **Final project**	**6**				
sub-total credits	**70**	**50**	**35**	**20**	**175**
sub-total hours	2856	1427	918	340	5541

a: Preparatory and Architectural Design studios in the BArch part; and Architectural, Urban, and Restorative Design studios in the MArch part of the course.

b: Including Building Sciences; Building Services; Construction Material and Detailing; Structural Calculations; and similar courses.

c: Including courses in History and/or Theory of: Architecture, Islamic Art, Urban Design, and Restoration.

d: Identical general subjects in all universities and disciplines including Persian Language, Foreign Languages, Islamic Studies, Physical training, etc.

*: Small figures between parentheses represent the corresponding credits of the latest BArch programme (1999).

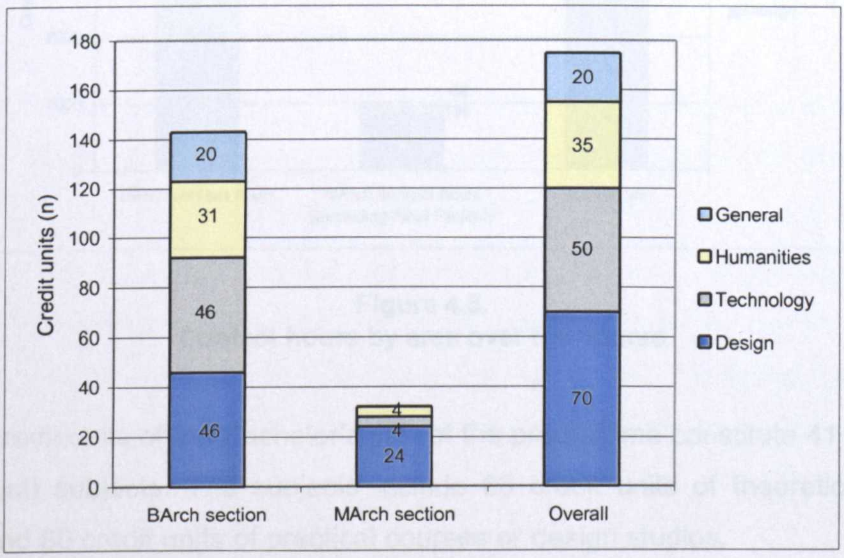

Figure 4.3.
Distribution of credit units by area over the course

It should be noted that each credit unit requires one contact hour per week if it is a theoretical lecture course, and three contact hours if it is a studio-based course, requiring practical work, projects, or field trips.

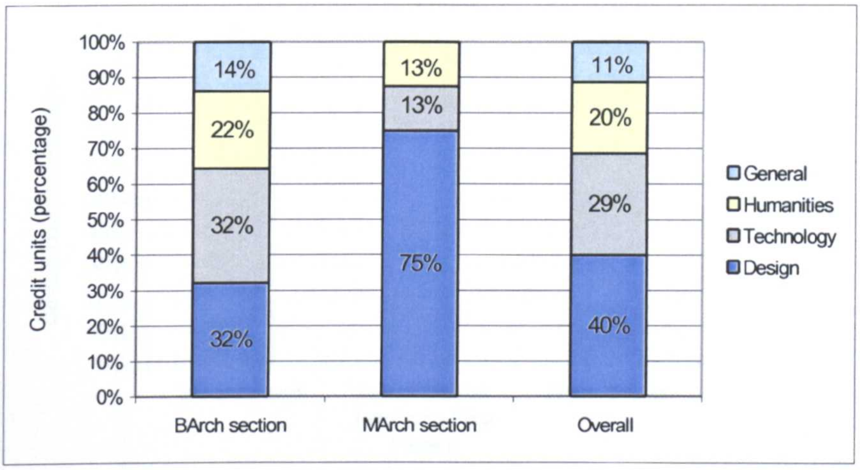

Figure 4.4.
Percentage of credit units by area over the course

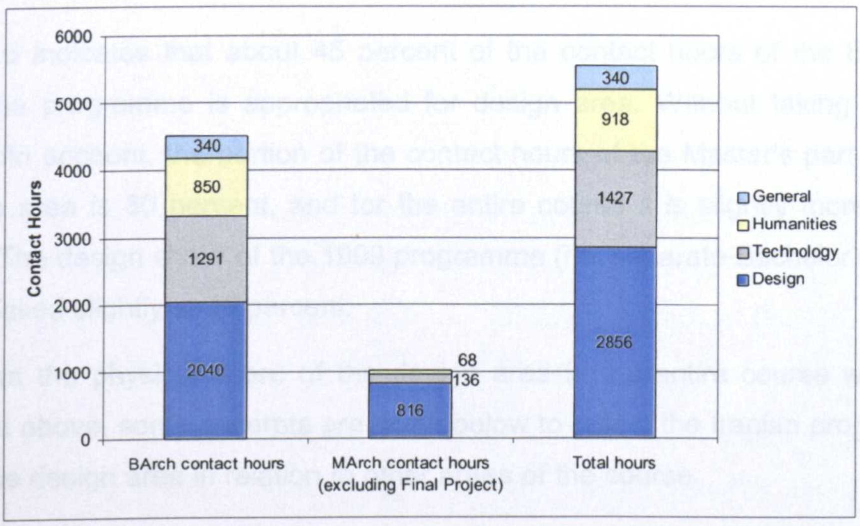

Figure 4.5.
Contact hours by area over the course

The 143 credit units of the Bachelor's part of the programme constitute 41 (separate or continual) subjects. The subjects include 63 credit units of theoretical lecture courses and 80 credit units of practical courses or design studios.

The Master's part of the course consists of 32 credit units of which 23 are design and practical courses and 9 are theoretical courses. Altogether, Master's credit units constitute 8 subjects.

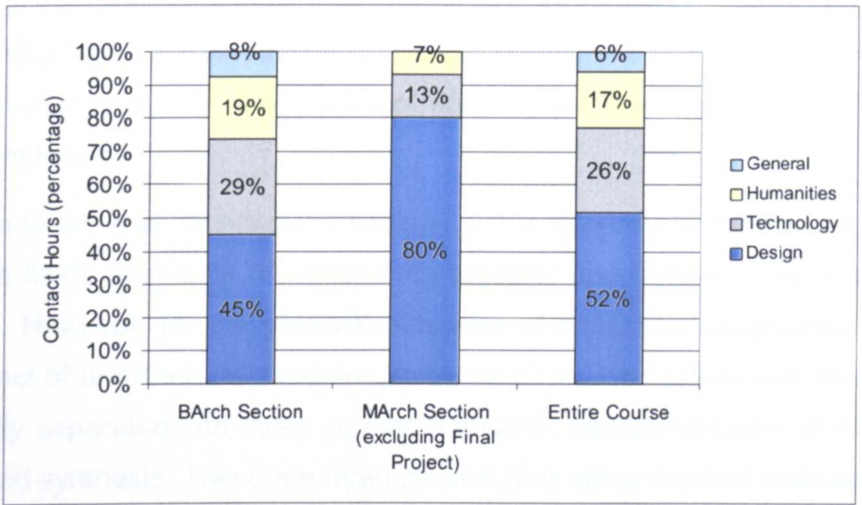

Figure 4.6.
Percentage of contact hours by area over the course

Figure 4.6 indicates that about 45 percent of the contact hours of the Bachelor's part of the programme is appropriated for design area. Without taking the Final Project into account, the portion of the contact hours of the Master's part allocated to design area is 80 percent, and for the entire course it is slightly more than 51 percent. The design share of the 1999 programme (i.e. separate Bachelor's degree) has increased slightly to 48 percent.

Apart from the physical share of the design area in the entire course which was presented above, some excerpts are given below to reflect the Iranian programme's view of the design area in relation to other areas of the course.

Drawing upon Persian etymological and lexical sources, the curriculum document [23] (under Definition and Aims) maintains that the meaning of the Persian equivalent of the word architecture transcends the physical existence of buildings, and bears notions of life and spirit: 'architecture is always conceived as the built environment

[23] The Curriculum and Syllabi of the continuous Master's degree in Architecture (1995). The Supreme Council for Higher Education Planning: The Iranian Ministry of Culture and Higher Education.

equipped with soul.'[24] Further, the document asserts that 'architecture is (the outcome of) a kind of creative act which aims at organising the human habitat, and covers a wide range of issues from meeting human physical/environmental needs to the expression of his/her affections and beliefs'.

Regarding the development of design idea and its formation, the document holds the view that 'architecture inevitably involves *creativity* and *innovation*, because in the absence of creativity', the document emphasises, 'the integrity of the design is not accomplishable.'

It goes on to say that 'architectural designing is to generate a unified integration out of diverse fields (elements of) which fuse together and become inseparable in the outcome'. However, for the practical purposes of education, programmers believe that 'the act of architectural designing, in terms of the type of involved issues, could be virtually separated into three generic domains', namely domains of knowledge, values, and synthesis. These are three parallel (but rather implicit) lines along which the content of the programme is arranged.

Further the document reads 'the knowledge domain is composed of the sciences which an architect needs in his/her work'. Seeing architecture, broadly, as manipulation of the *environment* for the use of *humans*, the document concludes that gaining sufficient familiarity with the related subjects of both physical and human sciences is necessary.

Concerning the domain of values the document asserts that 'the architect's mind is not a tabula rasa; in his/her attitudes, selected means and methods, and the sources he/she draws upon, and even in making decisions, he/she is always influenced by his/her values, beliefs, and world view.'

The third domain, namely synthesis, according to the programmers 'is in fact the main area of an architect's work and the realm of his/her creativity and innovation; where the architect, drawing upon his values and acquired knowledge, makes an effort to create spaces of quality.' It is further claimed that it is in the domain of synthesis where the artistic side of architecture is manifest, hence the need for continual exercises. While the sciences are regarded as contributors to the domain

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[24] In Persian language 'architecture' is 'معماری' (pronounced *me'mari* with *me* as in Mecca, *ma* as in March, and *ri* as in river). The (originally Arabic) root of the Persian word has several meanings including to live, to build, to enliven, to make habitable, etc. – and so implies the above derivative.

of knowledge, arts are known to be 'influential in the domain of synthesis'. The document claims that acquaintance with the arts (not necessarily a particular art) 'can lead to the development of artistic perceptiveness which furthers the architect's understanding of the diverse aspects of the phenomena he/she encounters'.

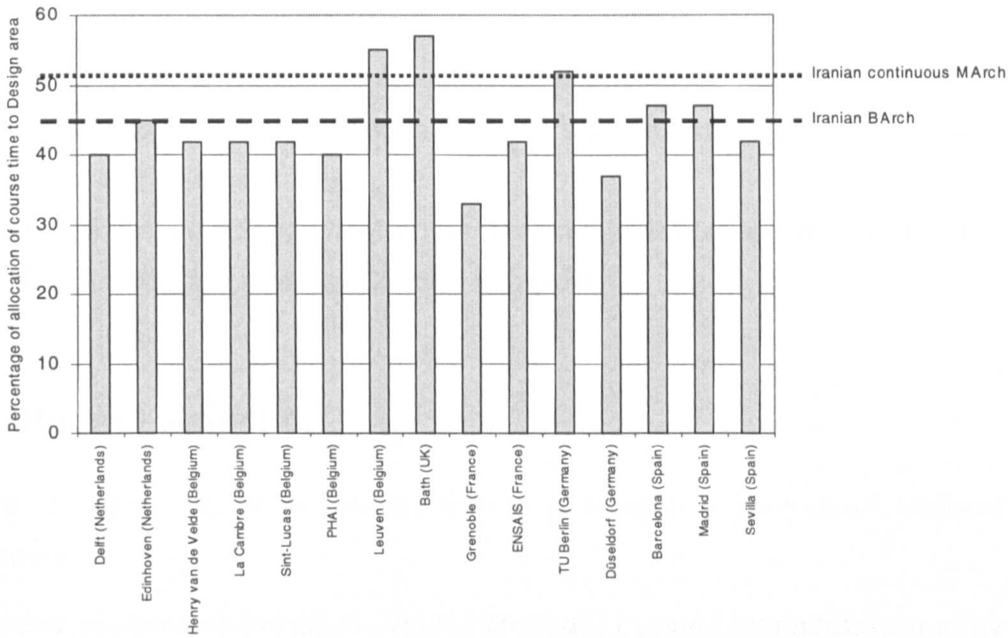

Figure 4.7
Comparison of percentage allocation of course time to Design area
in 15 European Schools of Architecture, and the Iranian programme
Adapted from Orbasli and Worthington (1995)

It could be concluded that, from the document's point of view, the synthesis domain (or design areas) is the core of the course; and while the study of both human and physical sciences provides the necessary ingredients, it is an intuitive or artistic understanding ability which facilitates the accomplishment of the architectural synthesis.

In order to indicate the proportion of the design area in the Iranian programme, in a comparative international perspective, the mentioned ratios could be compared with the percentages shown in Figure 4.7, (adapted from Orbasli and Worthigton, 1995; and Orbasli, 1997).

For the fifteen European schools of architecture in Orbasli and Worthington's (1995) comparative study (shown in the figure above), the average time allocated to the design area is 44.2 percent of the course (with a standard deviation of 6.51). Corresponding share in the Iranian programme (including the continuous Master's degree) is about 7 percent higher than the Orbasli and Worthington study's average. However, the design share of the BArch part of the programme is almost identical to the above international average.

In terms of the length of the course and total contact hours the Iranian curriculum is only comparable to the Spanish schools (the only schools requiring more than 5000 contact hours, in the same study).
More details about the arrangement of the Iranian BArch course subjects, by year and by area of study, are given in (Chapter 5,Table 5.1).

4.3. Student Selection

Entrance to higher education courses in Iran is through a centralised National Examination.

Before 1962 entrance examinations were individually planned and administered by universities. From 1962, however, after the establishment of a central board for supervision of entrance examinations, processes of admission to higher education began to undergo a gradual centralisation. In 1974, the year before the establishment of the National (Iranian) Organisation for Academic Assessment, the then central examination covered only part of the universities. The number of candidates who attended a central examination in 1974 was 32,838. They were competing to enter the courses of 12 state universities and other higher education institutions. The establishment of the national organisation in 1975 accelerated the process of centralisation noticeably. In that year, corresponding numbers reached a total of 187,267 candidates for 84 state universities and higher education institutions[25]. Yet, because of the administration of the entire or part of their

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[25] A Brief history of the National Organisation for Academic Assessment (1994). Tehran: National Organisation for Academic Assessment.

According to the information released by the organisation, the number of candidates for studying in state universities and higher education institutions in 2001 National Examinations was 1,593,521 (Hamshahri Daily, 3 July 2001, No. 2440, p12).

entrance exams, schools of architecture were exceptions until the Educational Reform and the release of the unified Architecture Curriculum in 1982.

Since 1982, centralised and unified entrance examinations have covered all higher education courses including architecture. The National Organisation for Academic Assessment has a dual mission in that regard. One, to introduce the universities' courses, available places, and their entry requirements to candidates in all disciplines; and two, to administer the National Examinations and to introduce the selected students to the universities for enrolment[26].

All candidates are required to have successfully passed the Final Secondary Education Certificate Examinations before taking the National Entrance Examinations.

The examinations, mainly in a multiple-choice test format, are administered in two stages. The first stage or General examination screens candidates to reduce the number of competitors to three times the available places. Then, through a second and more stringent stage (or Specialised Examination) entrants are selected from among the successful competitors of the first stage.

The first stage includes two sets of sub-exams. The first set includes cross-disciplinary sub-exams in general subjects such as Persian language and literature, foreign languages, history, etc. and the second set depends on the category of the courses a candidate applies for. Any higher education course is classified under one of the four groups as shown in Table 4-2; and (with little exception) an identical second set of sub-exams are given for all the courses which fall into the same group.

Candidates who apply for one or more courses from group 1 (which includes architecture) are also required to take a second set of sub-exams in Mathematics; Physics and Mechanics; and Chemistry in the first stage.

Every sub-exam of the first stage has a certain weight which is applied identically for all courses in the same group. After proper transformation, the average of the

[26] Key decisions, such as entry requirements for each discipline and the design of sub-exams, are made in association with the corresponding Planning Committee of the Supreme Council for Higher Education Planning.

Secondary Education Certificate Examination[27] is dealt with as a sub-exam score and is included among the scores.

Table 4-2
Examination Groups

Examination Groups		Example courses
1	Mathematical-Technological	All engineering courses including Architecture, Chemical, Civil, Electrical, Electronic, Mechanical Engineering etc.
2	Life-Sciences	Agriculture, Biology, Dentistry, Medicine, Pharmacy, etc.
3	Humanities	Archaeology, Education, Law, Politics, Sociology, etc.
4	Arts	Crafts, Drama, Music, Product Design, Visual Arts, etc.

In terms of content, the second stage is similar to the second set of the first stage. However, sub-exams are more stringent, and dissimilar weights are given to sub-exams for different courses.

The final score,[28] on the basis of which admission decisions are made, is a factor of both the first and second stages scores, the latter given twice the weight of the former. It should be noted that no minimum score is required in any single sub-exam. A candidate's weakness in a sub-exam may be compensated for by his/her strength in another sub-exam.

Before going into more details about the student selection method(s) for studying architecture, it should be mentioned that one of the peculiarities of the system is that, in effect, each candidate has the opportunity of applying for a large number of (sometimes very dissimilar) courses. This is predicated upon two notions. First, that it is not possible for the majority of school leavers to gain real acquaintance with the nature and requirements of the course(s) they apply for. Therefore, they cannot be forced to limit their choice to just one or two related courses. Second, little evidence is available as to why a candidate with more than one area of interest should be denied the right of application for courses from different areas.

[27] Referred to as (locally known:) Diploma Average in the following chapters.

[28] Referred to as Total Score in the forthcoming chapters.

A candidate's admission to a course is a factor of both his/her gained scores, and also his/her order of choices.

It should also be pointed out that the centralised admission system tends to take a humanitarian approach towards those candidates who did not have the opportunity of receiving proper prior education. Since the entrance examinations are highly competitive, admission quotas are applied to allocate a proportion of the available places to the latter candidates (e.g. Construction Corps who voluntarily serve in remote areas of the country). Those who are eligible for these 'Special' quotas, however, are required to score at least 70 per cent of the Total Score gained by the last 'Ordinary' quota entrant to the same course. Recently, contrasting views have emerged about the efficiency of this policy, however, and such quotas may face tight limitations in future.

4.3.1. Change to Student Selection Criteria

It was a common practice, before and after the Educational Reform until 1993 inclusive, that entrance examinations for architecture include some extra tasks. Known as design exams, such tasks usually included different components which required drawing and sketching skills, spatial manipulation and/or mental imagery, and artistic inclinations. Before 1994, a set of multiple-choice design tests was administered in the General stage, and several descriptive design tasks were given in the Specialised stage of the centralised entrance exams for architecture. Design tasks were given a more significant value than design tests. The former had a 40 percent share in the second stage, while the corresponding share of the design tests was less than 10 percent in the fist stage score. Moreover, as stated earlier, second stage was double-credited in the calculation of the total score.

Credits/weights for the chemistry, physics, mathematics, and design tasks of the Specialised stage were 1, 1, 4, and 4 respectively. However, since 1994, the design tasks were omitted and physics was given 4 credits. Chemistry and mathematics remained at the same number of credits as before (Table 4-3).

After a few years of employing the new selection method, contrasting views on the vices and virtues of the former and the new student selection method emerged among educators. Such views, however, remained mainly impressionistic and anecdotal, not based on a thorough and objective investigation of the problem.

Table 4-3
Weights of Specialised Stage Sub-exams

	Sub-exams			
	Chemistry	**Physics**	**Maths**	**Design**
1993 Exam	1	1	4	4
1994 Exam	1	4	4	_

There exists just a single brief study[29] which predates the implemented change in selection method. It investigates the performance of the accepted candidates of architecture in the National Entrance Examination. The study compares architecture entrants with those of two engineering courses, and implicitly paves the way for the change.

Because of the relevance of this study to the further sections of our work, it is dealt with in more detail below.

4.3.2. Critique of the Earlier Study

A total of 239, and 218 students were admitted to the state run university schools of architecture in 1991 and 1992 respectively. The study compared a number of entry qualification measures of the architecture entrants with those of the civil, and electronic engineering entrants. In the first part of the study, entrants to the same disciplines (but to different universities) were pooled together. In the second part, similar investigation was carried out for three individual universities. The measures included the following items.

- Group mean scores in each of the sub-exams (unweighted).
- Group mean overall scores (weighted).
- Group mean Diploma Average (secondary education certificate).

Moreover, by means of Pearson product moment correlation, the interrelationship of sub-exam scores was calculated for the architecture entrants. Also, architecture

[29] National Organisation for Academic Assessment (1993). A Study of the Entrance Examination Results of Architecture Entrants. Study Report no. 34. Tehran: National Organisation for Academic Assessment.

entrants were categorised according to the provinces they originated from. The study reported its findings as below.

> Collectively, architecture entrants score lower than civil, and electronic engineering entrants in each and every compared measure. There exists evidence that architecture entrants are also weaker than entrants to physics and mathematics courses.
>
> Comparison of the correlation coefficients shows that design exams have the lowest relationships to other sub-exams; this indicates a mismatch between design exams and other sub-exams.
>
> The majority of entrants are from the capital province (with a high relative admission rate). A small number of entrants come from remote provinces.

Additionally, the study referred to two actual but lateral issues. It pointed out that:

1. unlike other sub-exams, design exams, relied on subjects and materials for which no specifically fashioned course was provided in the secondary education.
2. The majority of the institutions which provided informal preparatory (or coaching) courses for the architecture entrance examinations were located in the capital. The institutions were not easily accessible to candidates from remote provinces.

By implication of the two latter points and the last finding (above) the study called into question the fairness of the design exams to candidates from less advantaged regions. At the same time, the lack of correlation between the scores of non-design and design sub-exams was regarded as an indication of the irrelevance of the latter[30] for the purpose of student selection.

Drawing on the above issues the study recommended that the Planning Committee for Architecture should reconsider the student selection method and the respective credits of the sub-exams.

Despite its well-meaning intent, the above study which appears to have stimulated the 1994 change, mixed up two separate issues and drew a hasty inference. Some of the results can be interpreted otherwise, and other conclusion(s) can be drawn.

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[30] This conclusion relies on the unspoken assumption that a good performance in bookish subjects such as physics and chemistry is necessary and sufficient for a good performance in all areas of architecture course.

The preponderance of entrants who were from privileged provinces, and the location of the majority of preparatory-course institutions in the capital are two undeniable facts. However, the establishment of a cause and effect relationship between them requires more hard evidence. It is quite conceivable that both of the facts might have arisen from a third or more factors. Yet, even if a causal relationship can be identified, and by inference the inequity in access to the course can be ascribed to that relationship, it does not follow that in the absence of a such relationship better equitable access opportunities will emerge. The latter issue will be taken up in chapter 6 where on the basis of hard evidence the consequences of the change, including the problem of equity, are studied. It will be shown that a worse kind of inequity has emerged after the change.

What seems more questionable, however, is the study's disregard of the potential usefulness of the design sub-exams. This was solely based on the ground of strong inter-correlations between bookish sub-exams, but low correlations between them and design exams.

Contrarily, this may be an indication of the importance of the design sub-exams. All that the correlational findings of the study suggest is that performance in two non-design exams are more likely to co-vary than it is the case with a non-design and a design sub-exam. To put it in a more applicable sense for the purpose of educational assessment, it suggests that if one performs well in the one of the non-design sub-exams, he/she is also very likely to perform well in others, hence repetitive exams may be pointless, unless otherwise proved necessary. Moreover, there is a likelihood that, due to their different natures, non-design sub-exams are not capable of gauging what the design exams check.

If external evidence shows that, for example, sketching ability contributes to performance in design and not in structural calculations, and ability in mathematics vice versa, the lack of correlation between the two abilities does by no means suggest the irrelevance of either of the two. Yet, regardless of the existence or non-existence of such external evidence, what is evident is that the relevance of a predictor can not be checked vis-à-vis another predictor whose relevance (to subsequent performance) is not yet established.

Therefore, the mentioned study must have built on the unexamined assumption that measures of a candidate's performance in the conventional (non-design) sub-exams are reliable predictors of his/her future performance in all areas of the course.

4.4. Discussion

Three background elements of the Iranian architectural education, namely prior education, architecture curriculum, and student selection system, were individually introduced above. However, what is very important to our study is the relationship between the above elements: in other words, whether they support or counter each other.

The student selection system, being a transient link between prior education and architecture education, is ideally intended to provide the latter with the fittest inputs from the former. Therefore, it is the selection system which should be planned according to the bodies it is intended to link. But the degree of agreement between the characteristics of the two bodies can facilitate or hinder the work of the linking element. Because of the two following reasons, evidence of discrepancy exists between what our prior education cultivates in practice, and what the core of our architecture programme theoretically requires.

1. It was shown that the Iranian programme of architectural education follows a conventional pattern which relies almost equally on lecture courses and design studios. Moreover, the curriculum document was shown to give a pivotal and integrative role to the design area of the programme.

It should be noted, however, that designing is a mental process which, despite the views of its first-generation researchers, defies the objectivity of scientific experiences and systematic approach. (However, by no means does this suggest that designing is an irrational process, or based on haphazard foundations).

Neither such thing as the-one-and-only right solution, nor a definitive formula exists for a design problem (Rittel and Webber, 1974; Broadbent, 1979; Schön, 1988; Lawson, 1997).

The process demands frequent cases of decision making on the basis of ill-defined information, and the designer is bound to make subjective value judgements during the course (Rowe, 1987).

The process involves both intuitive (i.e. less explicable) divergent thinking processes, and also rational/logical (and more explicable) convergent thinking processes.

Moreover, in the fields such as architecture, where the body of the design product communicates messages of meaning and impression, the process calls for the designer's perceptiveness of aesthetic matters and mental impressions (of form, material, space, etc) and also the designer's ability to handle those issues.

2. Contrasting views exist in the literature of education on the usefulness of conventional scholastic results for the prediction of students' performance in higher education (See Chapters 2 and 3). Despite those disagreeing views, we accept for the moment that a reasonable relationship exists between a student's performance in prior education and in the lecture-based parts of the architecture programme. However, this is not easy to generalise for the design area, because it relies on methods and skills other than what is unwittingly nurtured and encouraged in our secondary education.

It was shown that, contrary to what design thinking requires, our secondary education methods draw on rote learning which is indirectly but forcefully encouraged by the-one-and-only-right-answer type of examinations. This leaves little room for the development of divergent thinking skills, and may well undermine the motivation and self-confidence of students to develop their personal/subjective views, and their communication and challenge. Moreover, content-centredness methods and uniform curricula unintentionally promote conformity and lack of variety, and discourage critical thinking and diversity (Freire and shor, 1987; shor, 1993). Additionally, the inadequate provision and handling of art and design subjects hardly paves the way for prospective candidates for design-based disciplines to prepare for those courses.

The latter issue was alluded to earlier and left to be expanded on here.
The difficulty posed by the inadequate provision of art and design subjects in general education curricula is manifold. Some of the problems are as follows.

Underdevelopment of a Faculty

Firstly, learners are not provided with proper opportunities to systematically develop their awareness of art and design fields as two (interrelated) areas belonging to and contributing to humans' collective intellect. It is axiomatic in education that a comprehensive education system should help the learner develop his/her awareness and abilities intellectually, physically, and also emotionally. Where the content-centredness of the curricula, together with 'convergent' assessment methods, leave very little room for the exchange of personal views, intuitive understandings, and feelings, art and design activities seem to be a potential remedy. Because, to a lesser or greater degree, art and design problems involve semiotic dimensions and non-verbal communication, media which require and stimulate the expression of the feelings of oneself, and the appreciation of those of others. Baynes (1969), advocating the formal inclusion of design in the then British general education, highlighted a related problem potentially arising from the lack of design courses. He commented that such a lack would deprive the community at large of 'some sort of basis on which to cope with the intensely difficult design problems of the modern urban environment and modern technology.' Baynes might have overemphasised the effect of the deficiency. However, the difference between the designers' and non-designers' ways of understanding and evaluation of the artefacts and the environment has been documented in the literature of environmental psychology (e.g. Whitfield and Wiltshire, 1982; Devlin and Nasar, 1989; Purcell and Nasar, 1995). It has been evidenced that some of such differences arise from the educational differences of the two groups.

Underdevelopment of a Real Life Skill

The second problem arises from the fact that a great deal of real life problems are ill-defined problems for the solution of which solely mathematical logic of right-or-wrong answers do not work. This point was also among the reasons Laxton (1969) put forward when he argued for the need and value of design courses to be included in the secondary curriculum. In the absence of art and design modules, traditional system loses the chance of preparing educational grounds for the development of students' (beyond-logical) reasoning and decision-making skills. Not only did design education, as Laxton and his co-workers suggested, prove applicable and viable over time, but also Schön (1987) proposed that, other disciplines should emulate the design studio model of education for its reliance on 'reflection in action' which corresponds to real life circumstances of problem solving.

Some teachers and parents alike, tend to value art and/or design products for the beauty and/or the mechanistic utility of the students' works. Undoubtedly, in higher stages of education, due attention should be paid to the aesthetic and/or workability of the final product. However, what constitutes the main educational value of such programmes, especially in lower stages, is the opportunity they provide for the experience of 'designerly ways of knowing[31]', and the integrative skills such programmes are capable of fostering. The latter points emphasise the necessity for art and design modules in a comprehensive prior education. More than three decades ago, Laxton (in the same place) pointed out the problem of pervasive specialism and the consequent compartmental nature of education and claimed that not only could design, as a component of secondary education 'pull together these isolated subjects', but also 'it could even reinforce them by its own methods of analysis and evaluation.'

Practical Pitfalls

Thirdly, the lack of art and design-oriented activities in secondary education causes problems at the threshold of art, and design-related disciplines of higher education. Not only do the courses in such disciplines need to start at a lower rather than higher education level to compensate for the missing foundations, but also admission systems face a lack of objective evidence for the purpose of student selection. This deficiency becomes more serious when, contrary to a basic recommendation of educational assessment, an isolated one-off entrance examination is used to assess candidates' suitability for studying a particular course.

This should be put in the context of what was reported earlier (especially Chapter 3), that not only has evidence been found of significant psychological differences between the students of design and non-design based courses, but also architecture appears to be one of the disciplines for which solely academic predictors have frequently returned little prediction of students' future performance.

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[31] See Archer, L. B. (1979). Whatever became of Design Methodology. Design Studies. Vol. 1, No. 1, pp. 17-18; and Cross, N. (1982). Designerly ways of knowing. Design studies. Vol. 3, No. 4, pp. 221-227. As a pioneer of the field, Archer (in the former source) uses the term *designerly*, saying: 'My present belief, formed over the past six years, is that there exists a designerly way of thinking and communicating that is both different from scientific and scholarly ways of thinking and communicating, and as powerful as scientific and scholarly methods of enquiry, when applied to its own kinds of problems.'

In the latter source, Cross expands on the subject. He says that: 'designerly ways of knowing rest on the manipulation of non-verbal codes in the material culture; these codes translate messages either way between concrete objects and abstract requirements; they facilitate the constructive solution-focused thinking of designers, in the same way that other (eg verbal and numerical) codes facilitate analytic, problem-focused thinking; they are probably the most effective means of tackling the characteristically ill-defined problems of planning, designing and inventing new things.'

4.5. Conclusions

To summarise the observations of this chapter, there are some points which must be highlighted as they are more relevant to our research. These points are related to pre-university conditions, student selection system, and the unified curriculum of architectural education.

Lack of Related Academic Preparation for the Study of Architecture

It was shown that the design area has been regarded as the pivotal part of architectural education in the Iranian curriculum, and a noticeable share of the programme is given to this area.

At the same time, dominant features of our local prior education were shown to include content-centredness; traditional assessment methods; and the trivial share of art and design subjects in the curricula of secondary education.

It was argued that our formal prior education, therefore, fails to provide opportunities for the preparation for the study of courses such as architecture because half of the architecture programme relies on processes and activities for which almost no parallel is provided in secondary education.

The Need for More Systematic Research

As a consequence of the facts presented above, no applicable evidence of the candidates' design-related aptitudes and/or abilities is available. This poses a serious problem for the student selection system and calls for more objective and research-based planning of the entrance examinations. The only available study on student selection for the study of architecture was shown to be very limited and to have drawn inaccurate conclusions.

Unlimited choice of courses and the problem of motivation

It was mentioned that one of the features of the Iranian student selection system is that candidates are allowed to apply for a large number of (even) dissimilar courses.

Despite the reasons mentioned for that policy, the fact should not be ignored that in the overlapping areas of learning, problem solving, and creativity motivation is regarded as an influential factor (even from a computational approach to thinking processes, Simon 1979, p37, admits that 'motivation controls attention and hence influences learning'). In almost all recent sources on these mental processes, the concept of motivation constitutes one of the integral parts, and the positive effect of (particularly intrinsic) motivation on the processes mentioned has become an established subject (Biehler and Snowman 1993; Paris and Turner, 1994; Csikszentmihalyi and Rathunde, 1993; Amabile, 1996)

When candidates are allowed to apply for a number of dissimilar courses, they are less likely to apply only for the course which best matches their interest and motivation. But rather, because of the social value of possessing a higher education certificate, and also highly competitive examinations, candidates will tend to maximise their chances of merely entering higher education, irrespective of their interest in a particular course/field. Consequently, cases of dissatisfaction with the course, and tendency to transfer or withdraw will be more likely. (This matter will be dealt in more detail in the following chapters).

Uniformity: a methodological advantage

It was shown that, in terms of content and methods, both our prior education and architectural education systems are administered centrally and follow unified curricula. This has several drawbacks, some of which were mentioned above briefly.

The uniformity, however, is methodologically, to the advantage of the sampling matters of our case studies (next chapter). Since all of our study samples have experienced almost similar content and methods in their prior education, their academic qualifications are reasonably comparable. The same is true for their architectural education. Also, our findings are very likely to be applicable to other university schools of architecture in the country; and possibly to other architecture schools which, in a context of traditional prior education, like our schools, follow the conventional balance between studio and course modules.

An attempt was made in this chapter to portray those background issues which potentially influence Iranian architectural education, and also bear relevance to the focal part of the present research. The following chapter will report on an empirical study of the two methods of students selection and their academic consequences.

CHAPTER 5

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Body of the Data

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Limitations and Assumptions

Predictive Ability of the Two Student Selection Methods

Predictive Ability of the Entire Entrance Exam

Predictive Ability of the Specialised Stage of the Exam

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Interim Summary of Findings: Local Effects of Rise in Entrance Scores

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Chapter 5

Survey of Academic Performance

Introduction and Aim

A general perspective of the local prior and higher education was presented in the previous chapter to depict the particularities of the context in which our cases occur. Both the literature on student selection, and our survey of admissions tutors in schools of architecture showed that the relevance of conventional prior qualifications (or the results of scientific entrance exams) to the selection of the students of architecture remains in question. It is also very likely that, despite broad similarities among the architectural courses, due to the particularities of each school, no consensual solution to the problem will ever emerge. We focus, therefore, on particular cases. This chapter of the thesis aims at an empirical investigation of the relevance of two central (but different) entrance exams for the selection of students for studying architecture in Iran.

As described earlier, the term 'relevance' can be interpreted from at least two different viewpoints. Firstly, it might be interpreted as the *fairness* of the selection criteria in terms of their incremental relationship to the future performance of the selected students. This sort of relationship may be called the predictive ability of the exams.

Secondly, where a comparison between the two exams is concerned, 'relevance' may be interpreted from a pragmatic or *economic* standpoint. From this perspective, irrespective of the predictive ability of the exams, importance is given to the students' level of academic performance during the course. From this viewpoint, the selection method where students' subsequent academic performance stands collectively higher is deemed more 'relevant'.

In the following analyses, we consider relevance from both viewpoints. The exact operational questions, which we seek answers to, are given at the beginning of the respective sections below (see pages 193, 226, 229). It will be shown that there is little evidence in the present data to support the superiority of the new selection method which relies solely on educational qualification in mathematics and sciences.

This chapter consists of five sections (Figure 5.1).

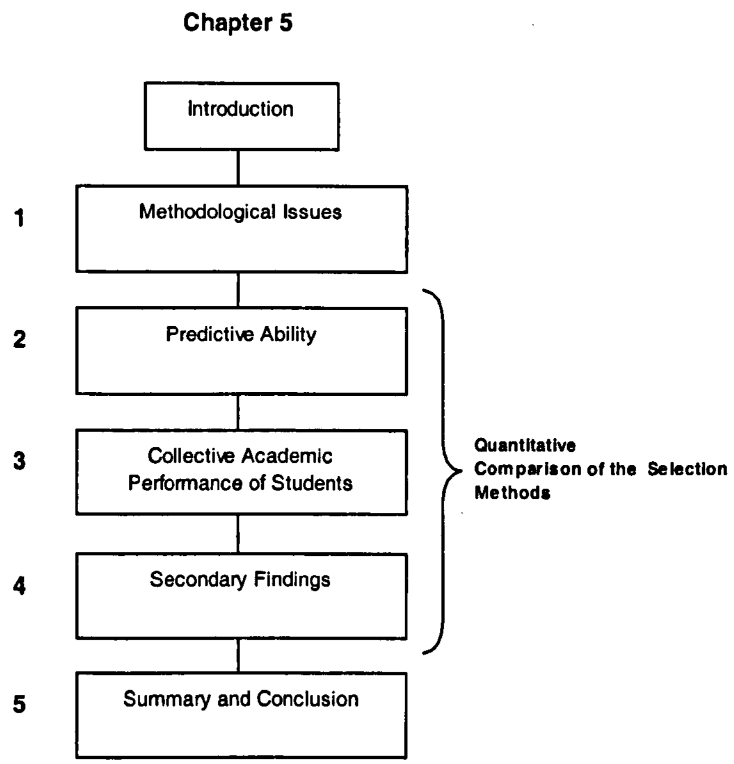

Figure 5.1. Constituent Sections of the Chapter

Section 1 is allocated to methodological issues and includes topics such as: sample, body of data, variables, statistical tools, limitations and assumptions.

Sections 2, 3, and 4 constitute the core of the chapter. Drawing on quantitative data, these sections deal with the comparison of the two student selection methods. Section 2 undertakes an exploratory investigation into the predictive ability of the two methods. Section 3, through a hypothesis testing approach, compares the methods in terms of collective academic performance of the students of each method; and Section 4 describes a series of secondary findings. Finally, the summary and conclusions of the chapter are presented in Section 5.

A series of 'interim summaries of findings' are presented during the chapter to facilitate both the communication of various findings and the final summarising and conclusion of the chapter.

5.1. Methodological Issues

What comes below includes only general methodological issues. Additional details are left to the corresponding parts where further clarifications seem necessary.

5.1.1. Sample

The three longest established university schools of architecture in Tehran were selected for the study. Two consecutive year cohorts (1993 and 1994) from each school comprised our initial samples.

The upper part of Figure 5.2 represents graphically the three schools and their respective pairs of cohorts. For ease of reference schools are designated A, B, and C, and cohorts are shown by their university labels followed by the last two digits of the year they were admitted to the schools. The smallest *initial* samples (i.e. B93 and C93) each included 40 and the largest sample (A93) included 65 students. There existed a small number of students who, due to personal circumstances such as illness etc. had not been able to follow the common pace of study, and their academic records included far fewer data than those of other students. These students were excluded from the initial samples. In total then, 295 students, for whom sufficient data was available, remained in the initial samples.

Later, however, marked academic and/or personal differences were detected between dichotomous clusters of students (such as gender or admission quotas). For the sake of homogeneity then, a process of screening was unavoidable and this reduced the size of initial samples. A detailed account of cluster differences and final samples is given in the 'Limitations and Assumptions' section. Suffice it to say here that the empirical studies of this chapter deal with the 'male Ordinary quota' section of the six initial samples.

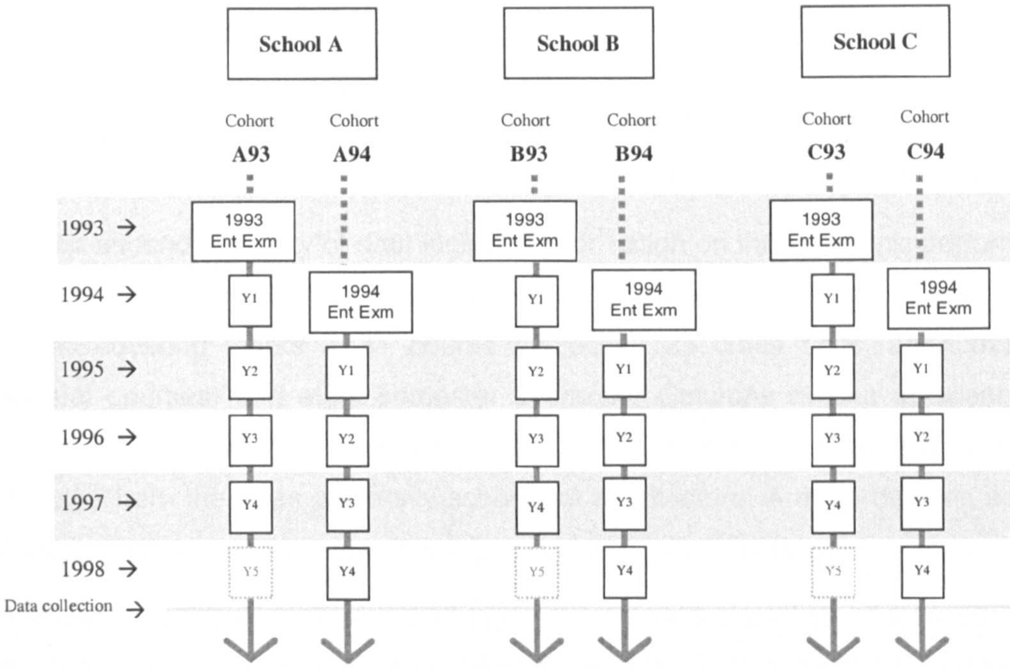

Figure 5.2. Graphical representation of the cohorts and the data

5.1.2. Body of the Data

Two main categories of quantitative data were collected for this part of the study.

- The first category mainly included the data which bore information about the pre-admission attainments of the students. Rectangles labelled 1993 or 1994 entrance examination in Figure 5.2 represent these data.

This part of data was collected from the National Organisation for Academic Assessment which is responsible for the design and administration of the National Examination for Entrance to Universities. Despite the wholehearted co-operation of the organisation, due to some external constraints, the obtainable data did not include all the theoretically existing and related information. The available pre-admission data included several pieces of scholastic and personal information for each student.

Scholastic information was composed of: overall score in the entrance examination[1] (which is the ultimate criterion for having access to a higher education course), scores in the sub-exams of the second stage of the entrance examination, type of

[1] It should be remembered that the National Examination for Entrance to the Universities is a two-stage examination.

Secondary Education Certificate[2], the total average of the Final Secondary Education Certificate Examination (mainly for 1994 entrants).
Non-scholastic or personal data consisted of gender, date of birth, and the quota through which students got their admission to universities (i.e. Ordinary or Special).

- The second category of data included information on the academic performance of students during at least the first four-year-period of the course[3] - i.e. academic reports covering marks in 41 course subjects (123 credit units, apart from the General courses) and eight semester averages. Columns of four adjacent small rectangles in Figure 5.2 represent such data. Academic performance data were collected from the three university schools of architecture. A more detailed account of the academic performance data is given below (see 'Variables').

Physically, both pre-admission and performance data were list- or table-formatted printouts. Since the schools used different systems of data handling, performance data records were multiform. The Excel programme was selected to input all the collected data on computer. For each cohort a separate table which included both pre-admission and performance data (i.e. course subject marks) was established. The tables were later converted into a uniform pattern of the study variables and were transferred to the SPSS programme for further analysis.

5.1.3. Variables

It seems necessary to make a methodological point here before describing the definitions of variables. While some parts of the collected data such as final score in entrance examination could be conceived (and directly applied) as study variables, some other data needed a process of treatment to render better meaningful measures. This is particularly true for the 'academic performance' data for which a number of constructed averages were calculated.

For instance, Yearly Average, as a familiar measure of performance, cannot be applied as a comparative measure unless it is based on an identical pattern of course subjects. In practice, however, this was not uniformly the case for all

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[2] In the Iranian secondary education system there exist several streams of different orientations such as Mathematics-Physics; Sciences; Culture-Literature; etc.. A large majority of entrants to university schools of architecture come from the Mathematics-Physics stream which also includes some other distant subjects in its curriculum.

[3] Theoretically, the BArch part of the course.

students. To make the Yearly Averages, therefore, identical patterns of yearly course subjects were applied for all students. These patterns (as shown in the rows of Table 5.1 below) relied on the prevalent sequence of the presentation of the subjects in the schools, not necessarily on the basis of the exact order by which any given student (e.g. a top or a poorly performing student) might have selected the course subjects.

In addition to Yearly Averages, a limited number of 'area' averages such as Design Studio, Technology, and Humanities Area Averages were also calculated. It was believed that the majority of the course subjects could be roughly categorised into a small number of distinct areas according to their nature. To state the inherent distinctions in brief, Technology area comprises a number of preparatory and main subjects which deal principally with the physical aspects of the building. As compared with the two other areas, problems in the Technology area are better defined and the logical/mathematical mode of thinking plays a dominant role in verification of, usually, a limited number of solutions. The problems in the Humanities and especially Design Studio areas are less amenable to clear definition and have a wider range of relatively correct solutions. While the former area, drawing upon verbal/linguistic abilities, takes a predominantly analytical approach, the latter area, usually by means of visio-spatial abilities, demands a further synthetic attitude to find integrative solutions which are responsive to, usually, both the physical and mental[4] requirements of a multifaceted problem. Columns of Table 5.1 represent three such main areas and their component course subjects. It was also postulated that the average mark of a student in an area thus acquired could be regarded as a measure of performance in the area. Points may be raised against the applicability of such averages, however.

It might be argued that, not only do area averages conceal the yearly variations of a student's marks in an area, but that they also fail to depict his/her latest attainment which is deemed more significant than previous attainments. Admittedly, while the average mark does not reflect the variation of individual constituent marks and the related trend, the use of area average, as a measure of performance in a certain area, still seems justifiable for two reasons.

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[4] Dealing with, for example, feelings, emotions, or semantic dimensions.

Table 5.1. BArch course subjects by year (rows) **and area** (columns)
General cross-disciplinary subjects not included.

	Design Studio Area	Credits	Technology Area	Credits	Humanities Area	Credits
Year 1 (7 subjects, 23 Credits)	Composition I	6	Geometry I	2	Human, Nature, and Architecture I	3
	Composition II	6	Geometry II	2		
			Mathematics I	2		
			Mathematics II	2		
Year 2 (10 subjects, 30 Credits)	Composition III	6	Structure I	2	Human, Nature, and Architecture II	3
	Architectural Design I	5	Structure II	2		
			Construction Material	3	Islamic Architecture I	3
			Land Survey	2	Technical Language	2
			Detailing I	2		
Year 3 (12 subjects, 34 Credits)	Architectural Design II	5	Structure III	2	Islamic Architecture II	3
	Architectural Design III	5	Structure IV	2	Rural Architectural Studies	3
	Rural Architectural Design	3	Detailing II	3	History of Architecture I	2
			Estimating	2		
			Light and Sound	2		
			Building Services	2		
Year 4 (12 subjects, 36 Credits)	Architectural Design IV	5	Climatic Design	4	History of Architecture II	2
	Architectural Design V	5	Structural Systems	2	Theory of Architecture	3
			Technical Design I	3	Research Method	2
			Technical Design II	3	Urban Planning Theory	2
			Construction management	2	Urban Design Theory	3
	9 subjects, 46 Credits		20 subjects, 46 Credits		12 subjects, 31 Credits	

First, because in a single case of assessment the likelihood that a student may perform incidentally better (or worse) than his/her real ability is much higher than (doing repeatedly the same) in a series of typically related assessments. In other words, averaging is very likely to cancel out the possible biases of individual assessments. Second, due to the fragmented programmes of architectural education, a measure of performance in an individual course subject is less likely to represent a meaningful and inclusive picture of a student's abilities in the related area. Undoubtedly, if a course subject demands an all-inclusive architectural approach and various undertakings on the part of the student, then the mark can be regarded as a significant and comprehensive measure of performance, irrespective of the student's initial attainments. In the case of our study, however, the only course subject meant to play this role was the Final Project, the marks of which were neither available nor logically applicable.

The reason for the unavailability was that our students were still far from doing their Final Projects. Furthermore, the facts that the students were neither required to submit their Final Projects at the same time nor were they to be examined by the same jury made the Final Project marks inapplicable. Despite the fact that the last prerequisite for graduation in the entire (six-year) course is a pass mark in the Final Project, such a mark bears no significance on its own, but rather, the overall average of all course subjects, including the Final Project, is conventionally regarded as the dominant measure of performance or competence. For that reason, a unified (four year) overall average was also employed as a performance variable.

Finally, cases of fail and resit constitute situations where the raw data cannot be directly applied, because for the purpose of quantitative analysis we can allocate only one column to each course subject. To tackle this issue, the average of fail and pass marks were applied for the students who failed and resat the same subject.

The following two tables represent the variables of the study. The pre-admission data construct the *predictor* variables (Table 5.2), and university marks shape *performance* variables (Table 5.3). The names of the variables are shown on the left of the tables, and the corresponding definitions are given on the right. Abbreviations in the middle are the short forms of variables which appear in the tables, charts, or graphs.

Table 5.2. Pre-admission or Predictor Variables

	Variable	Abbreviation	Definition
1.	**'Diploma' Average** (Secondary Education)	**Dipl Avrg**	The total average of marks in all the different subjects of the Secondary Education Certificate Examination (available for 1994 entrants)
2.	**Total Score** (in the National Entrance Examination)	**Total Scr**	A normalised overall score gained in the National Examination for Entrance to Universities according to which students are selected; a factor of the candidate's results in the two different (General and Specialised) stages of the National Examination
3.	**Specialised Exam Score**	**Spcl'd Scr**	Total weighted score in the Specialised part of the National Examination, i.e. the second stage; a factor of sub-scores in Chemistry, Physics and Mechanics, and Mathematics, and (up to and including 1993) Design
4.	**Scientific Score**	**Sci Scr**	Unweighted total of the Chemistry, Physics and Mechanics, and Mathematics scores of the Specialised Examination
5.	**Design Test Score** (up to and including 1993)	**Dsgn Test**	Sub-score in a multiple choice test in design related issues, as a part of the General stage of the National Examination
6.	**Drawing Tasks Score** (up to and including 1993)	**Drawing**	Sub-score in a number of drawing tasks, as a part of the Specialised stage of the National Examination
7.	**Mathematics Score**	**Maths**	Sub-score in the Mathematics test of the Specialised stage of the National Examination
8.	**Physics Score**	**Physics**	Sub-score in the Physics and Mechanics test of the Specialised stage of the National Examination
9.	**Chemistry Score**	**Chemistry**	Sub-score in the Chemistry test of the Specialised stage of the National Examination

--- End ---

Before the introduction of academic performance variables it should be mentioned that apart from the broad classification of the course subjects into the areas of Design Studio, Technology, and Humanities, three sub-areas were also established to narrow the first two areas down to more similar or cognate subjects. Table 5.4 (page181) represents the initial and secondary areas, and their incorporated course subjects. For a better grasp of the academic variables below, reference is made to the corresponding part of Table 5.4 to indicate the component course subjects of the variables.

Table 5.3. Academic Performance variables

	Variable	Abbreviation	Definition
1.	**Yearly Average**	**1st Yr Avrg** to **4th Yr Avrg**	The weighted average of the gained marks during each academic year of the course according to the credit units allocated to each subject of the course[5] Ref: the 'year' rows of Table 5.4.
2.	**Yearly Studio Marks**	**1st Yr Studio** to **4th Yr Stufio**	The average of the final studio marks in preparatory and/or architectural design studios gained during the two semesters of each academic year of the course[6]
3.	**Studios Average**	**Studio Avrg**	The average of final marks in studio works including all preparatory and architectural design studios during the BArch part of the course Ref: the 'Studios Area' column of Table 5.4.
4.	**Design Average**	**Dsgn Avrg**	The average of 6 combinatory final marks in studio works during the second, third, and fourth years of the course (excluding first year *preparatory* studios and Rural Architectural Design) Ref: the 'Archectural Design Area' boxes of Table 5.4.

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[5] Identical patterns of course subjects are applied for all students. Only architectural curricular subjects are taken into account, the uniform cross-disciplinary General Subjects such as Persian Language, Physical Education, Islamic Studies, etc. are not included.

[6] In the case of preparatory studios, final marks represent the cumulative assessment of a number of weekly or biweekly studio tasks.

	Variable	Abbreviation	Definition
5.	**Technology Average**	**Tech Avrg**	The weighted average of marks in all preparatory and main scientific and technological subjects of the course Ref: the 'Technology Area' column of Table 5.4.
6.	**Building Sciences Average**	**Bldng Sci Avrg**	The weighted average of marks in scientific and technological subjects of the course which mainly deal with the physical aspects of the building *excluding* two Mathematics and four Structural Calculation subjects which mainly rely on mathematical abilities Ref: the 'Building Sciences Area' boxes of Table 5.4.
7.	**Calculatives Average**	**Calc Avrg**	The average of marks in two Mathematics and four Structural Calculation subjects Ref: the 'Calculatives Area' boxes of Table 5.4.
8.	**Humanities Average**	**Hmn Avrg**	The average of marks in the subjects which mainly deal with the theoretical and historical aspects of the building and urban settings Ref: the 'Humanities Area' column of Table 5.4.
9.	**Overall Average**	**Ovrl Avrg**	The cumulative weighted average of all marks received during the four-year period (BArch part) of the course

Table 5.4. Constituent subjects of the Area Averages

Year	Design Studio Area	Credits	Technology Area	Credits	Humanities Area	Credits
Year 1 (7 subjects, 23 Credits)	Composition I	6	Geometry I	2	Human, Nature, and Architecture I	3
	Composition II	6	Geometry II	2		
			Mathematics I	2		
			Mathematics II	2		
Year 2 (10 subjects, 30 Credits)	Composition III	6	Structure I	2	Human, Nature, and Architecture II	3
	Architectural Design I	5	Structure II	2		
			Construction Material	3	Islamic Architecture I	3
			Land Survey	2	Technical Langu	
			Detailing I	2		
Year 3 (12 subjects, 34 Credits)	Architectural Design II	5	Structure III	2	Islamic Architecture II	3
	Architectural Design III	5	Structure IV	2	Rural Architectural Studies	3
	Rural Architectural Design	3	Detailing II	3	History of Architecture I	2
			Estimating	2		
			Light and Sound	2		
			Building Services	2		
Year 4 (12 subjects, 36 Credits)	Architectural Design IV	5	Climatic Design	4	History of Architecture II	2
	Architectural Design V	5	Structural Systems	2	Theory of Architecture	3
			Technical Design I	3	Research Method	2
			Technical Design II	3	Urban Planning Theory	2
			Construction management	2	Urban Design Theory	3
	9 subjects	46 Credits	20 subjects	46 Credits	12 subjects	31 Credits

(Architectural) Design Area

Calculatives Area

Building Sciences Area

5.1.4. Statistical tools

The questions in this chapter (described in sections 2 to 4) either check the incremental relationship of one variable to another, or examine the similarity of two groups of students (in terms of their collective location) on the same variable. As shown above, our variables consist of sets of students' scores/marks which, to take proper statistical heed, should be considered to be on an 'ordinal scale', because numeric intervals in our measures of assessment do not necessarily reflect equal distances in reality. Moreover, certain 'population measures' such as central tendency, and the distribution of the population from which our samples were derived are not known to us. Therefore, suitable non-parametric tools from among available statistical tools should be selected.

Considering the 'ordinal' nature of our data/variables, the appropriate non-parametric tool for checking the predictive ability of a variable, is 'rank correlation' and its test of significance (Siegel and Castellan, 1988; Cohen and Holliday, 1982; de Vaus, 1996). While the 'descriptive summary statistic' of correlation, technically referred to as correlation coefficient, represents the extent to which increments in one variable occur together with increments in another variable, the corresponding level of significance could be *roughly* regarded as an indicator of generalizability of the observed correlation (in the sample) for the population concerned. To be more precise, as concisely defined in the SPSS programme, the observed level of significance 'is the probability that a statistical result as extreme as the one observed would occur if the null hypothesis were true'. In our case, evidently, the null hypothesis implies the non-existence of a relation between the two variables.

Spearman's rho, and Kendall's tau (rank-order correlation coefficients) are two common statistics which are properly applicable for the investigation of relationship problems like ours. Due to the nature of our data, the former is used in this chapter. As a guideline, de Vaus (1996) suggests the use of Spearman's rho for the cases in which both variables have many categories, where Kendall's tau is regarded as applicable even if one or both variables have a small number of categories.

As regards the second intention, i.e. the comparison of two (independent) groups on the same variable, the Mann-Whitney U test (also known as Wilcoxon test) is appropriate. The test is known as a non-parametric alternative to the *'t'* test which is used to determine whether or not the means of two samples differ so much that the samples are unlikely to have been drawn from the same population. The Mann-Whitney U test, however, 'is used to evaluate the difference between population distributions', not the difference between population means' (Cohen and Holliday, 1982 p231). According to Berry and Lindgren (1996, p501) it is 'a rank test for comparing the location of two continuous populations that are unrestricted as to shape'. While the null hypothesis holds that the two populations are the same, the alternative hypothesis implies that the populations differ in location, i.e. one population is shifted to the right or the left of the other. (See also Everitt, 1998.)

As regards tests of significance, two-tailed tests were applied. Due to the diversity of our samples and the nature of our variables it was likely that an independent variable would show either positive or negative relationship to dependent variables. Therefore, non-directional null hypotheses were made, and two-tailed tests were employed.

It should also be noted that when the presence of a significant relation or difference is reported in the findings, it is in fact an implicative interpretation, and a technical finding put in a more easily comprehensible form. To be more precise, tests of significance deal with the level of confidence according to which we can reject a null hypothesis (the non-existence of a relationship or difference). When, at a significant level, a null hypothesis can be rejected, then, by implication, not by definite and all-inclusive evidence, we conclude that the alternative hypothesis should be true; where we may say *a certain (alternative) relation holds significantly.* To avoid a series of long repetitive statements, the simpler format is sometimes used.

5.1.5. Limitations and Assumptions

The quantitative study of this chapter relies on a particular assumption (item 5.1.5.1) and is confined to a set of limitations (items 5.1.5.2 to 5.1.5.4, below) without which the investigation was unmanageable. The assumption concerns the degree of standardisation of the national examinations, and the limitations involve the boundaries of the collected data and the studied samples.

5.1.5.1. Standard National Examinations

This study postulates that the National Examination for Entrance to Universities, as is held commonly by both its organisers and users, is a standard examination. Therefore, it is assumed that a certain subject's sub-exams in different years call for the same kinds and levels of abilities, and assess them similarly. No concrete evidence was obtainable in that regard, however. Still, the fact that, over the two entrance exams under the study (1993-1994), no noticeable change had occurred (either in the configuration of the exam-paper designer groups, the underlying sources of the exam-papers, or the educational backgrounds of the candidates) provides plausible evidence for this belief. The same seems tenable for the final Secondary Education Certificate Examinations.

5.1.5.2. Study samples: two adjacent cohorts in three schools

As mentioned before, our study sample includes 'two' adjacent cohorts from each of the three university schools of architecture. This limitation is the effect of both unintended and deliberate causes. Since the collected pre-admission and post-admission data were kept in different institutions it was necessary to request 'named' data to be able to match the former and latter sets of data for the purpose of further analysis. Named academic record, however, is the sort of information that the educational institutions are reluctant to hand out. Despite the welcoming response of the authorities involved, and the pledge of the author to not disclose any personally named data, it was easy to understand that due to the institutions' sense of responsibility and the administrative burden involved, any further request (to include a wider range of named data) could have easily lead the institutions to withhold their co-operation altogether. It should also be borne in mind that, at the time of data collection, the 1994 cohorts were the only cohorts who were both selected through the new selection method and who also could have finished their first four-year stage of the study. Since, on the one hand, one of the intentions of our study was to study the consequences of the two selection methods, and on the other, administrative restrictions did not leave a wide choice of samples, the best options were the 1993 and 1994 cohorts.

The restriction of the data to only two adjacent cohorts in each school, however, can be seen from a positive viewpoint which is the reliable similarity between all (prior and higher) educational processes that our consecutive sample groups had undergone. Reviewing a large number of educational studies on the relationship of prior educational attainment to subsequent performance in higher education, Peers and Johnston (1994) stressed the likelihood of 'staffing changes, content changes and variability in standards of marking' to distort the results of such studies. The assumption of the uniformity of the instructional and assessment processes in longitudinal educational studies which span a long period of time is very difficult to support. The question of possible significant differences between the instructions and assessment methods which our paired cohorts had experienced was discussed with the Heads of the departments or schools. Not surprisingly, no such difference was reported in any of the schools.

5.1.5.3. Further limitations of the initial sample

After data collection and inputting of the data on computer, initial observations showed considerable differences among different segments of the cohorts.

Lavin (1965) emphasised that for the study of the prediction of academic performance, the existence of different student strata was a necessity to be taken into consideration. Because, on the basis of empirical evidence from similar settings, different correlational patterns were found for different (gender, social, etc) groups of students. In totally different contexts, Gipps and Murphy (1994) and later Lavin (1996) represented the significance of consideration of such gender and social differences in their (non-architectural) educational studies. In closer settings to the present work, the Bartlett Research Unit, in their first study, reported that their female candidates had gained higher grades than male candidates on all entrance qualifications. The Bartlett research team, however, did not report the consequences of the mentioned differences, but to cancel out the effect of gender differences, they decided to limit their second and more thorough study to male-only samples. Contrary to the Bartlett study, Doan and Stiftel (1995) clearly showed that the pattern of relationship between their student selection criteria and academic performance measures was different for dissimilar social, and gender groups of students. It is quite conceivable that such dissimilar segments of the original groups may show different attitudes and motivation towards the education and instructions they are receiving, or even may face distinct types of educational problems. The lack of homogeneity then, can easily lead to the distortion of the outcome (of a bivariate analysis) by the influence of disregarded extraneous factors. In other words, differences in other factors may conceal or exaggerate the actual results. Below, instances of such differences are demonstrated.

As regards sub-sample dissimilarities, marked differences were observable, in the context of our study, between the Ordinary and Special quota parts of the original samples. On average, not only were the Special quota students older, but also marked differences existed in the two quotas' pre-admission, and performance records. Figure 5.3 shows the evident difference between the 1993 Ordinary and Special quota entrants[7] on Total Score in their entrance examination. To cancel out the possible influence of gender differences, only male students were included. By means of the Mann-Whitney test, the group differences on Total Score, and Special Exam Score were examined. According to the test results, illustrated in Figure 5.4, the null hypotheses of no difference between the two groups was rejected at a very high level of significance (p = .000). Figure 5.5 and Figure 5.6 represent the corresponding significant results for the 1994 entrants. The non-existence of difference between the 1994 quota groups was also rejected at the same level of significance.

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[7] All entrants who entered one of the three university schools of our study.

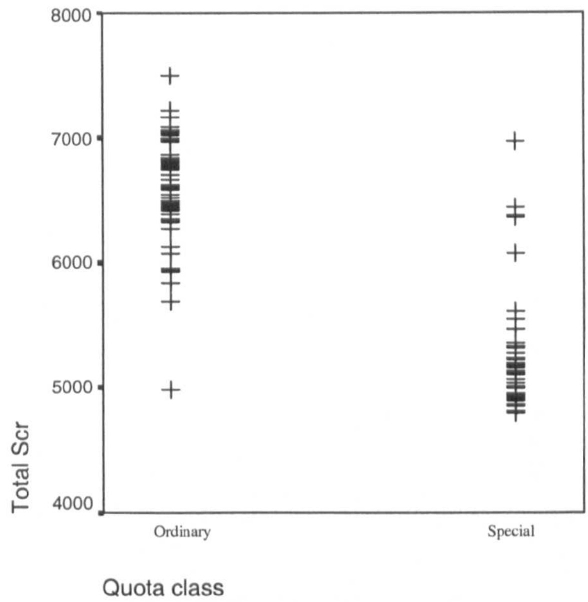


Figure 5.3. Scattergraph of Total Score (entrance exam) **by quota class**
1993 male entrants

Mann-Whitney test:

Ranks

	Quota class	N	Mean Rank	Sum of Ranks
Total Scr	Ordinary	75	66.95	5021.00
	Special	32	23.66	757.00
	Total	107		
Spcl'd Scr	Ordinary	75	67.59	5069.00
	Special	32	22.16	709.00
	Total	107		

A

Test Statistics[a]

	Total Scr	Spcl'd Scr
Mann-Whitney U	229.000	181.000
Wilcoxon W	757.000	709.000
Z	-6.607	-6.933
Asymp. Sig. (2-tailed)	.000	.000

a. Grouping Variable: Quota class

B

Figure 5.4. Mann-Whitney test:
quota differences on Total, and Specialised Exam scores
1993 male entrants

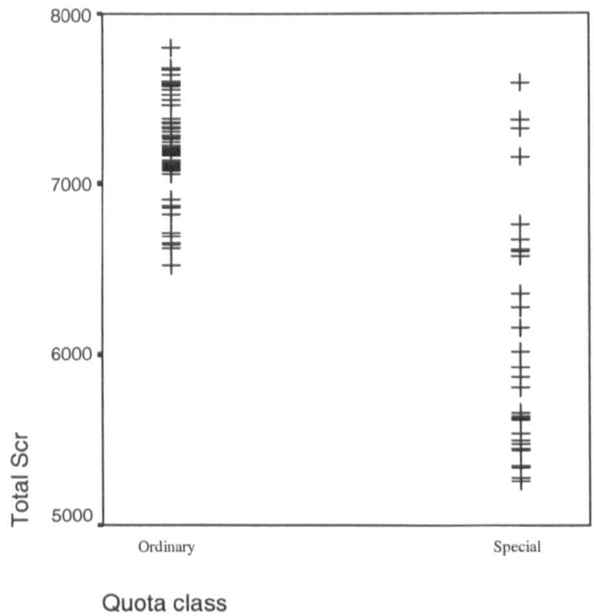


Figure 5.5. Scattergraph of Total Score (entrance exam) **by Quota class**
1994 male entrants

Mann-Whitney test:

Ranks

	Quota class	N	Mean Rank	Sum of Ranks
Total Scr	Ordinary	61	75.69	4617.00
	Special	47	27.00	1269.00
	Total	108		
Spcl'd Scr	Ordinary	61	75.52	4607.00
	Special	47	27.21	1279.00
	Total	108		

A

Test Statistics[a]

	Total Scr	Spcl'd Scr
Mann-Whitney U	141.000	151.000
Wilcoxon W	1269.000	1279.000
Z	-8.009	-7.947
Asymp. Sig. (2-tailed)	.000	.000

a. Grouping Variable: Quota class

B

Figure 5.6. Mann-Whitney test:
quota differences on Total, and Specialised Exam scores
1994 male entrants

The necessity of taking the quota differences into consideration is better illustrated in the following examples which show how the combination of the two quotas (or other dissimilar sub-groups) may affect the observed results. A set of scattergraphs and their respective correlation details are displayed below (Figure 5.7). The scattergraphs and correlation coefficients show the relationship between the Total Score (as predictor) and Overall Average (as performance measure) for two subsequent cohorts in school 'A'. The upper row deals with cohort A93 and the lower with A94. In the first scattergraphs of each row (i.e. graphs **a** and **d**) and their corresponding correlation details, the data of both quotas and also both genders are included.

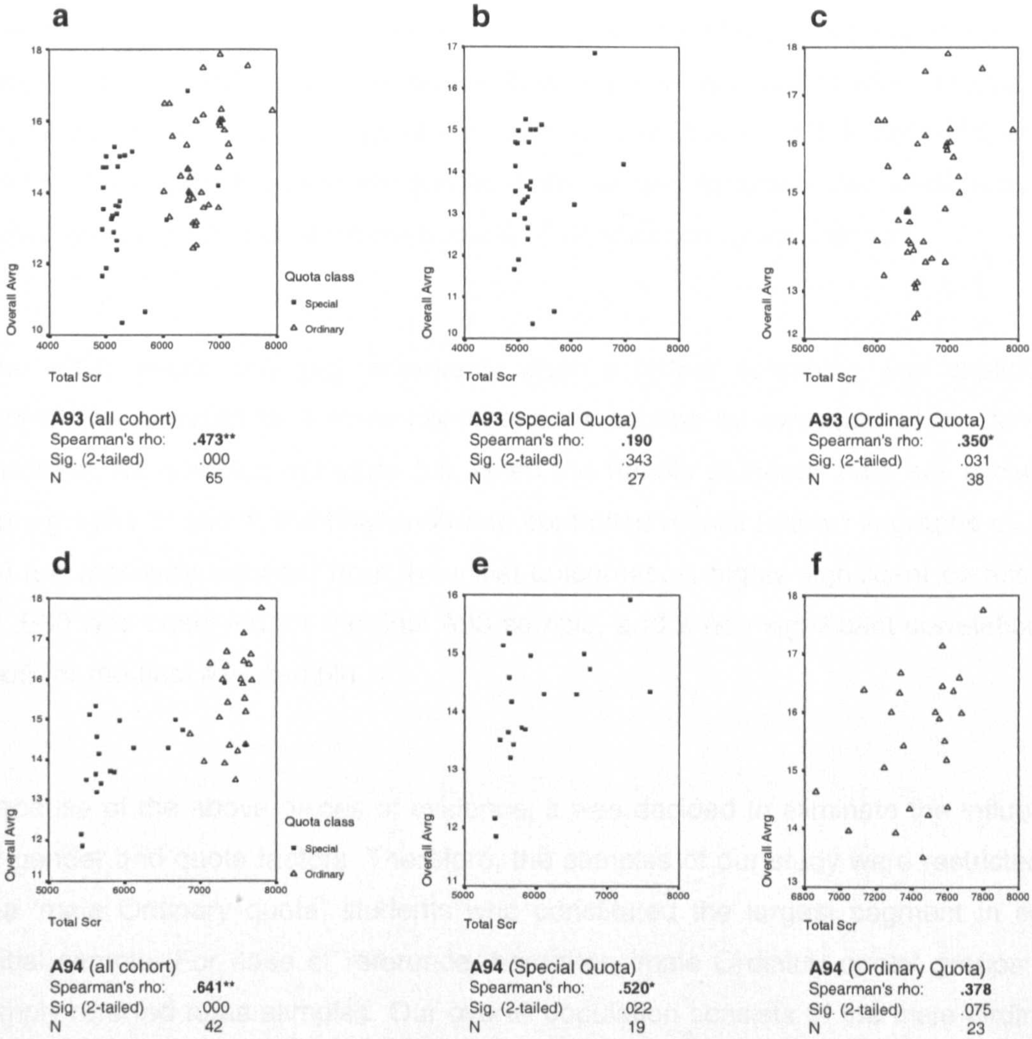


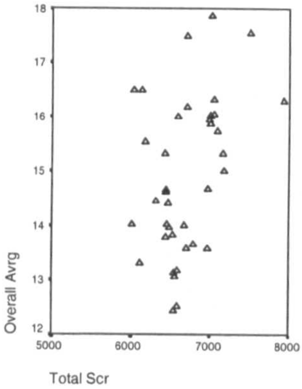
Figure 5.7. The relationship of Total Score to Overall Average; combined and separated quotas in school 'A'.

According to the displayed correlation details, the relationship between the studied variables was noticeably higher for A94 than A93 (i.e. r_s=.641 and .473 respectively, both significant at .000 level). Inspection of the two scattergraphs, however, shows two discernible clusters in each graph which are in fact the two different quotas (triangles represent Ordinary, and squares depict Special quota). In cases where such separate clusters exist, the correlation should be interpreted with caution. While the correlation coefficient is an unequivocal mathematical/statistical quantity, it does not necessarily follow that a similar relationship holds evenly in more homogeneous sub-groups. A further examination of the separate quotas reveals this more clearly. Despite the mentioned significant correlations, very low (.190) and insignificant correlation is observed for Special quota segment of A93, whereas for their A94 counterparts a statistically significant correlation of .520 is noticed (parts **b** and **e**). As regards the Ordinary quotas (both genders included) the coefficients are similarly around .35 but at different levels of significance (parts **c** and **f**).

The initial results changed remarkably when a further screening was applied to restrict the samples to a more homogeneous section by exclusion of the female students. As reflected in Figure 5.8, when the female students' data are excluded from graphs 'c' and 'f', the final and more controlled results (shown in graphs c1 and f1) are markedly different from the initial outcomes. A highly significant correlation of .530 was observed for the final A93 sample, and a non-significant correlation of .305 for the final A94 sample.

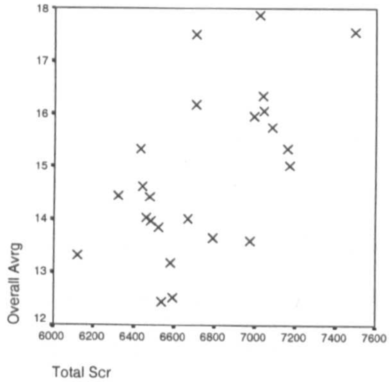
Because of the above pieces of evidence, it was decided to eliminate the influence of gender and quota factors. Therefore, the samples of our study were restricted to the 'male Ordinary quota' students who constituted the largest segment in each initial sample. For ease of reference, hereafter, 'male Ordinary quota' groups are simply referred to as samples. Our overall population consists of the male Ordinary quota students in the major Iranian university schools of architecture (each sample is meant to represent a population of similarly selected male students in the same school). The size of each eventual study sample is given in Table 5.5 (page 191).

c



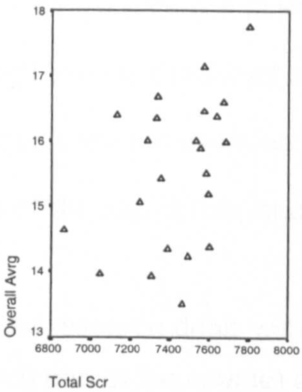
A93 (Ordinary Quota)
Spearman's rho: **.350***
Sig. (2-tailed) .031
N 38

c1



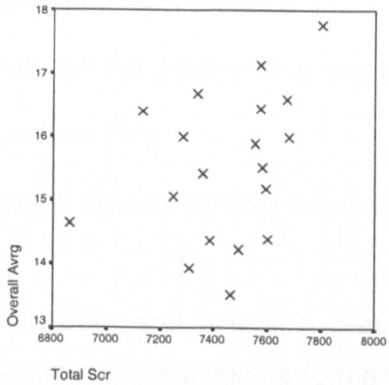
A93 (Male Ordinary Quota)
Spearman's rho: **.530****
Sig. (2-tailed) .008
N 24

f



A94 (Ordinary Quota)
Spearman's rho: **.378**
Sig. (2-tailed) .075
N 23

f1



A94 (Male Ordinary Quota)
Spearman's rho: **0.305**
Sig. (2-tailed) .204
N 19

Figure 5.8. The relationship of Total Score to Overall Average: Ordinary quota students in school 'A'.

Table 5.5. Size of eventual study samples

		Count
Univ/Cohort	A-93	24
	A-94	19
	B-93	17
	B-94	21
	C-93	20
	C-94	35
Group Total		136

5.1.5.4. Particular versus General measures of performance

In the area of educational research, where the relationship of the admission criteria to academic performance is the subject of investigation, some researchers limit the performance criteria to only *general* indicators such as: degree class; pass, withdrawal, fail; or the time of completion of the course. This might be due to either the lack of interest or, more importantly, to the disbelief of the researcher regarding the importance or accuracy of the *particular* measures such as marks and averages. While the significance and reliability of marks, as measures of performance, can be regarded as debatable issues, they are taken for granted here to bring the work within manageable limits.

In the context of the present survey, however, due to the following reasons, the mentioned *general* indicators lose their applicability for investigation of the relationship between entrance abilities and course performance.

1. Our students are not required to submit their Final Projects at the same time.
2. Final Projects are not examined by the same jury.
3. The rate of dropout is low, and prolonged time of (entire) course completion is common.

That is why our research deals with 'yearly', 'area', and 'overall' averages (during, or over the BArch part of the course) as indicators of academic performance.

5.2. Predictive Ability of the Two Student Selection Methods

The focus of this section is on the predictive ability of the two selection methods. For this purpose, finding answers to the following questions is the intention.

1. To what extent is each of the entrance exams predictive of the ensuing academic performance of the selected students?
2. Is one of the entrance exams preferable to another in terms of predictive ability?
3. In view of the application of an identical curriculum and syllabus in all the schools, does each of the entrance exams return comparable prediction results in different schools?
4. Does only one stage of each entrance examination return similar predictions to that of the entire examination?

The answer to the third question can show whether the application of identical and centralised entrance examinations is justifiable for entrance to all schools of architecture; and the answer to the fourth question will reveal if we can dispense with part(s) of the entrance examinations.

To answer the above questions, a number of matrices of correlation are employed. Each matrix may be viewed from different perspectives to answer more than one question.

Apart from the main questions, two secondary questions will also be dealt with in this section. It was mentioned earlier that some educational studies have claimed that secondary performance is a better predictor of university performance than is the result of a separate entrance test/examination. Likewise, evidence was found among the previous studies for the noticeable predictive ability of 'freshman' or first year average. These can have consequential implications if they are also true for our cases. Therefore, two secondary questions are also included in the inquiries of this section.

1. To what extent is the secondary education 'Diploma Average' predictive of the students' performance during the course? (Or, are the predictive results of 'Diploma Average' better or worse than those of the entrance examination?)
2. To what extent is 'first year average' predictive of subsequent performance during the course?

The following predictor variables will be applied separately for the study of the above questions.

- Total Score
- Specialised Exam Score

  Non-compound variables, i.e. scores in:
  - Design Test
  - Drawing Tasks
  - Chemistry Test
  - Physics Test
  - Mathematics Test
- Diploma Average (secondary education)
- 1st Year Average

Through the calculation of 'rank order' correlations, the relationships of Predictor variables to three sets of Performance variables are studied. These sets include Yearly Averages, Yearly Studio Marks, and Area Averages, which are reflected in joint or separate tables. Each table represents the correlation of a certain Predictor variable with a number of Performance variables (columns). Each row is allocated to one of our six samples. The three 1993 samples are displayed in the upper half of the tables and their 1994 peers are shown in the lower half. For the ease of understanding and comparison, decimal figures represent correlation coefficients only, and levels of significance are displayed graphically by the use of asterisk or plus signs. Where a significance level is above five percent (i.e. $p<.05$), the respective correlation coefficient is shown in bold additionally.

5.2.1. Predictive Ability of 'Total Score'

'Total Score' and 'Yearly Averages'

Correlations between Total Score (i.e. the eventual criterion for admission) and Yearly Averages are displayed in Table 5.6. As seen, the best correlations hold for A93 sample ranging from a minimum of .50 for the 2nd Year, to a maximum of .65 for the 1st Year Average. Three of the correlations are significant at above one percent level of significance ($p<.01$), and one of them above five percent ($p<.05$). B93 sample's results fall in the second rank. While their 2nd Year Average returns a low and non-significant correlation, their other yearly averages correlate between .51 and .57, all above five percent level of significance. Contrary to the previous samples, C93 sample's results tend to continually decline from .32 to -.08, all failing to reach a significant level.

No significant correlation (above five percent level) was found for any of the 1994 samples. Only a single case of correlation which amounted to .40 ($p < .10$) was found for B93 sample's 1st Year Average. However, the following correlations of the sample were always far smaller than that of its first year. All other correlation coefficients ranged between a maximum of .34 and a minimum of .04.

Table 5.6.
Relationship of 'Total Score' to 'Yearly Average'

Spearman rho Correlations

	Yearly Averages			
Sample	1st Yr	2nd Yr	3rd Yr	4th Yr
A 93 N = 24	.65**	.50*	.60**	.54**
B 93 N = 17	.51*	.34	.57*	.53*
C 93 N = 20	.32	.26	.17	-.08
A 94 N = 19	.21	.30	.34	.24
B 94 N = 21	.40+	.15	.04	.15
C 94 N = 35	.12	.24	.21	.18

**: p< .01; *: p< .05; +:p< .10 (all 2-tailed).

'Total Score' and 'Yearly Studio Marks'

Concerning the relationship of Total Score to Yearly Studio Marks among the six samples (Table 5.7), again A93 sample's data yielded significant results for all the four years and, in average, highest correlations. However, the sizes of the correlations were not as large as those of the Yearly Averages for the same sample, except for the 2nd year Studio Average. Their 1st Year Studio Mark returned a correlation of .53 ($p < .01$) and dropped slightly to .51 for the 2nd Year but at five percent level of significance. While for the 3rd and 4th Year Studio Marks correlation dropped to similar sizes of .38 and .39, respective significance levels remained above five percent. For B93 sample, however, the first two Yearly Studio Marks were low (.35 and .33) and non-significant but their 3rd and 4th year results reached similarly around .50 and above five percent level of significance. In the case of C93 sample, a non-significant correlation of .33 is observed for the first year but falls sharply to .07 and then to -.10 and -.09 in the following years.

Among the 1994 samples, A94's results appear to be better than those of B94 and C94. However, only one significant correlation (r_s=.57; p<.05) is observed for the A94 sample under their 3rd Year Studio Mark. Their other correlations are uniformly around .36 but do not reach a significant level.

Table 5.7.
Relationship of 'Total Score' to 'Yearly Studio Mark'

Spearman rho Correlations

Sample	Yearly Studio Marks 1st Yr	2nd Yr	3rd Yr	4th Yr
A 93 N = 24	.53**	.51*	.38*	.39*
B 93 N = 17	.35	.33	.51*	.50*
C 93 N = 20	.33	.07	-.10	-.09
A 94 N = 19	.36	.34	.57*	.36
B 94 N = 21	.35	.06	.05	-.10
C 94 N = 35	.10	.28+	.13	-.10

**: p< .01; *: p< .05; +:p< .10 (all 2-tailed).

For the B94 sample, the 1st Year Studio returned a non-significant correlation of .35. However, it began to drop sharply to .06 and .05 for the 2nd and 3rd Year Studios, and showed a further fall to -.10 in the fourth year (all non-significant). The maximum correlation for C94 sample was observed for their 2nd Year Studio Marks, amounting to .28 and above the ten percent level of significance. Their remaining results ranged between .13 to -.10 (all non-significant).

'Total Score' and 'Area Averages'

As regards the relationship of Total Score to Area Averages (Table 5.8), rather similar patterns are found for A93 and B93. For A93 all correlations are significant at least at five percent level, ranging from .47 (for Building Sciences) to .62 (for Calculatives). For B93, three Area Averages of Technology, Building Sciences, and Humanities fail to reach a significant level. However, in other areas, their correlations range between .56 (for Overall Average) to .68 (for Studio Average). One of the latter correlations is above five percent, and the other three are above one percent level of significance. No significant result was found for the C93 sample. Apart from their Technology and Calculatives Averages, which returned correlation coefficients of .24 and .36, the other areas showed very poor correlations.

Table 5.8.
Relationship of 'Total Score' to 'Area Average'

Spearman rho Correlations

	Area						
Sample	Studio Avrg	Dsgn Avrg	Tech Avrg	Bldng Sci Avrg	Calc Avrg	Hmn Avrg	Overall Avrg
A 93 N = 24	**.52***	**.50***	**.56****	**.47***	**.62****	**.47***	**.53****
B 93 N = 17	**.68****	**.62****	.41	.28	**.63****	.32	**.56***
C 93 N = 20	.02	-.08	.24	.09	.36	-.03	.09
A 94 N = 19	.45+	**.47***	.12	.21	.16	.04	.31
B 94 N = 21	.13	-.03	.17	.08	.26	.12	.18
C 94 N = 35	.13	.13	.08	.10	.11	.13	.13

**: p< .01; *: p< .05; +:p< .10 (all 2-tailed).

Concerning the 1994 samples, the correlations between Total Score and Area Averages are very poor in general. The only noticeable results are the A94's correlations of Studio Average, and Design Average with the predictor. While the sizes of these correlations are .45 and .47 respectively, the latter is the only correlation among all 1994 samples' results which lies above five percent level of significance. The majority of other results are very trivial.

Attention is particularly drawn to the fact that, despite the emphasis of the 1994 entrance examination on mathematics and physics, almost every 1994 Total score correlation with Area Averages of Technology, Building Sciences, and Calculatives was far lower than its corresponding 1993 results. The latter areas, however, seem to be most related to the maths and physics sub-exams.

Table 5.9. Relationship of 'Total Score' to Performance variables

Spearman rho Correlations

	Yearly Averages				Yearly Studio Marks				Area Averages						
Sample	1st Yr	2nd Yr	3rd Yr	4th Yr	1st Yr	2nd Yr	3rd Yr	4th Yr	Studios	Dsgn	Tech	Bldng Sci	Calc	Hmn	Overall
A 93 N = 24	.65**	.50*	.60**	.54**	.53**	.51*	.38*	.39*	.52*	.50*	.56**	.47*	.62**	.47*	.53**
B 93 N = 17	.51*	.34	.57*	.53*	.35	.33	.51*	.50*	.68**	.62**	.41	.28	.63**	.32	.56*
C 93 N = 20	.32	.26	.17	-.08	.33	.07	-.10	-.09	.02	-.08	.24	.09	.36	-.03	.09
A 94 N = 19	.21	.30	.34	.24	.36	.34	.57*	.36	.45+	.47*	.12	.21	.16	.04	.31
B 94 N = 21	.40+	.15	.04	.15	.35	.06	.05	-.10	.13	-.03	.17	.08	.26	.12	.18
C 94 N = 35	.12	.24	.21	.18	.10	.28+	.13	-.10	.13	.13	.08	.10	.11	.13	.13

**: p< .01; *: p< .05; +:p< .10 (all 2-tailed).

To provide a wider perspective of the correlations between the final determinant of admission to the course (Total Score) and performance variables, all the mentioned results are shown in the joint Table 5.9. As compared to the reported results of the reviewed literature, it could be claimed that Total Score has shown reasonable predictive ability for samples A93 and B93 who had taken the 1993 (design-inclusive) entrance examination. It is also observed that the same predictor in the 1994 (design-exclusive) examination has lost its previous predictive ability considerably. Moreover, neither year's final selection criterion has shown any noticeable prediction of the performance of the samples of school C.

5.2.2. Interim summary of findings: Total Score

The above results can be summarised as follows.

1. The 1993 entrance examination (Total Score) showed a noticeable predictive ability in schools A and B. This was above the average prediction as reported by related previous studies. For school C, however, the results were generally poor.
2. Prediction of subsequent performance was not similar in all the schools.
3. The 1994 entrance examination (Total Score) showed generally poor predictions.

Parenthetical note

A parenthetical point that should be made here is the existence of a couple of isolated significant correlations for the A94 sample's data (3rd Year Studio, and Design Average). The question may come to mind as to why, despite the similarity between the nature of the subjects of the scientifically-based 1994 examination with the Technological, Scientific, and Calculatives areas of the course, the Total Score of the examination correlates better with some measures of Studio and Design performance than with measures of Scientific and Calculative performance. This point is taken up in Appendix 5-1. Suffice it to say that, the relationship between two variables may be partly or wholly due to the influence of a third variable. Evidence was found that some 'non-academic' factor (discussed in the next chapter) could have exerted such an influence. More details are given in Appendix 5-1.

5.2.3. Predictive Ability of 'Specialised Exam Score'

In the same manner, the correlations of Specialised Exam Score with the three sets of performance variables were calculated.

'Specialised Exam Score' and 'Yearly Averages'

Table 5.10 shows the correlations of the predictor with Yearly Averages. Similar to Total Score, Specialised Exam Score also correlated best with the Yearly Averages of the A93 sample. Moreover, for A93, all the latter correlations were much stronger than corresponding correlations with Total Score, and all were significant above one percent level. A93's 1st Year Average showed the highest correlation ($r_s = .74$), and the other Yearly Averages of the sample were at least .60. B93's results also showed improvements as compared to their Total Score results. Apart from 2nd Year, their other Yearly Averages correlated at least .54 and above five percent level of significance. For C93, the 1st Year Average showed a modest correlation of .45 (p<.05), but their following years' results remained non-significant, and very low correlations were found for their third and fourth year.

Table 5.10.
Relationship of 'Specialised Exam Score' to 'Yearly Average'

Spearman rho Correlations

Sample	Yearly Averages			
	1st Yr	2nd Yr	3rd Yr	4th Yr
A 93 N = 24	.74**	.61**	.68**	.60**
B 93 N = 17	.55*	.37	.54*	.54**
C 93 N = 20	.45*	.33	.13	.06
A 94 N = 19	.23	.35	.41+	.22
B 94 N = 21	.24	.18	.05	.02
C 94 N = 35	.28+	.34*	.34*	.42*

**: p< .01; *: p< .05; +:p< .10 (all 2-tailed).

Among the 1994 samples, A94's and B94's results showed a marked decrease as compared to the results of their 1993 peers. None of their correlations was above five percent level of significance. Conversely, C94's results showed improvements. While the correlation of their 1st Year Average had dropped to .28, their second and third year's results had risen to .34 and then to .42 in the fourth year (all significant above five percent level).

'Specialised Exam Score' and 'Yearly Studio Marks'

Table 5.11 represents the correlations of Specialised Exam Score with Yearly Studio Marks. As regards the results of 1993 samples, as before, A93 returned the best correlations, followed with a marked difference by B93 and then C93 samples. The results of A93 sample ranged from a maximum of r_s=.64 (p<.01) for the 2nd Year Studio Marks to a minimum of r_s=.45 (p<.05) for the 4th Year. B93's results, conversely, ranged from a non-significant correlation of .30 for the 2nd Year to a significant (p<.05) result of .56 for the 4th Year Studio Marks. While their first and third year correlations showed a modest magnitude (.43 and .47), both were only above ten percent level of significance. C93 showed a modest correlation of .44 for 1st Year Studio Mark. However, the respective level of significance just failed to reach a five percent level (p=.051). Apart from the latter borderline result, other C93's results were very low to zero.

Table 5.11
Relationship of 'Specialised Exam Score' to 'Yearly Studio Marks'

Spearman rho Correlations

	Yearly Studio Marks			
Sample	1st Yr	2nd Yr	3rd Yr	4th Yr
A 93 N = 24	.56**	.64**	.51*	.45*
B 93 N = 17	.43+	.30	.47+	.56*
C 93 N = 20	.44+	.12	.00	.04
A 94 N = 19	.30	.36	.54*	.33
B 94 N = 21	.20	-.16	-.08	-.04
C 94 N = 35	.23	.34*	.45**	.21

**: p< .01; *: p< .05; +:p< .10 (all 2-tailed).

The pattern of 1994 correlations of Specialised Exam Score with Yearly Studio Marks was very different from the 1993 pattern. Only one of the A94 results reached five percent level of significance (r_s=.54 for 3rd Year Studio) and their other results ranged insignificantly between .30 and .36. No relationship was observable for the B94 sample. Moreover, three negative correlations were found for the latter sample. However, all were very low and non-significant. C94 returned better correlations than C93. While their first and fourth year results were low and non-significant, their 2nd and 3rd Year Studio correlated significantly ($r_{s=}$.34 and .45 respectively).

'Specialised Exam Score' and 'Area Averages'

Table 5.12 represents the correlations of Specialised Exam Score with Area Averages. A series of modest to high correlations are observed for all performance measures of the A93 sample. Such correlations ranged from a minimum of .57 for Building Sciences to a maximum of .75 for Calculatives Average. All A93's results are above one percent level of statistical significance. Apart from the Technology, Building Sciences, and Humanities Areas, which failed to reach above five percent level of significance, B93's results ranged between r_s=.59 (p<.05, for Studio Average) and r_s=72 (p<.01, for Overall Average). C93's results appeared to be very different from those of its 1993 peers. Among their results, only Calculatives Average tended to correlate with the predictor variable. The size of this correlation was .41. However, its level of significance fell between five and ten percent. The other Area Averages of C93 sample returned mainly very low and non-significant correlations.

Table 5.12. Relationship of 'Specialised Score' to 'Area Averages'

Spearman rho Correlations

	Area Averages						
Sample	Studio Avrg	Dsgn Avrg	Tech Avrg	Bldng Sci Avrg	Calc Avrg	Hmn Avrg	Overall Avrg
A 93 N = 24	**.61****	**.59****	**.68****	**.57****	**.75****	**.57****	**.64****
B 93 N = 17	**.72****	**.63****	.47+	.35	**.70****	.30	**.59***
C 93 N = 20	.16	.04	.37	.26	.41+	.02	.17
A 94 N = 19	.41+	.45+	.21	.25	.35	.00	.30
B 94 N = 21	-.03	-.09	.21	.26	.18	-.03	.12
C 94 N = 35	**.36***	**.38***	.21	.20	.18	**.43****	**.35***

**: p< .01; *: p< .05; +:p< .10 (all 2-tailed).

The 1994 samples' results showed contrary patterns to those of the 1993 samples. For A94, apart from two correlations (Studio, and Design Average) which fell between five and ten percent level of significance, no other significant correlation was found. For B94, not only was no single significant correlation found, but also the observed correlations were very low (three negative correlations existed among the results). As compared to their 1993 fellows, for the C94 sample, however, the results showed noticeable improvements. While no significant outcome was found for their Technology, Building Sciences, and Calculatives Averages, their remaining results ranged from a minimum of r_s=.35 (p<.05; for Overall Average) to a maximum of r_s=.43 (p<.01, for Humanities Average).

Attention is drawn to the predominantly low correlations for all the three 1994 samples in the Technology, Building Sciences, and Calculatives areas of the course despite the fact that in 1994 the Specialised Examination was composed of chemistry, physics and mechanics, and mathematics sub-exams. This implies that, despite the apparent similarities between the predictor and scientific performance variables (in terms of the nature of their problems, notations, means and methods of investigation, etc.), the 1994 Specialised Exam Score fails to make any significant prediction of the students' performance in areas such as Building Sciences, and Calculatives.

Table 5.13 displays the correlations of Specialised Exam Score with all the different performance variables in a single table. Among the 1993 samples, A93 shows the best relationships between the predictor and performance variables. The majority of the A93's results are highly significant and the size of relationships varies from modest to high correlations. B93's results come next. While half of their correlations fail to reach above five percent level of significance, their remaining results are still noticeable and comparable to A93's results. Hardly showing a significant relationship, C93's results bear no resemblance to the results of its two fellow samples. Only for their 1st Year Average a modest and significant (p<.05) correlation is observed.

The pattern of 1994 correlations shows a marked change (lower half of Table 5.13). For the samples from schools A and especially B, almost all the previously observed relationships decline drastically. Among a number of 30 correlations for the two samples, only one shows a slight rise, and the rest diminish. Six very low negative correlations are observed for B94, but none of the sample's correlations are statically significant. As compared to the results of their previous year fellows, C94's results, despite instances of fall, show improvements for the majority of the correlations, varying from a low to a modest range, and at least above five percent level of significance.

Table 5.13. Relationship of 'Specialised Score' to Performance variables

Spearman rho Correlations

Sample	Yearly Averages				Yearly Studio Marks				Area Averages						
	1st Yr	2nd Yr	3rd Yr	4th Yr	1st Yr	2nd Yr	3rd Yr	4th Yr	Studios	Dsgn	Tech	Bldng Sci	Calc	Hmn	Overall
A 93 N = 24	.74**	.61**	.68**	.60**	.56**	.64**	.51*	.45*	.61**	.59**	.68**	.57**	.75**	.57**	.64**
B 93 N = 17	.55*	.37	.54*	.54**	.43+	.30	.47+	.56*	.72**	.63**	.47+	.35	.70**	.30	.59*
C 93 N = 20	.45*	.33	.13	.06	.44+	.12	.00	.04	.16	.04	.37	.26	.41	.02	.17
A 94 N = 19	.23	.35	.41+	.22	.30	.36	.54*	.33	.41+	.45+	.21	.25	.35	.00	.30
B 94 N = 21	.24	.18	.05	.02	.20	-.16	-.08	-.04	-.03	-.09	.21	.26	.18	-.03	.12
C 94 N = 36	.28+	.34*	.34*	.42*	.23	.34*	.45**	.21	.36*	.38*	.21	.20	.18	.43**	.35*

**: $p < .01$;   *: $p < .05$;   +: $p < .10$ (all 2-tailed).

The comparison of Table 5.9 and Table 5.13 indicated that for the 1993 samples, in the majority of cases, Specialised Exam Score alone had been able to render equal or better predictions than those of Total Score. In a few cases for the 1993 samples, where Total Score correlation had preceded its corresponding Specialised Exam Score correlation, the differences were hardly more than trivial. Among the 1994 samples, Specialised Exam Score correlations were clearly better than those of Total Score in school C. For the 1994 samples from schools A and B, Total Score seems to predict slightly more accurately overall. The latter precedence, however, due to the mainly low and non-significant correlations, hardly conveys any significance or practical implication.

5.2.4. Interim summary of findings: Specialised Score

The above results can be summarised as follows.

1. Different patterns of prediction were found in dissimilar schools.
2. The Specialised Score of the 1993 (design inclusive) examination showed a reasonable predictive ability in schools A and B (generally above the average prediction as reported by related previous studies). The same predictor showed mainly low correlations in school C.
3. Conversely, the Specialised Score of the 1994 (design exclusive) examination returned better predictions for school C, but poorer predictions for schools A and B.
4. On the whole, the Specialised Exam Score returned comparable results to that of the Total Score.

To sum up, the above findings suggest that: 1) the implementation of an identical examination for all the schools seems to be questionable; and 2) the Specialised Examination alone would have sufficed for the purpose of student selection without any significant loss of predictive ability.

Possible objections

Before dealing with other predictor variables and their respective patterns of relationship to performance variables, it seems timely to elaborate on two curious points here. The first point concerns the possibility of initial differences among the samples of the same year as the cause of dissimilar patterns of correlation. The second issue concerns the likelihood of the contrasting 1993 and 1994 correlations having arisen from the dissimilar dispersions of the respective entrance records. These possible (and plausible) doubts are studied in detail below.

1. Objection One:
Possibility of initial differences affecting the results

As reflected in Table 5.9 and Table 5.13, a considerable degree of resemblance was observable between the correlational patterns of samples A93 and B93. C93's pattern of correlations, however, appeared very different from those of its peers. As regards the 1994 samples (in Table 5.9), while a couple of significant correlations were observed for the A94 sample, patterns of correlation (between Total Score and performance variables) for the samples could not be regarded as being conspicuously different. However, clear differences were noticed again, in Table 5.13, especially between C94's pattern of correlations and those of B94.

It might be argued that such different patterns of relationship could have been related to the initial sample differences, i.e. the difference between each sample's collective status on predictor variable(s) and that of another sample.

To study the initial similarity or dissimilarity between each pair of samples, Mann-Whitney U tests were carried out to see if a series of typical null hypotheses of no difference (between each sample's scores on a predictor variable and the corresponding scores of any other sample) could be rejected. A necessary detour is made here to reflect the test results and the possible implications.

Three separate parts of Table 5.14 show the results of the Mann-Whitney test for possible pairs of samples (rows) on predictor variables (columns). The first part of the table compares pairs of samples who entered the schools in 1993, the second part focuses on the 1994 samples, and the last part studies the difference between the subsequent samples in each school. The latter part will be used below to tackle a forthcoming question. Decimal figures in the body of the table represent the levels of statistical significance of the test results. Those levels of significance which are above five percent (i.e. $p<.05$, the usual level at which the null hypothesis is rejected) are shown in bold, and those between five and ten percent are underlined. Sample code below each figure indicates the sample whose 'mean rank' was larger, i.e. the sample who scored collectively higher than its counterpart. Evidently, due to different components, no comparison could be made of the Specialised Exam Scores of the subsequent samples within the same school.

As seen in the upper part of Table 5.14 (1993 samples) the null hypotheses of no difference between the A93 and B93 samples can be rejected ($p<.05$) for two variables. The results indicate that the A93 and B93 samples were significantly different in terms of their Total, and Scientific scores. They were also very close to rendering a significant difference on Specialised Exam Score ($p = .051$).

Table 5.14. Test of difference between pairs of samples on entrance examination measures

Level of significance of Mann-Whitney test

		Total Scr	Spcl'd Scr	Sci Scr
Comparison of **1993** samples	A93 vs B93	**.033**	.051	**.019**
	Higher scorer	A93	A93	A93
	A93 vs C93	.112	.525	**.026**
	Higher scorer	A93	A93	A93
	B93 vs C93	.577	.311	.460
	Higher scorer	C93	C93	C93
Comparison of **1994** samples	A94 vs B94	**.000**	**.002**	**.001**
	Higher scorer	A94	A94	A94
	A94 vs C94	**.000**	**.000**	**.000**
	Higher scorer	A94	A94	A94
	B94 vs C94	**.007**	1.00	.470
	Higher scorer	B94	C94	B94
Within school comparisons	A93 vs A94	**.000**	_	**.000**
	Higher scorer	A94		A94
	B93 vs B94	**.000**	_	**.002**
	Higher scorer	B94		B94
	C93 vs C94	**.000**	_	**.001**
	Higher scorer	C94		C94

Comparison of the A93 and C93 samples shows slighter differences. Only on Scientific score could the null hypothesis be rejected above five percent level of significance. No remarkable difference was observed between the A93 and C93 samples on Total or Specialised scores.

As regards the B93 and C93 samples, none of the tests of significance reached the critical level to reject the null hypotheses.

The above results suggest that the closest samples, in terms of their collective rank on overall entrance measures, are B93 and C93, and the farthest samples are A93 and B93.

Concerning the 1994 samples, on the basis of the results shown in the middle rows of Table 5.14, like their 1993 fellows, B94 and C94 appear to be the closest. Despite the fact that their Total scores are significantly different, the inspection of the results of other variables does not indicate the existence of any significant difference between the two samples on their Specialised, and Scientific Score variables. Since the Total Score is a factor of both the General and Specialised Exam scores, it is very likely that the samples' difference in Total Score had arisen mainly from their difference in General Examination results. The A94 sample results show that they had performed significantly better than both their 1994 counterparts on the entrance examination variables.

As regards the 'within school' comparisons, the null hypotheses of no difference between the subsequent samples (in the same school) can be rejected at a very high significant level for Total, and Scientific scores in all three schools. Collectively, each 1993 sample had scored significantly higher than its 1993 peer on the mentioned variables.

The differences between the samples in their entrance examination scores can be summarised as follows.

- Among the 1993 samples:
    1. The largest gap was found between the entrance examination scores of the A93 and B93 samples.
    2. B93 and C93 returned the closest sets of entrance examination scores.
- Among the 1994 samples:
    1. On the three studied variables, A94 entrance examination scores were significantly different from those of B94, and especially C94 (A94 scoring higher).
    2. B94 and C94 returned the closest sets of entrance examination scores.
- In each school, the 1994 samples located significantly higher than their 1993 peers on both the Total Score, and Scientific Score variables.

To return to the question, i.e. the possible influence of the sample's initial differences on the observed relationship patterns, the Mann-Whitney test findings and the previous correlation tables (in particular Table 5.9 and Table 5.13) should be considered together.

The joint results indicate that the extent (or pattern) of the observed relationships cannot be ascribed to the relative rank of the samples on their entrance examination results. Because there exist cases where either despite the initial difference between two samples, comparable patterns of admission-performance relationship are found for them; or in spite of their initial similarities, contrasting patterns of relationship are observed. A further examination of Table 5.9 and Table 5.13 in the light of the above findings clarifies the issue.

For instance, the notion that the remarkable pattern of A93 and the poor pattern of C93 relationships (in Table 5.9) could have simply arisen from the samples' rank in the entrance examination finds no plausible support for the following reasons. The upper part of Table 5.14 under Total Score shows that the null hypothesis of no difference between A93 and B93 can be rejected for two variables. The second row of the same table indicates that no significant difference can be identified between A93 and C93 on their Total Score. However, there exists evidence of significant difference between A93 and C93 in Scientific Score. At the same time, none of the same null hypotheses can be rejected for C93 and B93, implying that they must have been closest to each other in terms of their entrance examination results. On the whole then, A93 and B93 should be regarded as the furthest, and A93 and C93 the closest samples together in terms of their overall entrance examination results. Nevertheless, the observed correlations for B93 are comparable to the noticeable correlations of A93, whereas C93's correlations remain mainly fruitless and bear no resemblance to A93's results.

Similar evidence can be found for Specialised Exam Score through the inspection of Table 5.13 and Table 5.14. The middle part of Table 5.14 shows that on Specialised Exam Score no significant difference can be claimed between B94 and C94. Yet the pattern of B94's correlations is very dissimilar to C94's results. Therefore, it appears that the difference in the initial collective rank of the samples cannot be held responsible for difference in their subsequent patterns of admission-performance relationship.

Discussion

While evidence contradicts the notion that initial differences could have caused different correlational patterns, it seems likely that the ethos of each school might have influenced its observed pattern of relationship. Concerning the 1993 samples' results, schools A and B, which were most dissimilar in terms of their entrants' records, showed very similar correlational patterns. These schools (A and B) are the closest contextually, not only in terms of establishment and staff, but also because of their location in comprehensive universities and neighbouring Humanities or Art schools. Contrarily, schools B and C were the closest schools in terms of their entrants' records but showed different patterns; they are also very different contextually and in terms of their background.

Despite the widespread poor predictive ability of the 1994 entrance examination (Total Score) in all three schools, it was observed that the displacement of emphasis from design and drawing tasks to physics in the 1994 entrance examination was associated with improvements in the correlation patterns of the technologically-based school (C), and decline in the other schools' results on their Specialised Exam Score (Table 5.13).

The similarities and differences between the schools' results tend to suggest that each school might have exercised its particular attitude towards the reception (and fostering) of the abilities their entrants showed in the entrance exams. Nevertheless, this is not enough evidence to generalise the finding. From among the available previous studies, only the Bartlett study looked into its individual cohorts' yearly results and investigated the consistency of the correlation patterns, both from year to year and from cohort to cohort. The team claimed, though, that no consistent pattern could be detected. It should be noted, however, that for the last of the three cohorts of the Bartlett study some new selection and also educational policies were employed and the expectation of a consistent pattern may not be easily justified.

Our available data include the information on the entrance and academic performance of three pairs of cohorts who entered schools in two consecutive years, and through two different selection methods. A future study of some adjacent cohorts (i.e. from both before and after the change to entrance examination) is necessary to illustrate how consistent the patterns remain in any given school and under each of the two selection methods.

2. Objection Two: Dissimilar predictive abilities of the two exams and dispersion of entrance scores

- As regards the predictive ability of the Total Score in different years, despite the fact that, according to the lower part of Table 5.14, both Total and Scientific Scores of each 1994 sample were significantly higher than those of their corresponding 1993 peers, the majority of the admission-performance correlations of the 1994 samples, as compared to the corresponding 1993 results, showed sharp drops (Table 5.9). Apart from one correlation, the rest of the 29 correlation coefficients of A94 and B94 samples decreased. While a number of the C94 sample's correlations rose, the main body of their correlations remained very low and none of them reached a five percent level of significance.

Concerning the predictive ability of the Specialised Exam Score in different years, similar drops in correlations (to that of the Total Score) were observed for 1994 samples from schools A and B (Table 5.13). C94 results, as compared to those of C93, however, showed a sort of inversion where several previously highest correlations fell, and a number of earlier very poor correlations increased to become modest and significant.

It might be argued that the reason for the observed falls in the 1994 samples' correlations is the smaller variability of the 1994 samples' scores than those of the 1993 samples. However, two points exist which cast doubt on the reality of this claim.

Table 5.15 and Table 5.16 reflect such variations (for Total, and Scientific Scores). The mean, standard deviation, and 'coefficient of variation' of the variables are given in the tables for each of the 1993 and 1994 samples. Coefficient of Variation is a statistic which can be employed to compare the extent of variability of two or more sets of data (technically, it is a hundred times standard deviation divided by the mean of the sample, shown in percentage). As seen in the tables, it should be accepted that all coefficients of variation of the 1994 samples are smaller than those of the 1993 samples.

1. It should be noted, however, that the range and/or relative variation of the values under study have no bearing on the 'calculation' of the 'rank order' correlation coefficient because such a correlation coefficient is only affected by the ranks of values and the number of cases involved.

Table 5.15. Mean and variation of Total Score among samples

Sample	Mean	Std Deviation	Coefficient of Variation
A93	6742	332	4.9%
A94	7447	222	3.0%
B93	6441	442	6.9%
B94	7160	267	3.7%
C93	6529	363	5.6%
C94	7079	211	3.0%

Table 5.16. Mean and variation of Scientific Score among samples

Sample	Mean	Std Deviation	Coefficient of Variation
A93	1742	330	18.9%
A94	2127	176	8.3%
B93	1382	494	35.7%
B94	1852	273	14.7%
C93	1476	409	27.7%
C94	1816	241	13.3%

2. Moreover, it should be noted that despite smaller variation in C94's Scientific Scores (than that of C93), higher correlations were observed for the C94 sample. Therefore, the differences observed between the two entrance exams' predictions cannot be attributed only to the dissimilarity in the range and variation of the samples' entrance scores (this issue will be discussed further, under the title 'predictive ability of 1st Year Average').

Also, it seems opportune to mention here that Peers and Johnston (1994) reported that differences among a number of samples in their size of correlation (between admission and performance variables) were not explicable by range variation in admission variable. They referred to instances of two highly selective disciplines (i.e. sciences and medicine) which showed larger correlations than a less selective discipline between the admission and performance variables of their students.

Nevertheless, if because of the small range or variation of scores the differences among the raw scores are so minute that the respective ranks exist only in theory (without any clear external effect), then the selection on the basis of such scores is called into question in the first place, unless evidence can be found that, despite the fall in admission-performance correlations, the overall performance has otherwise improved. This latter issue will be investigated in sections 5.3 and 0 below.

5.2.5. Predictive ability of the non-compound predictors

Now we turn back to the study of the predictive ability of the individual non-compound predictors, i.e. sub-scores in separate sub-exams of the entrance examinations. The correlations of such predictors with those performance variables which seem to be better related to them are examined below for two purposes. First, to see if such variables were able to render equivalent results to those of the compound predictor variables. Second, to find out whether similar patterns of relationship could be found in different schools.

Design Test and Drawing Tasks

Up to and inclusive of 1993, the Design Test and Drawing Tasks were constituent parts of the entrance examination for studying architecture. The Design Test included 60 multiple choice questions which were intended to gauge candidates' aptitude for various subjects/areas which were believed to be generic prerequisites for designing. The test often included questions on graphical communication, spatial understanding and mental imagery, intuitive understanding of statics and dynamics of forces, history of art and architecture, etc.. The content validity of the different areas of the test, however, was neither easy to examine nor necessarily self-evident. Table 5.17 displays the relationship of the Design Test to a number of performance variables for 1993 samples.

Table 5.17.
Relationship of 'Design Test' to performance variables

Spearman rho Correlations

Sample	Yearly Studio Marks				Area Averages		
	1st Yr	2nd Yr	3rd Yr	4th Yr	Studios	Dsgn	Overall
A 93 N = 24	**.44***	.33	.30	.35⁺	.39⁺	.40⁺	**.45***
B 93 N = 17	.34	.32	.12	-.06	.14	.14	.23
C 93 N = 20	.25	.22	-.19	-.10	.13	-.02	.01

**: p< .01; *: p< .05; +:p< .10 (all 2-tailed).

For the A93 sample only, the Design Test tended to show a couple of modest and significant correlations. The correlations of B93 and C93 failed to return any significant result, the latter being the poorer. Despite being low and non-significant, the largest correlations of B93 and C93 were found for their 1st and 2nd Year Studio Marks.

The comparison of Table 5.17 with the corresponding parts of Table 5.9 and Table 5.13 shows that, on the whole, Design Test on its own had had poorer predictive ability than Total Score, and Specialised Exam Score to predict the studio or design-related and Overall Average results.

The Drawing sub-exam included various tasks. For instance, candidates had to redraw a given drawing (of an object or a perspective) from a different point of view or after implementing imagery alterations; complete a given incomplete scene; graphically communicate a particular concept or meaning (e.g. design of a logo or a cover for a specific book), or other similar tasks. The Drawing Tasks Scores of the 1993 examination correlated better than the Design Test with the same performance variables (Table 5.18). In all the three schools, the predictor returned modest to high and significant correlations with 1st Year Studio.

Table 5.18.
Relationship of 'Drawing Task' to performance variables

Spearman rho Correlations

Sample	Yearly Studio Marks				Area Averages		
	1st Yr	2nd Yr	3rd Yr	4th Yr	Studios	Dsgn	Overall
A 93 N = 24	**.65****	**.67****	**.65****	**.54****	**.71****	**.67****	**.59****
B 93 N = 17	**.63****	.16	.36	.46+	**.59***	.44+	**.63****
C 93 N = 20	**.45***	.30	.13	.08	.32	.17	.08

**: p< .01; *: p< .05; +:p< .10 (all 2-tailed).

While the correlations of the C93 sample began to diminish after the first year, the A93 correlations showed a quite steady trend for three years and a small fall in the fourth year. The B93 results dropped severely in the second year but began to show improvements (reaching to r_s=.46; p<.10) later. For both the A93 and B93 samples the predictor also showed modest to high significant correlations with areas of Studios, and Overall Average.

The comparison of Table 5.18 with the corresponding parts of Table 5.9 and Table 5.13 shows that the Drawing Tasks variable, on its own, had correlated better than Total Score, and Specialised Exam Score with design-related performance variables in schools A and C. However, except for 1st Year Studio, other such correlations were non-significant in school C. Concerning school B, the results are a little equivocal. Despite a few strong correlations, there is not enough evidence to conclude that Drawing Tasks had enjoyed a preferable predictive ability to those of Total Score or Specialised Exam Score in school B.

Chemistry, Physics, and Maths Scores

Although it may seem difficult to think of a self-evident relationship between the chemistry and physics sub-exams with design-related areas of the course, it seems quite acceptable to anticipate a relationship between the mentioned sub-exams and the scientific, and other (predominantly) objective performance variables[8]. Theoretically, scores in maths and scientific sub-exams may show relationship to the latter variables, at least, through either or both of the following ways.

First, due to having apparently similar ingredients, methods of investigation, notation, etc, there may exist common or similar features between the predictor and performance variables. Therefore, competence in the latter may call for similar (or previously developed) abilities which the former had already required, hence the likelihood of arriving at noticeable correlations. The major body of mathematics studied in the last years of high school, the maths sub-exam of the entrance examination, and the Calculative subjects of the course, for example, share many commonalities.

Second, in cases where no apparent similarity exists between the predictor and (the objective) performance variable, still it is likely that performance in both a particular part of the entrance examination and also in a specific area of the course requires drawing on similar but tacit factors such as abstract reasoning or logical/mathematical thinking abilities which are especially essential for dealing with a wide range of academic (and also non-academic) well-defined problems.

For the above reasons, and with the same intention of our previous correlational studies in mind, it also seemed opportune to examine individual relationships of the Chemistry, Physics, and Maths Scores with Yearly Averages, Scientific Areas[9], and Overall Averages.

Chemistry Score

The correlations of Chemistry Score are shown in Table 5.19. For the A93 sample a single modest and significant correlation is observed on 1st Year Average (r_s=.50; $p<.05$). The predictor also tended to show some low correlations with other performance measures for A93. The correlations, however, reached above only ten percent level of significance at best. The results of the B93 and C93 samples were low or very low and non-significant.

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[8] Such as Building Sciences, Calculatives, or Yearly Averages, as compared to design-based variables.

[9] Including Technology, Building Sciences, and Calculatives Averages.

For A94 very low to low and non-significant correlations were found (majority of them being negative).

Table 5.19.
Relationship of 'Chemistry Score' to performance variables

Spearman rho Correlations

Sample	Yearly Averages 1st Yr	2nd Yr	3rd Yr	4th Yr	Area Averages Tech	Bldng Sci	Calc	Overall
A 93 N = 24	**.50***	.37⁺	.32	.40⁺	.36⁺	.32	.38⁺	.35⁺
B 93 N = 17	.28	.21	.14	.39	.11	.02	.10	.32
C 93 N = 20	.16	.20	.05	-.06	.29	.19	.34	.10
A 94 N = 19	-.21	-.13	.17	-.10	-.14	-.11	-.12	-.06
B 94 N = 21	.03	.10	.07	-.22	.31	**.63****	.06	.01
C 94 N = 35	.23	.13	.05	.12	.17	.16	.18	.13

**: p< .01; *: p< .05; +:p< .10 (all 2-tailed).

On the whole, the results of B94 and C94 cannot be regarded as better than those of B93 and C93. Evidently, a single but highly significant correlation (r_s=.63; with Building Sciences) exists among the B94 results. However, contrary to the A93 results, other B94 results are mainly trivial and fall even lower than a ten percent level of significance. While none of the constituent subjects of the Building Sciences area deals with chemistry, it seems difficult to find an explanation, other than mere chance, for the emergence of that single and noticeable correlation.

Altogether then, apart from the meagre correlations of the A93 sample, Chemistry Score failed to show any noticeable and consistent relationship with the subsequent academic performance for both 1993 and 1994 samples.

Physics Score

Table 5.20 reflects the relationships of the Physics Score to performance variables. Only for Technology, and Calculatives Area Averages of the A93 sample are significant correlations found (r_s=.44 and .46; p<.05). Despite apparent similarities between the predictor and technological areas, all other correlations for other 1993 and 1994 samples failed to reach a significant level. Regardless of the level of statistical significance, in the majority of cases the sizes of correlations are very low as well.

Table 5.20.
Relationship of 'Physics Score' to performance variables

Spearman rho Correlations

Sample	Yearly Averages				Area Averages			
	1st Yr	2nd Yr	3rd Yr	4th Yr	Tech	Bldng Sci	Calc	Overall
A 93 N = 24	.24	.31	.29	.18	**.44***	.39+	**.46***	.25
B 93 N = 17	.11	.01	.13	.30	.02	-.03	.24	.11
C 93 N = 20	.07	.00	.06	-.05	.14	.03	.30	.01
A 94 N = 19	.09	.04	.25	-.24	.07	-.05	.34	-.08
B 94 N = 21	.16	.13	-.07	.08	.11	.21	.04	.08
C 94 N = 35	.20	.26	.19	.29+	.08	.04	.07	.24

**: p< .01; *: p< .05; +:p< .10 (all 2-tailed).

Only non-technological correlations of the C94 sample can be regarded to have shown slight but almost consistent improvements.

Maths Score

Finally, Table 5.21 displays the relationships of the performance variables to Maths Score. A number of modest to high and significant correlations are found for A93 and B93 samples. Common variables on which both samples showed correlations included 3rd and 4th Year Average, Calculatives Average, and Overall Average. All C93's results were trivial and non-significant. The same is true for A94 and B94. The C94 sample's results showed slight improvements compared to those of C93 but returned only one significant correlation with 3rd Year Average (r_s=.37; p<.05).

Table 5.21.
Relationship of 'Maths Score' to performance variables

Spearman rho Correlations

Sample	Yearly Averages 1st Yr	2nd Yr	3rd Yr	4th Yr	Area Averages Tech	Bldng Sci	Calc	Overall
A 93 N = 24	.53**	.35+	.48*	.45*	.53**	.42*	.60**	.45*
B 93 N = 17	.26	.37	.76**	.58*	.34	.24	.52*	.54*
C 93 N = 20	.23	.07	-.13	-.20	.09	-.03	.23	-10
A 94 N = 19	.08	.29	.26	.20	.10	.24	.16	.20
B 94 N = 21	.15	.10	.01	.05	.08	.02	.14	.09
C 94 N = 35	.17	.25	.37*	.31+	.22	.24	.23	.26

**: p< .01; *: p< .05; +:p< .10 (all 2-tailed).

While the relationship between Maths Score and Calculatives Area seems to be the most self-evident, and most expected, correlations between the two variables for both A94 and B94 samples were very low. The correlations of Maths Score with all other studied variables of A94 and B94 had declined. For C94, the correlation of Maths Score with Calculatives remained exactly the same as that of C93, whereas some improvements were observed on the majority of other C94 variables.

The comparison of the above results of Chemistry, Physics, and Maths Scores with the related parts of Table 5.9 and Table 5.13 shows that only occasional scattered cases existed where the above non-compound variables showed better correlations than the compound predictors. On the whole, each of the Chemistry, Physics, and Maths variables on its own had had poorer predictive ability than Total Score, and Specialised Exam Score.

5.2.6. Interim summary of findings: non-compound predictors

1. From among our non-compound variables, only Drawing Tasks (for the prediction of design-related performance variables) tended to show comparable predictive ability to those of the compound predictor variables. In school A, Drawing Tasks returned even higher correlations than those of Total Score and Specialised Score predictors.
2. Other non-compound predictor variables failed to correlate better than Total Score, and especially Specialised Exam Score with the corresponding sets of performance variables with which they were logically expected to correlate.
3. The 1993 Drawing Task Score, and Mathematics Score were the only predictors which showed fairly similar correlations for two of the samples (namely A93 and B93).
4. The prediction of the non-compound variables were not similar in all the schools. Only for A93 did all the non-compound predictors returned a number of significant correlations.
5. Apart from a single case of significant (but unexplainable) correlation, the 1994 Chemistry, Physics, and Math predictors failed to show any noticeable correlation with the seemingly related performance variables of the scientific areas in all the schools.

Parenthetical note

Since the non-compound variables of Chemistry, and Physics Score showed very trivial correlations in most of the studied cases, it was thought that it might have been possible for the Specialised Exam Score variable to return similar correlations even if the Chemistry and Physics scores had been excluded from it. Therefore, by the sum of Maths Score and Drawing Tasks Score (equal weights) a new compound variable was constructed. Correlations of the latter variable with the same sets of performance variables were calculated and compared with the previous results. It was found that despite the barrenness of the Chemistry and Physics Scores as single (or non-compound) predictors on their own, the inclusion of them in the compound variable improves the results.

5.2.7. Predictive Ability of Diploma Average

After the study of the predictive abilities of the entrance exams' variables, correlational patterns of Diploma Average are investigated below (Table 5.22) to see whether it had a better predictive ability than the one-off and isolated (1994) entrance examination. It should be noted that the available data of Diploma Average did not include all the members of our 1994 samples. In school A, it was limited to only 11, and in schools B and C to 16 and 28 students respectively. Therefore, the results of this section should be dealt with caution.

Table 5.22. Relationship of (Secondary Education) 'Diploma Average' to Performance variables

Spearman rho Correlations

Sample	Yearly Averages				Yearly Studio Marks				Area Averages						
	1st Yr	2nd Yr	3rd Yr	4th Yr	1st Yr	2nd Yr	3rd Yr	4th Yr	Studios	Dsgn	Tech	Bldng Sci	Calc	Hmn	Overall
A 94 N = 11	.17	.27	.33	.36	.32	.44	.51	.33	.38	.38	.14	.29	.08	**.69***	.34
B 94 N = 16	.29	-.04	.11	-.09	.02	-.35	.17	-.16	-.01	-.11	.34	.42	.21	.06	.09
C 94 N = 28	.24	.28	.23	.08	.08	.20	-.03	.07	.08	.10	.32	**.40***	.37+	.07	.16

**: p< .01; *: p< .05; +:p< .10 (all 2-tailed).

From among the 45 possible correlations of the table, only two significant correlations emerged; one for each of the A94 and C94 samples. The former was a high correlation of .69 with Humanities Average and the latter was a modest correlation of .40 with Building Sciences Average. The correlations in Table 5.22 were compared with the correlation matrices of Total Score, and Specialised Exam Score which were separately calculated for exactly the same students (i.e. those whose Diploma Average was available). Detailed tables are given in Appendix 5-2. Apart from the two significant correlations in Table 5.22, only in a few cases could the correlations of Diploma Average be regarded to be (insignificantly) better than those of Total Score, or Specialised Exam Score in particular.

The mentioned local cases of larger (but non-significant) correlations do not provide enough evidence to conclude that Diploma Average on its own had been generally preferable to the entrance examination in terms of predictive ability. While on the whole, the correlations of Diploma Average in schools A and B were not markedly different from the correlations of Total score or Specialised Exam Score, the superiority of the Specialised Exam Score to Diploma Average was very clear in school C.

Altogether then, despite the claim of previous studies about the usefulness of high school results for the prediction of subsequent academic performance, our Diploma Average variable showed no better relationships than those returned by the previous predictors. It is not known to what extent the high stakes of the 1994 entrance competition (leading possibly to over-reliance on high but unrelated qualifications) or the inherent discrepancy between the particularities of the high school and architectural education could be held responsible for the poor predictive ability of the Diploma Average.

5.2.8. Predictive ability of 'First Year Average'

After the study of the relationships of the entrance examination predictors to performance measures, here we look into the corresponding relationships of the 1st Year Average. Contrary to the entrance exams results, which were the product of external and detached systems of assessment, 1st Year Averages were the effect of internal assessments of the schools. Moreover, the ingredients of the 1st Year Average variable bore more resemblance than those of the entrance examination to the following parts of the course. Therefore, the emergence of more consistent correlations was anticipated.

As shown in Table 5.23, the prevalence of significant and strong correlations is not comparable to what was observed in the previous tables. Moreover, the similarity between the results of the fellow samples from the same schools (e.g. A93 and A94) seems, not surprisingly, restricted to this table. As compared to the results of the two other schools, the results of school B appear less consistent. A separate study of the correlations between the successive pairs of Yearly Studio Marks (not presented here) showed that such correlations in school B were smaller than those of schools A and C. This point suggests that in school B, the teams of different year design tutors should have applied less harmonious criteria for the tutoring and/or assessment of studio works. Bearing in mind that the studio marks of each year have a noticeable share in the average mark of the same year, the above point tends to explain the fluctuations of correlations in school B.

Table 5.23.
Relationship of the 1st Year Average to performance variables

Spearman rho Correlations

Sample	Yearly Averages			Yearly Studio Marks			Area Averages						
	2nd Yr	3rd Yr	4th Yr	2nd Yr	3rd Yr	4th Yr	Studios	Dsgn	Tech	Bldng Sci	Calc	Hmn	Overall
A 93 N = 24	.80**	.81**	.79**	.88**	.53**	.67**	.84**	.81**	.78**	.72**	.76**	.83**	.86**
B 93 N = 17	.24	.57*	.38	.21	.30	.44	.61**	.38	.76**	.69**	.80**	.22	.73**
C 93 N = 20	.79**	.75**	.62**	.55*	.53*	.46*	.68**	.60**	.82**	.74**	.83**	.49*	.84**
A 94 N = 19	.76**	.36	.75**	.63**	.37	.57*	.67**	.59**	.85**	.78**	.65**	.76**	.81**
B 94 N = 21	.42	.45*	.40	.34	.40	.03	.61**	.34	.57**	.30	.63**	.25	.54*
C 94 N = 35	.81**	.69**	.69**	.69**	.57**	.59**	.81**	.74**	.82**	.71**	.77**	.67**	.89**

**: p< .01; *: p< .05; (all 2-tailed).

Despite the mentioned differences, for the area averages of Studios, Technology, Calculatives, and also Overall Average strong and invariably significant correlations are observed for all the 1993 and 1994 samples in the three schools. Concerning the Overall Average, for example, while the correlations of 1st Year Average for the 1993 and 1994 samples in school B were .73 (p=.001) and .54 (p=.011), corresponding correlations in schools A and C ranged between .81 and .89 (p=.000 in both cases).

It should also be noted that, for all the schools, the 1993 entrance examination showed stronger predictions of 1st Year Average than did the 1994 examination.

One may doubt, however, that the larger correlations for the 1st Year Average variable are due to its larger variations than those of, say, the Specialised Score, rather than because of the nature of the variable itself. To examine this, two series of coefficients of variation were calculated for each cohort, one for 1st Year Average, and the other for Specialised Score. The results are shown in Figure 5.9. Decimal figures below the bars show the correlation between the variable which each (blue or maroon) bar represents and Design Average for each cohort.

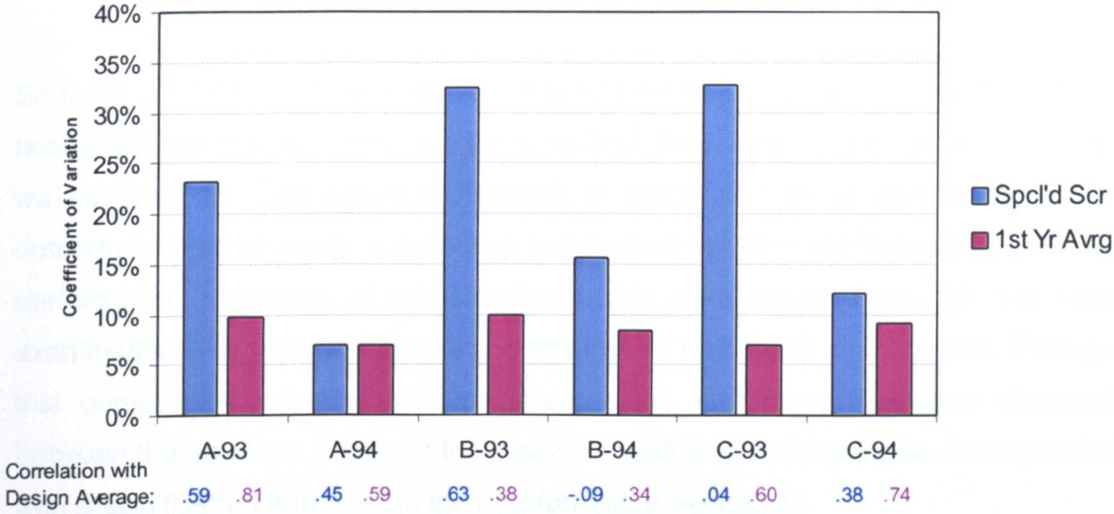

Figure 5.9. Coefficient of variation and size of correlation: Comparison of 1st Year Average and Specialised Score

As seen in the figure, despite predominantly larger coefficients of variation for Specialised Score, in five out of six cases, 1st Year Average returned larger correlations than did the other variable. This suggests that the higher correlations of 1st Year Average are indicators of its actual relevance to performance in the course.

5.3. Collective Performance Associated with the Selection Methods

So far in this chapter, the predictive ability of the whole, and component parts of the two different entrance exams has been studied. Now, from an alternative viewpoint, we compare the two selection methods in terms of their associated academic outcomes. In other words, a collective comparison will be made between a series of performance measures of the samples which were selected through the 1993 examination with the corresponding measures of their 1994 counterparts. Through this comparison we will examine whether the significant difference observed between the entrance scores of the matched 1993 and 1994 samples corresponded with a significant differences in their performance measures.

Before going to the operational questions (or the null hypotheses) of this section, four graphical examples are illustrated in Figure 5.10 to provide a more tangible grasp of the issue. The records of the A93 and A94 samples in two of the entrance (or predictor) variables, and also two of the performance variables are shown in the joint scattergraphs of the figure. The name of the variable under study is given below each scattergraph. As observed in the upper part of Figure 5.10, the overall superiority of A94's scores in the entrance examination (Total Score and Scientific Score) to those of the A93 sample is evident[10]. To a slightly lower degree, the same seems also true for one of the performance variables, namely Humanities Average. As regards the Design Average variable, however, the difference does not appear to be significant.

While such scattergraphs illustrate the extreme cases (of similarity or contrast) clearly, it is difficult to decide about the degree of difference between middling cases. In order to avoid subjective comparisons of the results and to arrive at a more objective conclusion about the existence or non-existence of differences, Mann-Whitney tests were again applied.

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[10] This superiority was shown before, in the lower part of Table 5.14.

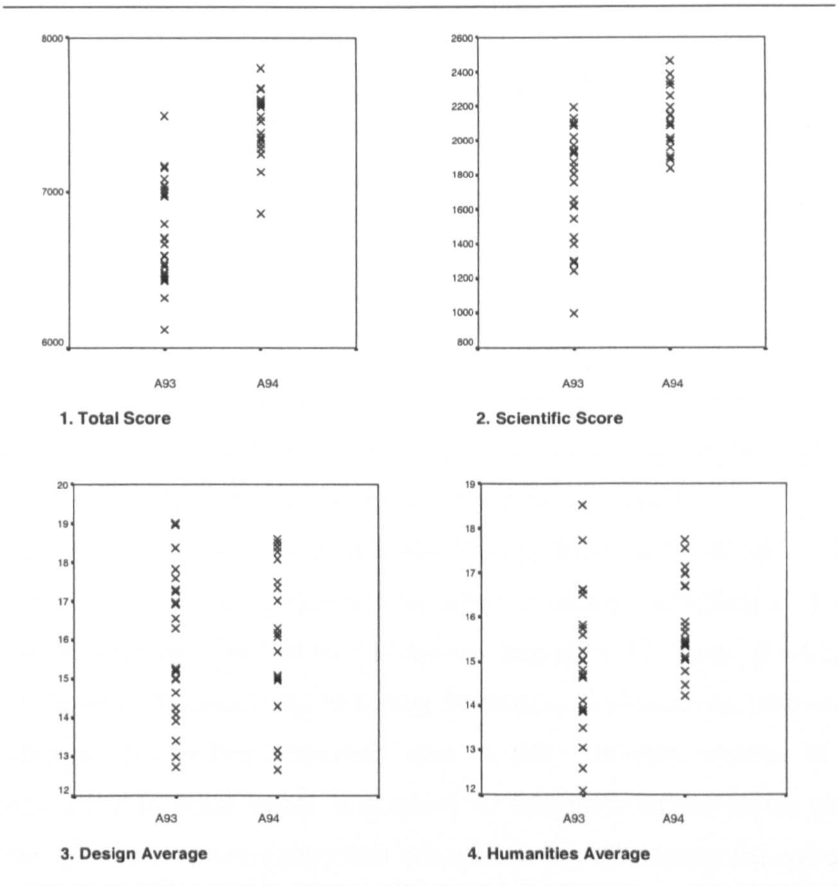

Figure 5.10.
Comparison of A93 and A94 samples at entrance and over the course.

5.3.1. Hypothesis testing

Since the 1994 selection criteria put the emphasis on mathematical and scientific qualifications, our particular interest is in the influence of this emphasis on the design-related courses. It is thought that the omission of design-related parts, and the higher importance given to physics in the second method would attract candidates of higher ability in scientific subjects, but hardly lead to a better performance in the Design area. Evidently, to establish a confident 'causal' link between the changes applied to the selection method and any rise (or fall) in the performance of the students involved needs much richer data/evidence. Our emphasis here is on the 'difference' between the differently selected groups of students in their performance in separate areas of the course.

To check this for the Design area, we assume the following null hypothesis.

- There is no difference in their Design performance between the students who were selected through the old method, and the students who were selected through the new method.

Also, a series of similar null hypotheses is assumed for performance in other areas of the course (e.g. the Technology area).

Earlier, the results of the lower part of Table 5.14 indicated that each 1993 sample had a significantly higher entrance rank than its 1994 counterpart in each of the Total Score, and Scientific Score variables (maximum p=.002).

In the same manner, a series of Mann-Whitney tests are carried out below to examine the significance of difference between matched samples in a number of performance measures. The latter measures included 4th Year Studio; the area averages of Design, Technology, Building Sciences, Calculatives, Humanities; and Overall Average. Since the observed rise in the entrance scores of the 1994 samples was likely to have either a positive or negative influence on some of the performance measures, non-directional alternative hypotheses were assumed to be able to report significant outcomes of any direction.

Table 5.24 displays the results of the paired samples in each school. Similar to Table 5.14, decimal figures in the body of the table represent the levels of statistical significance of the test results. Those levels of significance which are above five percent (i.e. p<.05) are shown in bold. The detailed 'rank' tables and 'test statistics' tables of this section are given in Appendix 5-3.

In the light of Table 5.24, the observed differences in the scattergraphs of Figure 5.10 are now easier to interpret. The table suggests that the overall differences between the A93 and A94 samples in their Humanities Average (as observed in Figure 5.10, section 4) had been significant at a .025 level; and the samples' differences in Design Average (Figure 5.10, section 3) had failed to reach a significant level (p=.541).

As shown in Table 5.24, for the 4th Year Studio, Studios Average and Design Average variables, the null hypothesis of no difference (between the pair of 1993 and 1994 samples) cannot be rejected in any of the schools.

Table 5.24. Test of difference between matched samples on performance measures
Level of significance of Mann-Whitney test
(Cases of significant difference are shown in bold)

Samples	4th Yr Studio	Studios Avrg	Dsgn avrg	Tech Avrg	Bldng Sci Avrg	Calc Avrg	Hmn Avrg	Overall Avrg
A93 and A94	.282	.280	.541	.100	.163	.065	**.025**	.104
B93 and B94	.462	.983	.913	**.027**	**.000**	.126	**.005**	.134
C93 and C94	.085	.228	.172	**.006**	**.000**	.299	**.000**	**.003**

On the 4th Year Studio variable, however, the difference between the 1993 and 1994 samples in school C is not very far from a critical level to reject the null hypotheses of no difference (p=.085; two-tailed). Table 5.24 also indicates that only in school C had the significant rise in entrance measures been associated with a significant rise in Overall average (p=.003). The only performance variable in which a significant rise was observed for all the 1994 samples was Humanities Average, the area in which manner of teaching, learning, and particularly assessment is barely different from what the students had experienced in their prior education (before entering the university schools). Building Sciences and (most likely as a consequence) Technology are the two areas which come after Humanities. For the Building Sciences and Technology significant improvements were observed for the 1994 samples from schools B and C. Concerning the Calculatives Average variable, only in school A was the 1994 sample close to showing a significantly higher collective rank (p=.065).

5.3.2. Interim summary of findings: improvement of performance

Along with the significant rise in the collective entrance rank of each 1994 sample, evidence of significant rise in one or more *non-design* performance areas of the course was found for each of the samples. However, none of the 1994 samples showed a significantly higher collective rank than their 1993 fellows in the *design-related* areas.

5.4. Secondary Findings

5.4.1. The Local Effect of Rise in Entrance Scores

Closer examination of the 1993 and 1994 samples' course performance brought a new question to mind as to how evenly the observed improvements in the 1994 samples' performance were distributed between the initially high-scorer and low-scorer portions of a sample[11]. This question arose because, in a number of boxplots and scattergraphs, it was found that along with a marked rise in the entrance scores of a 1994 sample a proportionate rise was also found in the lower limits of their performance graphs in one or more areas of the course. However, no noticeable rise was found for the upper limits of the same graphs (see Figure 5.10, section 4; Humanities Average, for example). Is it likely, then, that some of the observed improvements had been concentrated in a particular area of the sample (e.g. among the low-scorers but not the high-scorers)? And, by the same token, is it likely that a local significant improvement had been concealed because of a neighbouring local fall in the same sample?

If, together with the significant initial rises in the entrance scores, we locate cases in which a significant rise in subsequent performance is found for only the low-scorers, but not for the high-scorers, then it suggests that the rise in the minimum scores of the entrance examination to a higher level must have exerted a positive and significant effect on performance, but the rise in the maximum entrance scores has had no significant effect. This is comparable to a situation where the gradual illuminating of an initially dim desktop improves the reader's vision. However, above a certain level of illumination no further improvement occurs and excessive light is more likely to impair than improve the vision (see Appendix 5-6 for example).

To turn the objective of this section into an operational question we are interested in knowing:

- whether similar differences[12] to those observed between the paired samples (e.g. A93 and A94) also existed between the upper (or lower) *halves* of the samples (e.g. A93 High-scorers, and A94 High-scorers).

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[11] I.e. those who had scored above or below the average score of their peers in the entrance exam.

[12] That is: a significant, or non-significant difference.

To investigate the latter question the samples were first divided into two sub-samples, the members of each having scored either a higher or lower than *median* Scientific Score. For the ease of reference these sub-samples are referred to as high-scorers, and low-scorers (Figure 5.11). Earlier, it was described that we regarded our data to be in an ordinal level, and used non-parametric tools. Therefore, the upper and lower halves of the samples are those who had scored respectively above or below the median of a certain variable. In this way the extreme scores cannot influence the measure. Moreover, each sample is divided into two equal size sub-samples the size of each is still amenable to the intended statistical test.

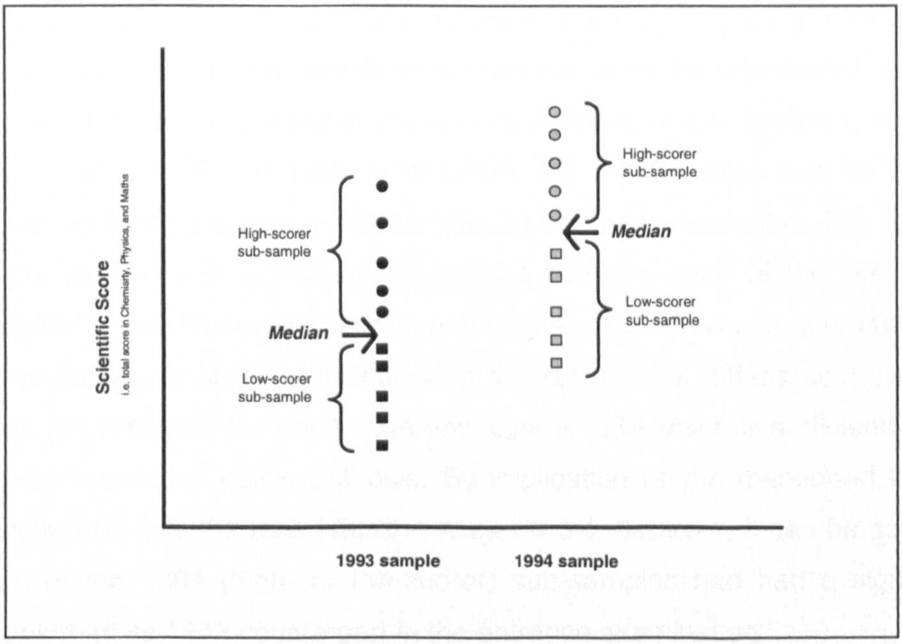

Figure 5.11. Schematic representation of the high- and low-scorer sub-samples within each school

The Scientific Score seemed to be the most appropriate variable in which the initial differences between the samples could be demonstrated and examined. First, because it is a compound variable which includes more than one sub-score in quite related areas, therefore, it is less likely to be biased or affected by chance. Second, its components were the same in the two entrance exams, and also its three sub-scores were unweighted.

Through the use of the Mann-Whitney test, the differences between each 1993 high-scorer sub-sample and its corresponding 1994 sub-sample in the same school were examined. The same was done for the low-scorer sub-samples. The variables in which the differences were studied included both *predictor* variables (namely Total score, and Scientific Score) and also the eight *performance* variables of the previous section as reflected in Table 5.24. The detailed tables of the tests of this section are given in Appendix 5-4. The appendix includes both 'ranks' tables which include the 'mean rank' of each sample on every variable under study, and also 'test statistics' tables which display the related values and levels of significance of the tests.

Earlier, the reflected results in Table 5.14 showed that within each university school, the null hypotheses of no difference between the matched pairs of the *whole* samples in the Total Score, and Scientific Score could be rejected at very high levels of significance. According to the results of Appendix 5-4, Section 1, which are reflected in Table 5.25 and Table 5.26 below, the same is also true for both the high-scorer, and also low-scorer sub-samples of the original samples. The latter fact implies the existence of significant differences between each of the two (paired) sub-samples in two important entrance variables. As shown in the tables, the majority of the levels of the significance of the results (i.e. differences) are highly significant (p=.000) and the least observed level is .033 which is sufficiently critical to reject its respective null hypothesis. By implication of the mentioned levels of significance, and also the rank tables in Appendix 5-4, Section 1, it can be concluded that each of the 1994 (high- or low-scorer) sub-samples had had a significantly higher rank than its 1993 counterpart in the entrance examination.

In the same manner, the differences between each 1993 (high- or low-scorer) sub-sample and its fellow 1994 sub-sample in eight performance variables were examined (Appendix 5-4, Section 2). Table 5.27 and Table 5.28 display the results for the high-, and low-scorer segments of the original samples separately.

Table 5.25.
Comparison of the entry scores of the matched high-scorers
Level of significance of the Mann-Whitney test

Samples	Total Score	Scientific Score
A93 and A94	**.000** A94	**.000** A94
B93 and B94	**.000** B94	**.033** B94
C93 and C94	**.000** C94	**.005** C94

The sample code below each figure indicates the sample whose 'mean rank' is larger.

Table 5.26.
Comparison of the entry scores of the matched low-scorers
Level of significance of the Mann-Whitney test

Samples	Total Score	Scientific Score
A93 and A94	**.000** A94	**.000** A94
B93 and B94	**.000** B94	**.000** B94
C93 and C94	**.000** C94	**.000** C94

The sample code below each figure indicates the sample whose 'mean rank' is larger.

Table 5.27. Test of difference between matched High Scorer sub-samples on performance measures
Level of significance of Mann-Whitney test
(Cases of significant difference are shown in bold)

Samples	4th Yr Studio	Studios Avrg	Dsgn avrg	Tech Avrg	Bldng Sci Avrg	Calc Avrg	Hmn Avrg	Overall Avrg
A93 and A94	.354	.923	.923	.688	.923	.722	.960	.923
B93 and B94	**.039***	.423	.252	**.016**	**.000**	.112	.152	.261
C93 and C94	.073	**.012**	**.013**	.175	**.000**	1.000	**.000**	**.008**

*: B93 ranking higher

Table 5.28. Test of difference between matched Low Scorer sub-samples on performance measures
Level of significance of Mann-Whitney test
(Cases of significant difference are shown in bold)

Samples	4th Yr Studio	Studios Avrg	Dsgn avrg	Tech Avrg	Bldng Sci Avrg	Calc Avrg	Hmn Avrg	Overall Avrg
A93 and A94	.432	.148	.464	**.001**	**.012**	**.004**	**.002**	**.012**
B93 and B94	.325	.500	.327	.588	**.003**	.587	**.021**	.395
C93 and C94	.325	.931	.796	**.018**	**.000**	.183	**.001**	.209

To facilitate the interpretation of the tables and to provide an easier grasp of the results, six sets of boxplots[13] are presented below to accompany the corresponding rows of the two preceding tables. (Figure 5.12 to Figure 5.17). Each set of boxplots includes four graphs and deals with two similar (high, or low) sub-samples from the same school. The upper (simple) boxplot, as a graphical supplement to Table 5.25 or Table 5.26, illustrates the position of the matched sub-samples on the corresponding Scientific Score variables, and the lower (cluster) boxplots, as graphical supplements to Table 5.27 or Table 5.28, display the position of the same sub-samples on the performance variables. The boxes (and whiskers) of the *performance* variables (not the Scientific Score variable) in which a significant

[13] A boxplot is a graphical presentation of the dispersion of a sample in a variable. The box represents the inter-quartile range (from lower quartile to upper quartile, where the middle 50% of the values locate) and often includes a median line. Whiskers extend to the minimum and maximum values.

difference was identified between the 1993 and 1994 sub-samples, are shown in bold. It should be noted that for the comparison of the samples' performance in the cluster boxplots, the boxes of the same colour should be compared with each other. The larger the (vertical) gap between two similar (inter-quartile) boxes, the more the likelihood of a significant difference between them.

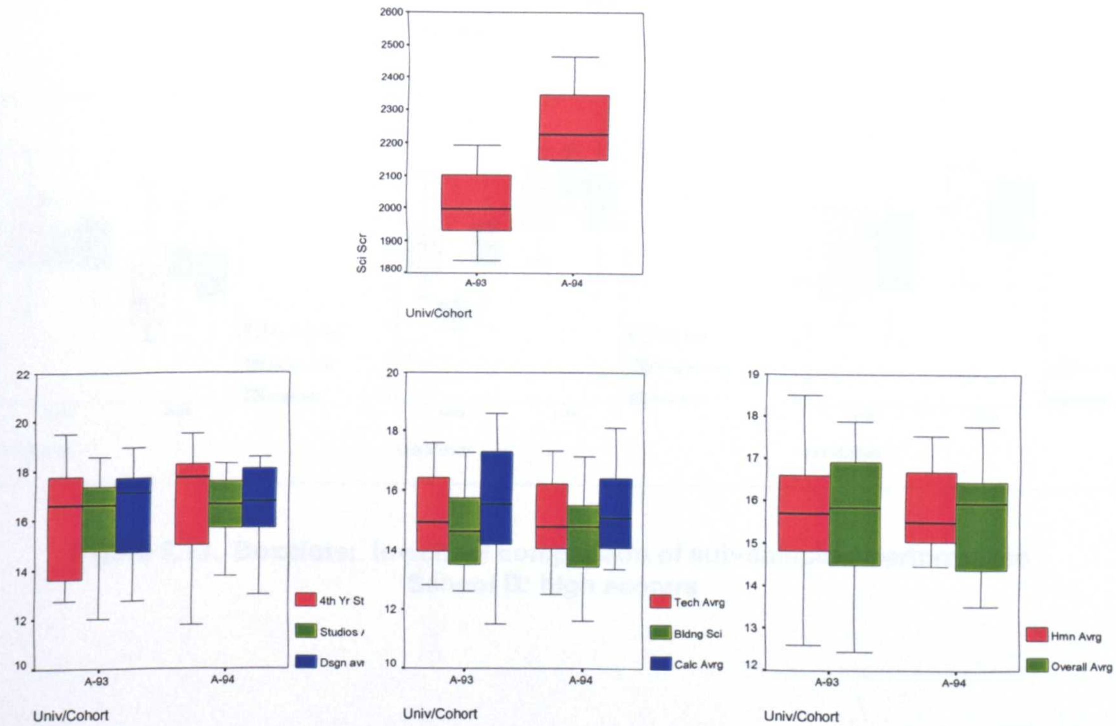

Figure 5.12. Boxplots: in-school comparison of sub-samples' performance School A: high scorers

The first row of Table 5.27 and the boxplots of Figure 5.12 show that, despite significant initial differences between the high-scorers of A93 and A94, no significant difference can be found in any of their studied performance variables. While in scientific areas, the high-scorers of A93 enjoyed a slightly better status, and in other areas the A94 high-scorers appeared to perform a little better, all such differences remained far from a significant level. This implies that, in school A, the significant rise in entrance qualifications has not been able to contribute towards any significant improvement in the 1994 sub-sample's performance.

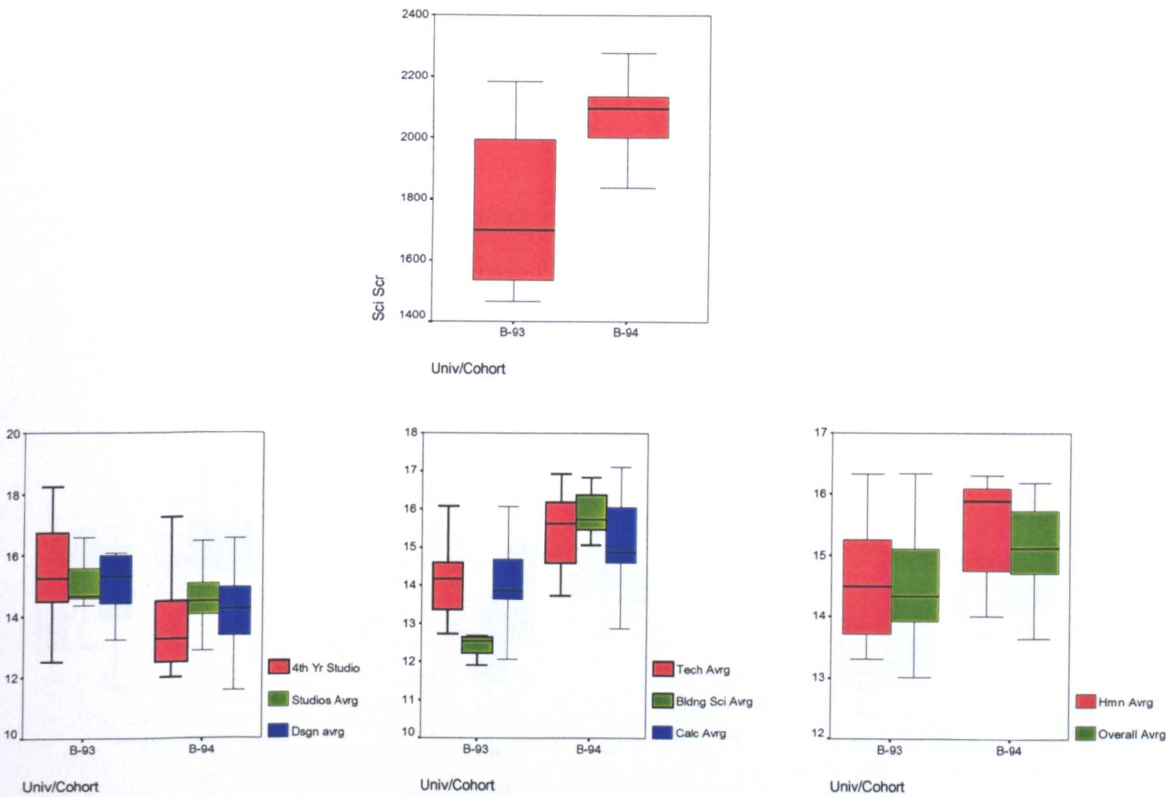

Figure 5.13. Boxplots: in-school comparison of sub-samples' performance School B: high scorers

Likewise, the second row of Table 5.27 and the boxplots of Figure 5.13 show the differences between the high-scorer sub-samples in school B. As shown in the table and figure, for the 1994 high-scorers in school B, only in the performance areas of Technology and Building Sciences was a significant rise associated with the initial significant rise in entrance scores. All the differences in the areas of Calculatives, Humanities, and Overall Average fell short of returning a significant difference. In design-related areas, the 1994 high-scorers in school B had performed slightly poorer than their 1993 fellows; and the fall in their performance in 4th Year Studio, however, reached a significant level.

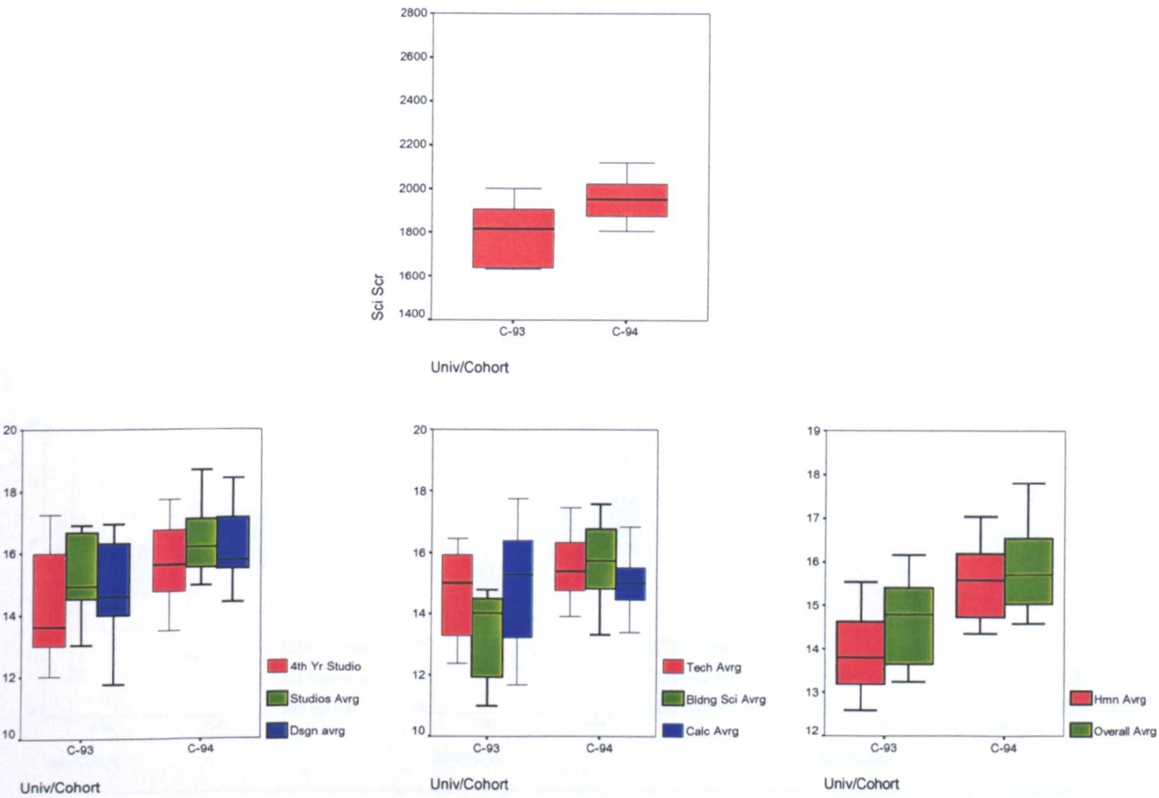

Figure 5.14. Boxplots: in-school comparison of sub-samples' performance School C: high scorers

The corresponding results of high-scorers in school C can be observed jointly in the third row of Table 5.27 and Figure 5.14. In the Calculatives area, virtually no difference can be identified between the 1993 and 1994 high-scorers in school C, and the differences in the Technology area, and 4th Year Studio do not reach a significant level. However, for the 1994 high-scorers in school C, a significant rise is observed in all other variables including, contrary to other schools, Studios Average and Design Average.

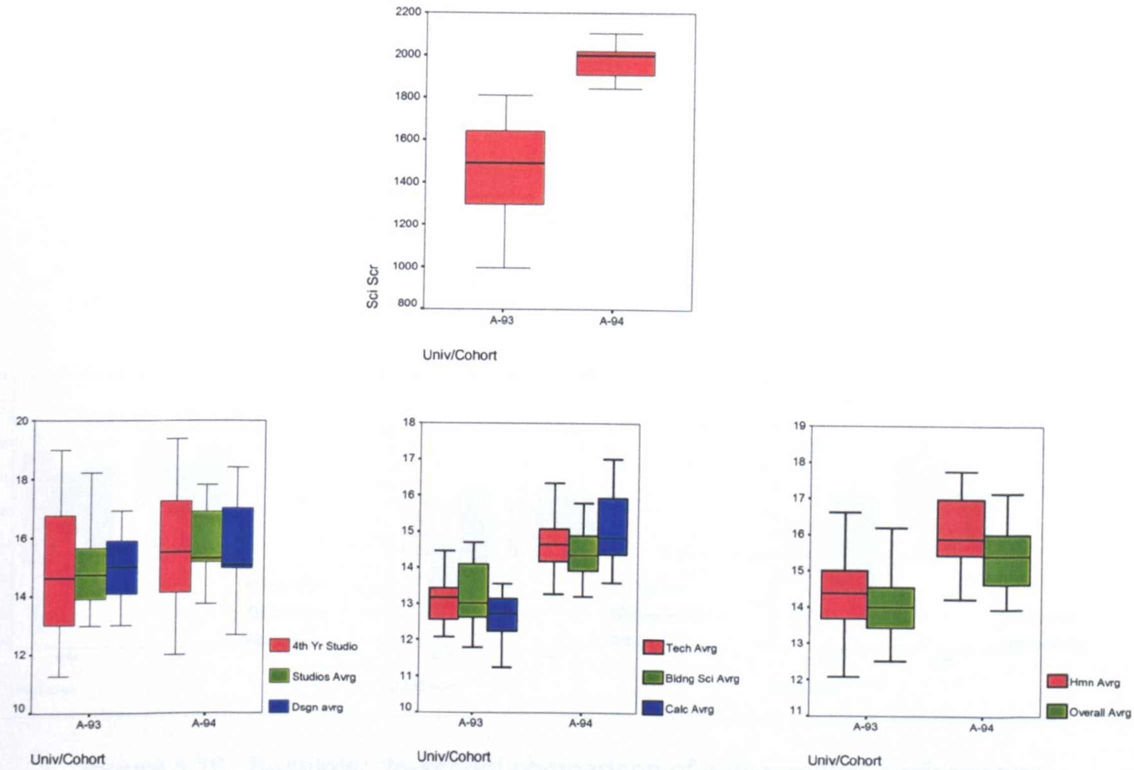

Figure 5.15. Boxplots: in-school comparison of sub-samples' performance School A: low scorers

Similar results for the low-scorer sub-samples are given in Table 5.28 in conjunction with Figure 5.15, Figure 5.16, and Figure 5.17. The first row of the table and also Figure 5.15 show that along with the significant rise in entrance scores of the 1994 low-scorers in school A, evidence of significant rise is observable for all their performance areas except for the design-related areas.

Table 5.28 and Figure 5.16 show that the initial significant differences between the low-scorer sub-samples in school B had been associated with significant rise in only the Building Sciences and Humanities areas. Similar to the case of school A, no significant rise was found in the design-related areas.

Finally, Table 5.28 along with Figure 5.17 indicate that, the 1994 low-scorers in school C had performed significantly higher than their 1993 fellows only in the areas of Technology, Building Sciences, and Humanities. Similar to what was found in the two other schools, despite the significant rise in the entrance scores of the 1994 low-scorers, no significant rise was found in their design-related performances.

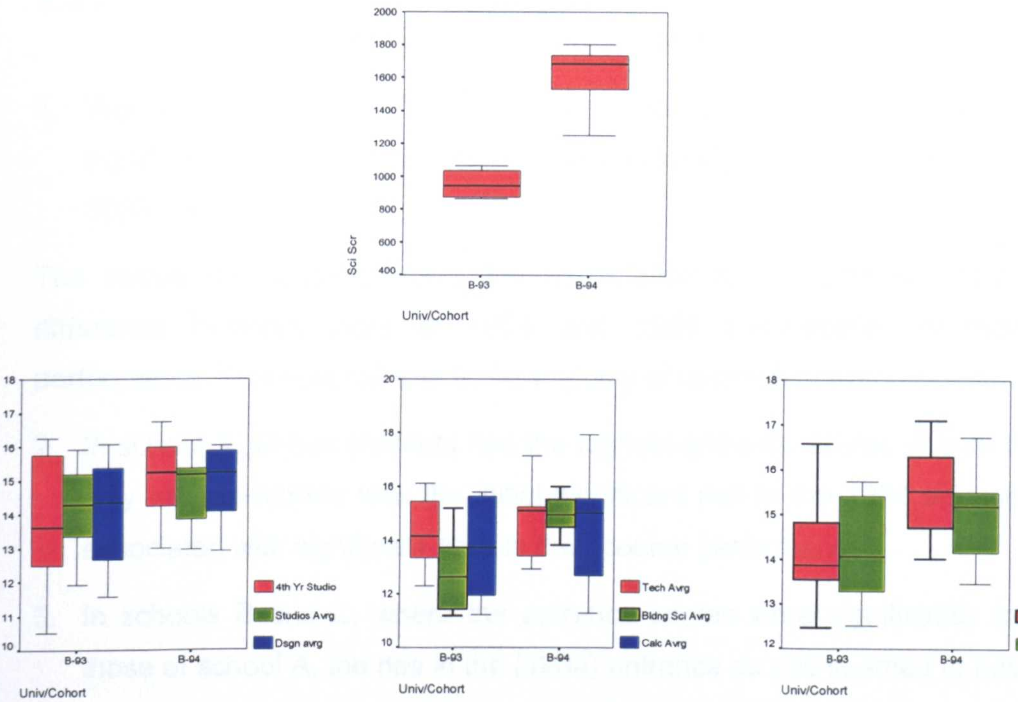

Figure 5.16. Boxplots: in-school comparison of sub-samples' performance School B: low scorers

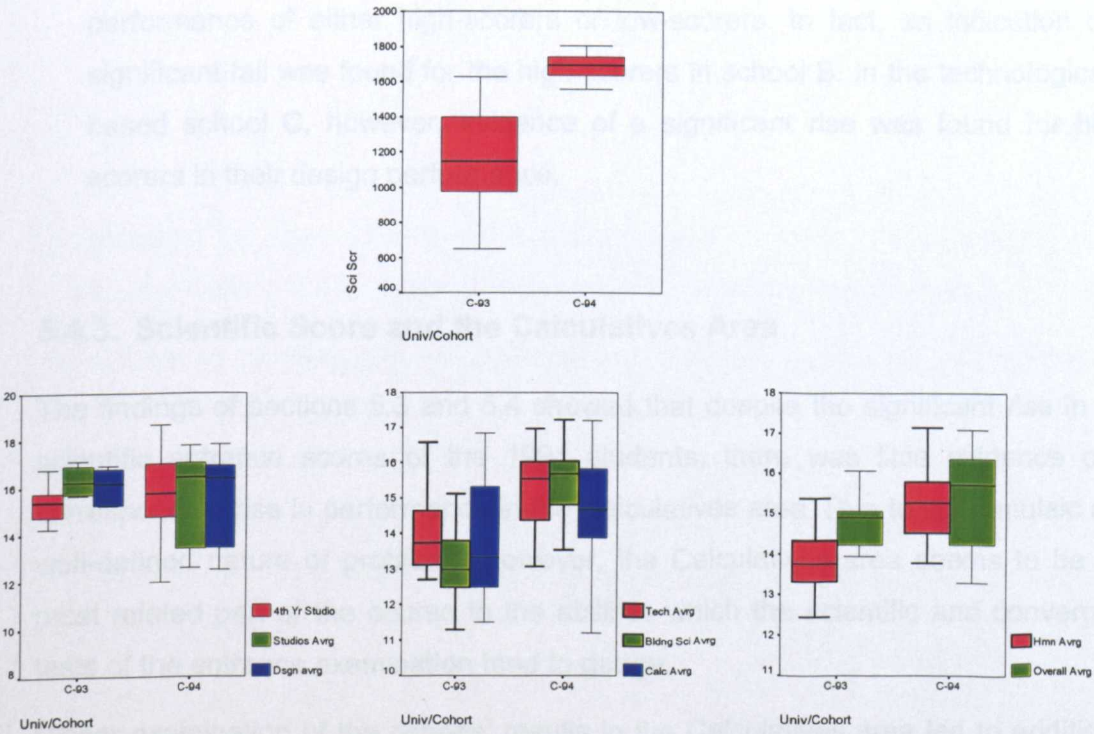

Figure 5.17. Boxplots: in-school comparison of sub-samples' performance School C: low scorers

5.4.2. Interim summary of findings: local effects of rise in entrance scores

1. We saw that each of the 1994 high-scorer or low-scorer sub-samples had a significantly higher rank in its entrance scores compared to its corresponding 1993 sub-sample.

The above fact brought about the expectation of a corresponding pattern of difference between pairs of 1993 and 1994 sub-samples in their course performance. This was not true in the majority of cases, however.

2. In school A, whose students had the highest entrance scores in both the years, only for low-scorers was the initial significant rise in the 1994 entrance scores associated with significant rises in their course performance.
3. In schools B and C, where the entrance scores were significantly lower than those of school A, the rise in the (1994) entrance scores seemed to have helped both the high-scorers and low-scorers in some areas of performance such as Building Sciences.
4. In schools A and B (based in comprehensive universities) the rise in the entrance scores was not associated with a positive significant rise in the design performance of either high-scorers or low-scorers. In fact, an indication of a significant fall was found for the high-scorers in school B. In the technologically-based school C, however, evidence of a significant rise was found for high-scorers in their design performance.

5.4.3. Scientific Score and the Calculatives Area

The findings of sections 5.3 and 5.4 showed that despite the significant rise in the scientific entrance scores of the 1994 students, there was little evidence of a corresponding rise in performance in the Calculatives area. Due to its formulaic and well-defined nature of problems, however, the Calculatives area seems to be the most related part of the course to the abilities which the scientific and convergent tests of the entrance examination tend to gauge.

Closer examination of the cohorts' results in the Calculatives area led to additional findings which seem worthy of mention here. It was found that, compared to the 1993 students, a smaller percentage of the 1994 students failed in the subjects of the Calculatives area; on the other hand, the latter students had higher entrance scores than those 1993 students who did not fail. More details are given below.

The comparison of the failure cases showed that there was a significant difference between the 1993 and 1994 students across all schools. The following table compares the students who completed all the course subjects of the Calculatives area without any failure (Pass group) against the students who had to resit one or more course subjects to complete the area (Fail group). While 43 per cent of the 1993 students fell in the 'Fail' group, only 24 per cent of the 1994 students did so (Table 5.29). The difference is statistically significant above a five per cent level.

Table 5.29

Entrance year * Calculatives Pass/Fail Crosstabulation

			Calcs Pass/Fail		
			Pass	Fail	Total
Entrance year	1993	Count	35	26	61
		% within Entrance year	57.4%	42.6%	100.0%
	1994	Count	57	18	75
		% within Entrance year	76.0%	24.0%	100.0%
Total		Count	92	44	136
		% within Entrance year	67.6%	32.4%	100.0%

$\chi^2 = 5.33$; df = 1; p = .021

The following bar chart compares the median Scientific Score of the student groups which are shown in the table above. Groups are divided by entrance year.

The difference between the 1993 'Pass' and 'Fail' groups in their entry Scientific Score is highly significant (p=.01), but the corresponding difference between the two 1994 groups is far from a significant level (p=.82) (Appendix 5-5, Section 1).

As seen in Figure 5.18, the median Scientific Score of those 1994 students who had fail(s) in the area is noticeably higher than that of each 1993 group (those who had fails, or those who did not).

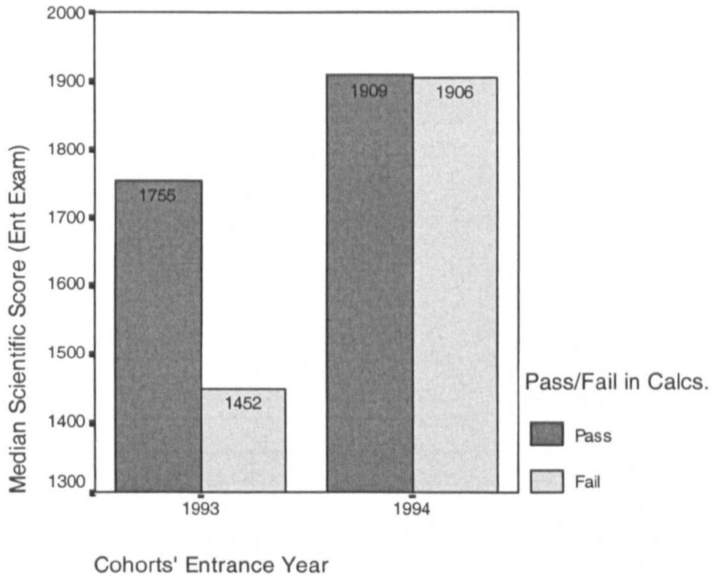

Figure 5.18.
Median Scientific Score by performance in the Calculatives area across university schools

Pass: students who completed the area without any cases of failure.
Fail: students who completed the area after resitting one or more subjects.

According to a Mann-Whitney U test, the difference between the 1994 'Fail' group and the 1993 'Pass' group was above a five percent level of significance (p=.026, two-tailed; p=.013, one-tailed), suggesting that, collectively, the 1994 'Fail' group was stronger than the 1993 'Pass' group in Scientific Score at entrance (Appendix 5-5, Section 1).

In order to avoid the possible distortion that the pooling of data from three schools may have caused, a similar study was carried out for the most competitive school, i.e. school A.

As shown in Figure 5.19, while the difference between the A93 'Pass' and A93 'Fail' groups in their Scientific Scores is very clear (p=.001), this is not the case for the two A94 groups (p=.32) (Appendix 5-5, Section 2). The A94 'Fail' group scored even slightly higher than the A94 'Pass' in the Scientific Score.

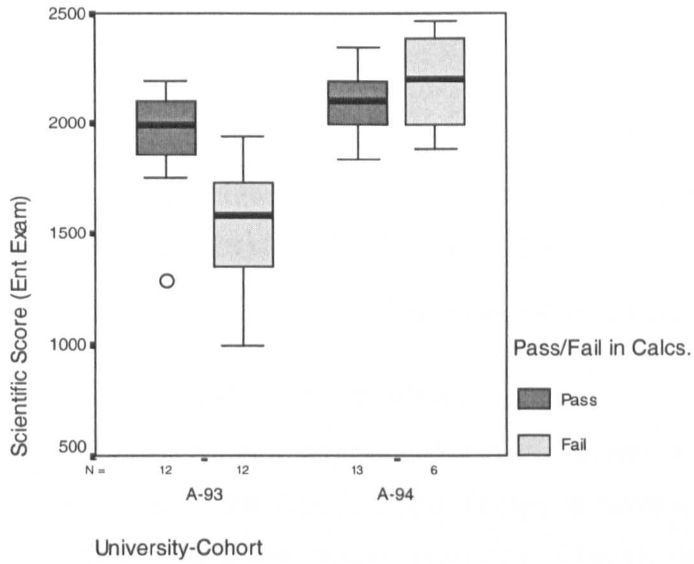

Figure 5.19.
Median Scientific Score by performance in the Calculatives area in university school 'A'

Pass: students who completed the area without any cases of failure.
Fail: students who completed the area after resitting one or more subjects.

Despite the small size of these sub-samples, the difference between the A93 'Pass', and A94 'Fail' groups in their entrance Scientific Scores just failed to reach a significant level, by two-tailed testing (p=.05). However, as the figure suggests, it is justifiable to adopt a one-tailed test in which case a Mann-Whitney U test returns a p=.025 level of significance (Appendix 5-5, Section 2).

The findings above suggest that, along with the new (1994) student selection method, failure in the Calculatives area decreased. However, the difference in the entrance Scientific Scores, which clearly existed among the 1993 students who passed the area directly, and those who had to resit, faded away for the 1994 students. In other words, fewer of the latter students failed, but those who did had had much higher entrance scores. This suggests that some non-academic reasons must be responsible for these cases of failure.

5.5. Summary and Conclusion

In this section, first, a summary of the findings of the chapter is presented, and then a conclusion is drawn of the points suggest by the findings.

The main findings of the survey can be classified under the following topics.

The results of the 'predictive ability' investigations

1. In two of the schools, which were contextually similar and located in comprehensive universities, the (1993) design-inclusive entrance examination showed a far better predictive ability than the (1994) design-exclusive examination which showed poor predictions. In the third school which was located in a technological university both entrance exams returned very poor predictions, and no particular superiority could be found for one of the exams over another.
2. In terms of predictive ability, only one of the two stages of the exams, namely the Specialised Examination, appeared to be sufficient for the purpose of student selection, because it returned comparable or even better correlations with performance measures than those returned by the entirety of the exams.
    2.1. The 1994 Specialised Examination (which consisted of only maths and sciences sub-exams) appeared to be the best predictor in the technologically-based school, returning a number of significant and rather consistent results. The same predictor showed poor results (but generally comparable to those of the entire 1994 examination) in the two other schools.
    2.2. The 1993 Specialised Examination (which included design related tasks) showed the best predictions in the comprehensive schools.

The above findings suggest that the technologically-based school is more responsive to the scientifically-oriented examination, and other schools are more in tune with the design-inclusive examination. This finding should be treated with caution at the moment because our samples were limited to only two subsequent entrance years. If corresponding results of samples from adjacent entrance years to those of our samples (e.g. 1992 and 1995) show similar patterns of prediction, then the observed differences call into serious question the use of an identical entrance examination for different schools.

The entire entrance examination score or the score of only the specialised part of it showed better relationships with the performance measures than those of the individual scientific sub-exams. Even for the scientific areas of performance, in almost all cases, no individual scientific sub-exam, on its own, proved a better predictor than the entire or specialised part of the entrance exams. The 1994 sub-exams of Chemistry, Physics, and also Maths showed especially poor relationships to performance measures.

Among the individual sub-exam scores, only the Drawing Tasks of the 1993 examination showed a comparable or better predictive ability (for design related performance) than those of the whole or specialised part of the examination.

'First Year Average' showed the most consistent and strongest relationships with the measures of subsequent performance.

The results of the 'collective performance' comparison

1. The overall entrance rankings of the students who were selected through the 1994 entrance examination were significantly higher than those of their 1993 peers.
2. Isolated evidence was found of a corresponding rise (to the above) in the performance of the 1994 students in non-design areas of the course.
3. No significant rise was observed in the design performance of the 1994 students compared with that of their 1993 peers.

Secondary findings

1. Closer examination of the entrance and performance results showed that the rise in the performance of the 1994 students was neither evenly distributed within the samples, nor was it similar among the schools.

When each sample is divided (according to the Scientific Score in the entrance examination) into two high-scorer and low-scorer sub-samples of the same size, a significant rise is observed in each of the 1994 sub-sample's entrance ranking (as compared to that of its 1993 peer). However, different performance outcomes were associated with the initial rises.

1.1. In the school whose students normally had the *highest* entrance scores no evidence was found of a significant rise in performance for high-scorers. Only for low-scorers was there evidence of significant improvement in performance.

1.2. In the comprehensive schools no evidence was found of a significant rise in design related areas. This was true for both high- and low-scorers. In fact, evidence was found of a significant fall in the design performance of high-scorers in one of the schools.

1.3. Only in the technologically-based school was evidence observed of a significant rise in design performance, and this was limited to the high-scorers.

2. The rise in the (1994) Scientific Scores (at entrance) was associated with a decrease in the rate of failure in the Calculatives area. However, contrary to the case of the 1993 students, no difference was found between the entry Scores of the students who performed successfully, or unsuccessfully in the area. In other words, it was possible to fail in the area with a remarkably high entrance score.

Conclusion

As regards the preference of one of the selection methods over another, identical conclusions cannot be drawn for all the schools. Our findings provide sufficient evidence to question the suitability of any of the student selection methods for all the schools, and suggest the necessity of individual selection procedures.

On the whole, the findings suggest that the first method had a better predictive ability, while the second method was associated with better collective performance. It should be noted, however, the latter superiority failed to include the Design area.

The above findings also suggest that the Specialised part of the entire Entrance Exams, on its own, would satisfy the same predictive purposes that the entire exams do. If we were to select students only on the basis of Specialised part, however, the first method of selection would be advisable for comprehensive schools, and the second method for the technological school.

Drawing on a series of academic data, the consequences of the application of two selection methods were examined in this chapter. Evidence was found earlier for the existence of non-academic factors which might influence students' performance. What follows in the next chapter is a survey to see whether non-academic differences existed among the entrants of the two system, and if so, whether these differences had academic implications.

CHAPTER 6

Survey of Non-Academic Differences

Chapter 6

Survey of Non-Academic Differences

Introduction and Aim:

In the previous chapter two methods of student selection were examined focusing on the relationship between entry qualifications and academic performance of the students. In this chapter, the focus of study is on non-academic characteristics. It was felt that there was a need for a survey of non-academic characteristics due to the reasons given below.

- Design area forms the core of our programme of architectural education (see Chapter 4).
- Design activity is commonly regarded as creative or ill-defined problem solving. Designing relies on non-verbal (visio-spatial) intelligence (Cross 1982, 1995) in addition to mathematical, and linguistic intelligence. Conventional school leaving examinations, and university entrance tests usually take account of the latter kinds of intelligence and tend to ignore the former.
- We saw that the secondary education which our students had experienced predominantly dealt with well-defined problems or rote learning circumstances, and promoted the abilities required to solve these kinds of problems. Therefore, qualifications in those areas do not necessarily represent students' abilities in ill-defined problem solving situations (see Chapter 4).
- We saw that the significant rise in the scientific entrance scores was not necessarily associated with a corresponding rise in students' performance (especially in the design area). Also, toghether with the rise in entrance scores, the relationship between 'Total Score' and course performance declined.
- At the same time, there are indications that non-academic factors (such as motivation, interest, spatial ability, etc) can influence the academic performance of students (Amabile, 1983, 1996; Schiefele et al 1992; Stringer, 1971; Clausen-May 1998).

Was it likely then, that, between the groups of differently selected students, there existed some sorts of non-academic differences which could have meaningful bearing on their academic performance?

In this chapter, we assume that, irrespective of the method of selection, previous academic results (secondary school and entrance exam) are adequately related to the students' performance in the scientific and humanities areas of the course. The focus of this chapter is mainly on the abilities connected to performance in the design area.

It was decided, therefore, to investigate two inter-related questions in this chapter.

- Whether (apart from the academic factors) any non-academic factors were identifiable which showed a relationship with the academic performance of the students, especially in the Design area.
- Whether differently selected cohorts were also different in their non-academic attributes.

In order to collect the necessary information about students' backgrounds, a questionnaire was designed. A translation of the questionnaire is given in Appendix 6-1.

In the following, first, the method of data collection and analysis is described. The results of the survey are reported in the second section, and the primary and secondary findings of the survey are presented in the third section.
It will be shown that non-academic differences existed between the two groups. Moreover, some of the non-academic variables showed noticeable relationships to the subsequent performance of students.

6.1. Method

6.1.1. Design of the questionnaire

Before the introduction of the questionnaire, it should be mentioned that the designed questionnaire is not claimed to be a specialised tool. It is evident that the design, and especially validation of a reliable tool of this kind may fall well beyond the boundaries of PhD research. Our questionnaire, however, was a preliminary attempt to explore and hopefully discover some of the differentiating characteristics.

It is also opportune to make the point here that our survey was literally the second in its kind, in a context where no established tool exists. Three of our questions (no. 7, 14, and 15 in Appendix 6.1; page 368) were modified adoptions from the questions of the previous survey carried out by Nadimi (1996). A brief comparison of the findings of the first survey and our survey will come at the end of this chapter.

For the design of the questionnaire, we needed, firstly, to find a number of basic factors which would indicate a candidate's aptitude for, or his/her willingness to get involved in architectural (or similar) design problems. In the search for such factors, two sources were used. The first source was the present author's 'own hunches[1]', which were formed over his academic career of tutoring students of architecture; and the second was his background study of the literature on 'design' and 'creativity' during the course of this research. The first source helped to produce a (tentative) short list of the factors which according to the present author's educational observations seemed to be influential in developing design abilities, and the second source contributed to the verification, or rectification of the list of the potential factors.

Extensive research on design thinking has been carried out. Individual pieces of research have disclosed only small parts of a highly complicated and elusive phenomenon. Despite the fact that some studies have investigated the differences between the expert and inexperienced designers, still little is known objectively about the factors that can indicate an individual's suitability for certain design fields. Under the same educational circumstances, do candidates develop their design skills equally?

As Lawson (1997, pvii) emphasises 'we all can do design' and 'we can learn to design'; and design 'is not a mystical ability given only to those with recondite powers'. Further, he continues that design is 'a skill which for many, must be learnt and practised, rather like the playing of a sport or a musical instrument' (p11). Does this imply that gaining expertise in design is only a matter of practice?

In his introduction to 'The Nature of Expertise', Posner (1988) draws on empirical evidence to show that despite the emphasis of some studies on the reduction of the subject of expertise to practice there is sufficient reason to suggest that individuals

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[1] The third class of sources as suggested by de Vaus (1996).

may differ in gaining expertise due to their particular (innate) abilities. As regards the matter of producing an expert, however, he argues that creation and maintenance of the motivation needed for continual training may be equally or more important than the innate abilities.

In an interview with Professor Lawson (in April 1999), the present author put the question as to whether any possible individual differences existed that could influence their learning of design skills. He replied that there are some 'predispositions' which can make an individual more prepared than another for learning the skills which a particular discipline requires.

Altogether, diverse characteristics/attributes have been enumerated for designers in the related literature. The most frequent examples of these include: high spatial sense; interest in the concrete; flexibility of thought; wide range of interests; tolerance of ambiguity and uncertainty; perceptive and intuitive cognitive preferences; etc. (Lawson, 1978, 1984, 1997; Cross, 1982, 1995; Tovey, 1984; Durling, 1998).

It was thought that the literature on creativity was a promising source which could contribute to the design of our questionnaire, because design is commonly viewed as a creative act.

Lawson (1997, p148) says that from most people's point of view design is 'the most creative of human pursuits'. He further states that 'no book on thinking processes involved in design could be complete without some examination of the fundamentals of creativity and creative thought'.

Some evidence of creative thinking ability is usually one of the requirements of gaining admission to design-related courses. In their survey of admission policies in British schools of architecture, Gartshore and Mayfield (1988) had asked the admissions tutors to select, from a list of 11 personal attributes, the three which they considered most important in a successful candidate. It emerged that out of 26 respondents, 22 had mentioned creativity (the most favoured attribute), followed by 20 instance of self-motivation. The other attributes were significantly less frequent.

Similarly, creativity was a recurrent response given by a sample of architecture scholars to one of Nadimi's (1996, p50) open-ended questions about the 'major attributes of architectural education'.

We also saw, in Chapter 4, that the curriculum and syllabus document of Iranian architectural education regards architectural design as a creative act.

Most importantly, if we agree with researchers such as Amabile (1996) that there is a 'continuum of creativity'[2], and that creativity is not a dichotomous variable, then design thinking (because of the nature of its problems and processes involved[3]) corresponds well with creative thinking.

The terms 'creative' and 'creativity' convey a wide range of meanings and connotations. They may range from unique and historic instances of original ideas to daily life innovations. Studies on creativity are usually classified under three topics of creative 'person', 'process', or 'product'.

There is also another classification which divides the subject into two areas of 'historical creativity' and 'psychological creativity'. The former refers to the emergence of an original idea which *no one* had ever had it before; and the latter concerns the cases in which the *person involved* could not have had the idea before (see Boden, 1990, Chapter 3). Dasgupta (1994) furthers Boden's classification by dividing each of the two previous categories into two sub-categories in terms of 'originality' or 'novelty' of the idea. While the focus of the historical creativity studies falls on geniuses such as Einstein and Picasso, that of psychological creativity involves daily cases in schools, offices, etc (Perkins, 1982; Weisberg, 1993; Sternberg and Lubart 1993). Reviewing various definitions of creativity, given by previous researchers, Amabile (1996, p35) proposes that a product or response is creative to the extent that '(a) it is both a novel and appropriate, useful, correct or valuable response to the task at hand, and (b) the task is heuristic rather than algorithmic.' These stipulations are true for most design problem solving examples.

One of the recent trends in creativity studies concerns the 'where' of creativity (as opposed to the triple areas of person, process, and product). In other words, the circumstances which are supportive of the conception of creative ideas have come to the forefront (e.g. Csikszentmihalyi, 1988b; Feldman, 1994; Amabile, 1996). This

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[2] Amabile (1996, p38) extents this continuum to include 'from the lowest "garden variety" levels where ordinary individuals are doing everyday things in appropriate ways that are somewhat novel, to the highest levels of creativity where geniuses are producing notable work that transforms fields and even societies.'

[3] These are reflected well in the works of, for example, Rittel and Webber, 1974; Akin, 1986; Rowe, 1987; Cross, 1996; and Lawson, 1997.

trend, which takes social/environmental circumstances into account, emphasises that, apart from cognitive factors, intrinsic motivation, familiarity with the field, and supportive environment are influential factors for the emergence of creative ideas.

From amongst the various implications of the design and creativity sources, the following items were selected to form the basis of our questions. These were the items that, considering the limitations of our study, appeared the most suitable to being turned into questions without the need for a special expert tool. In total, six types of information were sought. Brief descriptions of their bases are as follows.

- Despite the fact that the main focus of the questionnaire was on non-academic factors, it was decided to take the opportunity to collect some missing academic data which could shed light on our investigation. The first group of questions (numbers 1 to 5) concerned the sort of student academic background not necessarily reflected in the official data collected from the schools or the National Organisation for Academic Assessment. For instance the second question asked whether students had taken (an informal architectural or other) coaching course before the entrance examination – a piece of information not reflected in any academic record.

- Questions six through eight were intended to gauge the extent of the students' previous knowledge of the course. It was thought that the better a candidate's prior familiarity with the course, the more realistic his/her understanding of it would be, and, therefore, the more reasonable his/her evaluation of the correspondence between his/her abilities and interests with what the course requires.

An attempt was made, through question seven, to investigate the ways of getting acquaintance with the course, and thus to evaluate the richness of such instances of familiarity. The eighth question sought the students' personal views about the degree of agreement between their prior perception/conceptualisation of the course with what they actually experienced later.

- Except for poor examples, architectural design inevitably involves both semantic and physical aspects. Therefore, 'metaphoric appreciation[4]' can be regarded as a

[4] Proposing a 'material culture' in which designers are immersed, Cross (1982, p225) argues that a significant branch of 'designerly knowing' 'is the knowledge that resides in objects'. Borrowing the term 'metaphoric appreciation' from Douglas and Isherwood (1979), he goes on to say that metaphoric appreciation 'is an apt name for what it is that designers are particularly skilled in, in "reading" the world of goods, in translating back from concrete objects to abstract requirements'.

requisite for the accomplishment of the design[5]. Since all artistic fields deal, to a higher or lesser degree, with languages of signs, symbols, similes or the like, it is conceivable that interest (and especially involvement) in artistic matters testifies to the relative fulfilment of the requisite, i.e. one or another kind of metaphoric, symbolic, or analogical appreciation. In a workable search for such evidence, question nine was intended to check whether a student's familial background showed interest in any artistic field/matter; and question ten looked for the instances of real participation in such matters by the student or his/her family.

- In both the literature on creativity, and literature on learning a pronounced emphasis is put on the individual's motivation for the subject/field, and also the maintenance of the motive, either by educators or the person (e.g. Biehler and Snowman, 1993; Paris and Turner, 1994; Weisberg, 1993) . In particular, intrinsic motivation, as an on-going drive, is an indication of the individual's interest in and the value she/he puts on the attended subject. Questions 11 to 14 were devised to test the students' motivation to study the course.

- In the subsequent group, question 15 dealt with the student's innermost interests and skills in the past (before starting the course). In fact, an attempt was made to find out how visio-spacial, non-visio-spacial but artistic, or neither of the two the students' interests and skills were. Question 16, to borrow one of the Bartlett study's expressions, looked for the traces and the extent of 'tactile' or handicraft involvement by the students in the past[6].

- Previous questions were intended to divide and approach the problem from the researcher's viewpoint which was informed mutually by the reviewed literature and his observations during his teaching/tutoring of students of architecture. Those

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Also, Gruber and Davis (1988, pp254-5) highlighted the role of metaphor in the conception of a creative idea. They enumerated various possible roles a metaphor can take. These included serving as: (1) a 'modality of thought'; (2) a synthesising link between disparate domains; (3) an analytic tool to break up a complex idea into components; and (4) an expressive media for the purpose of emphasis or a better communication. Moreover, they proposed that metaphors (5) help to concretise abstract ideas; and (6) illuminate the abstract idea which links a group of separate concrete experiences.

[5] See, for example, what Lawson (1994) reports in *Design in mind* about MacCormac's account of the designing of the Fitzwilliam College chapel where the congregation space of the chapel was seen as a free floating vessel or a 'ship'. Such broad but principal notions not only give the building its unique characteristic but also direct the selection of the constituents and the manner of their integration.

[6] According to the Bartlett study (reviewed in Chapter 2), 260 candidates who had met the initial admission requirements had been significantly different from the general population of students in more than half of the 32 scales of the DPI psychological test. The largest difference had been on the 'tactile and handicraft interests' scale. Also, in his experiment on students of architecture and students of science Lawson (1997) found that students of architecture showed interest in the concrete, as opposed to science students who were interested in the abstract.

questions, however, limited the respondents to state factual information narrating their background but did not leave room for them to express their views about the issue. The last group of questions, including three open-ended questions, provided room for the students to reflect their views about the entrance examinations and student selection. Such views could have been formed by either or both of their personal, and vicarious educational experiences they experienced in the university schools.

6.1.2. Rectification

The questionnaire was checked with three architectural academics. Also, a pilot survey was conducted with the co-operation of twelve third year students mainly to see whether the wording was clear enough, and if they could follow and respond to the intended aspects. Proper amendments to the initial version were applied through the integration of some response options, and two initially separate questions.

6.1.3. Implementation

- In co-ordination with the Head of each school/department, an invitation letter was given to each concerned student to attend the questionnaire survey session. The letter bore some general information about the research and was signed jointly by the respective school/department Head and the author.

- The timing of each school's session was so planned that it did not demand any extra (irregular) presence in the school. Proper co-ordinations were made with the year design tutors to conduct the session in conjunction with one of the studio briefings which all the students were in principle supposed to attend.

- The author attended all three schools in person to explain briefly to the students about the survey and the significance of their participation. Being seen by the participating students and talking to them prepared the ground for a better rapport which attracted their co-operation and also made it possible to clarify any trivial misinterpretations. However, some students did not show willingness to come forward in the first place; and obviously, no justifiable obligation existed to make the subjects take part in a such survey. As shown in Table 6.1, 34 percent of the students (n=101) responded to the questionnaire (universities A, B, and C: 51, 26, and 23 per cent respectively).

Table 6.1. Size of the Entire cohorts, and samples in each school.

University	Entire students		Respondents	
	Entrance year		Entrance year	
	93	94	93	94
A	65	42	22	33
B	40	48	11	12
C	40	60	5	18
Sub-total	145	150	38	63
Total	**295**		**101**	

The rate of participation and response appeared to be a factor of implicit affinity the students felt with the author or his base school. Due to the initially small attendance of the concerned students in one of the schools, an extra session (without the presence of the researcher) was organised and one of the assistant professors of the school supervised the session.

6.1.4. Analysis

Coding

Our questionnaire included both multiple choice and open-ended questions. Whereas the former dealt mainly with factual or quantitative data, the latter were predominantly in search of qualitative data. Responses to the multiple choice questions were easily amenable to coding for further considerations.

Responses to open-ended questions, in particular questions 17 to 19 needed further contemplation. To process such answers, responses (of all respondents) to each individual question were first reviewed together. In the subsequent step, the keywords of each response were derived and then matching keywords were brought together to form higher level categories. These categories were then coded for the purpose of tabulation and statistical investigations.

A second analysis of the open-ended questions was conducted by a second analyst (a PhD in architecture who was familiar with the educational context of the schools). The list of the above 'categories' was first introduced to her. She was then asked to assign to each response as many of the above 'categories' as she identified mentioned in the response, and to suggest any notion uncovered by the coding categories. The results of the two analysts were well matched; only negligible differences between the two processes emerged. Responses to the questions whose answers could rank the respondents (e.g. questions 6 and 7) were coded on a three point scale of 1 to 3 where 1 represented the poorest class of response.

Holistic comparison

For the holistic comparison of the entrants of the two years, the main emphasis was put on the questions which dealt with the prior status of the students, i.e. before starting their course in universities. Thus, the observed differences between the collective results of the two groups are very likely to be attributable to the different student selection systems. Answers to some open-ended questions which dealt with the educational experience of students in university schools, however, might have been influenced by idiosyncratic educational (or other) preferences of each school. Since the rates of response were not similar in the three schools (technologically based school's being the lowest), the collective findings from the open-ended questions regarding educational experience are likely to be slightly biased towards the two similar schools (this point is attended to and examined under the results of Question 18).

Statistical tool

For the analysis of the representativeness of the samples and also responses to the 'prior status' questions Chi square tests were applied. Since we were interested to know whether any differences existed between the two 1993 and 1994 groups on specific variables, Chi square test which, according to Cohen and Holliday (1982, p77), tests 'departure from independence between two factors' seemed the most proper tool. In fact a number of null hypotheses of no difference between the groups were thus tested. The SPS programme was applied to carry out the tests.

Representativeness

To study the collective differences between the entrants of the two years, it was first necessary to satisfy the requirement of proper sampling. In other words, we had to know how representative of the *entire* (1993 or 1994) groups, in terms of gender and admission quota, the corresponding *respondent* groups were. Since students were under no obligation to attend the survey, our samples were in fact self-selected samples which included only 34 percent of the original groups of students. Moreover, the proportions of different gender, and quota segments were not *exactly* equal to those of the original groups. However, no significant differences existed between the samples and their original groups in that regard.

To examine the possible differences, the original and respondent groups of each entrance year (e.g. *entire* 1993 and *respondent* 1993) were cross-tabulated once by *gender* and once by *quota* variable. By means of a Chi square test, all such differences were examined (the Chi square tables are given in Appendix 6.2; page 371). Corresponding pie charts and related test results are presented in Figure 6.1 and Figure 6.2. None of the gender or quota differences between the entire and respondent group of the same year were statistically significant.

The largest deviation was observed on the quota proportions between the 1993 respondents and the 1993 entire group, the former including a smaller proportion of Special Quota students. Yet, the difference was not significant at all (χ^2 =1.421; df=1; p=.233). This means that the gender and admission quota proportions of each respondent group can be regarded as adequately in agreement with the corresponding proportions in the entire group of the same year. It seems plausible, therefore, that our results could be generalised for the populations under study.

Noticeably, the proportions of gender and especially admission quota were also reasonably similar between the two respondent groups.

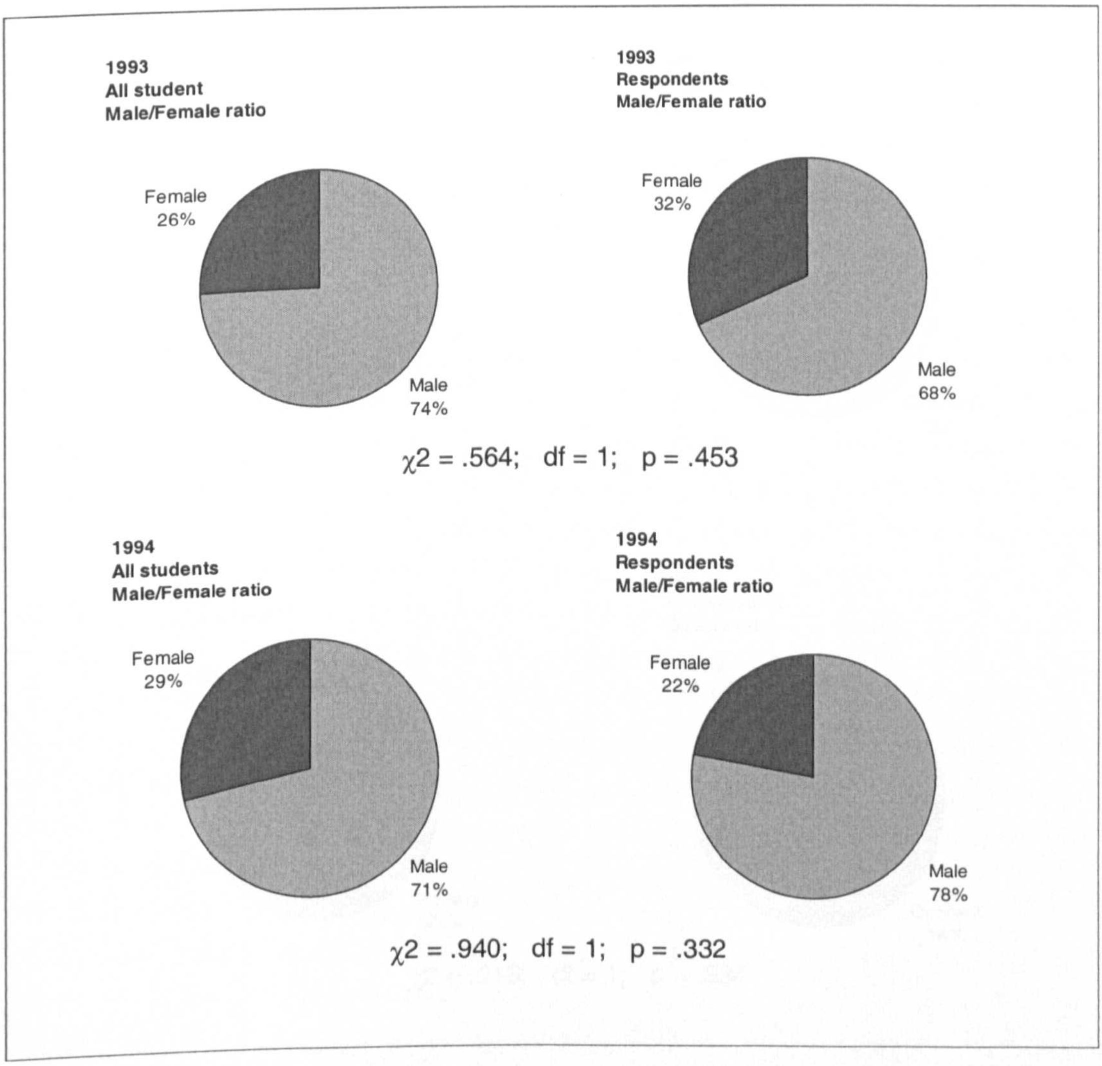

Figure 6.1. Comparison of gender proportions in the entire and respondent groups of students

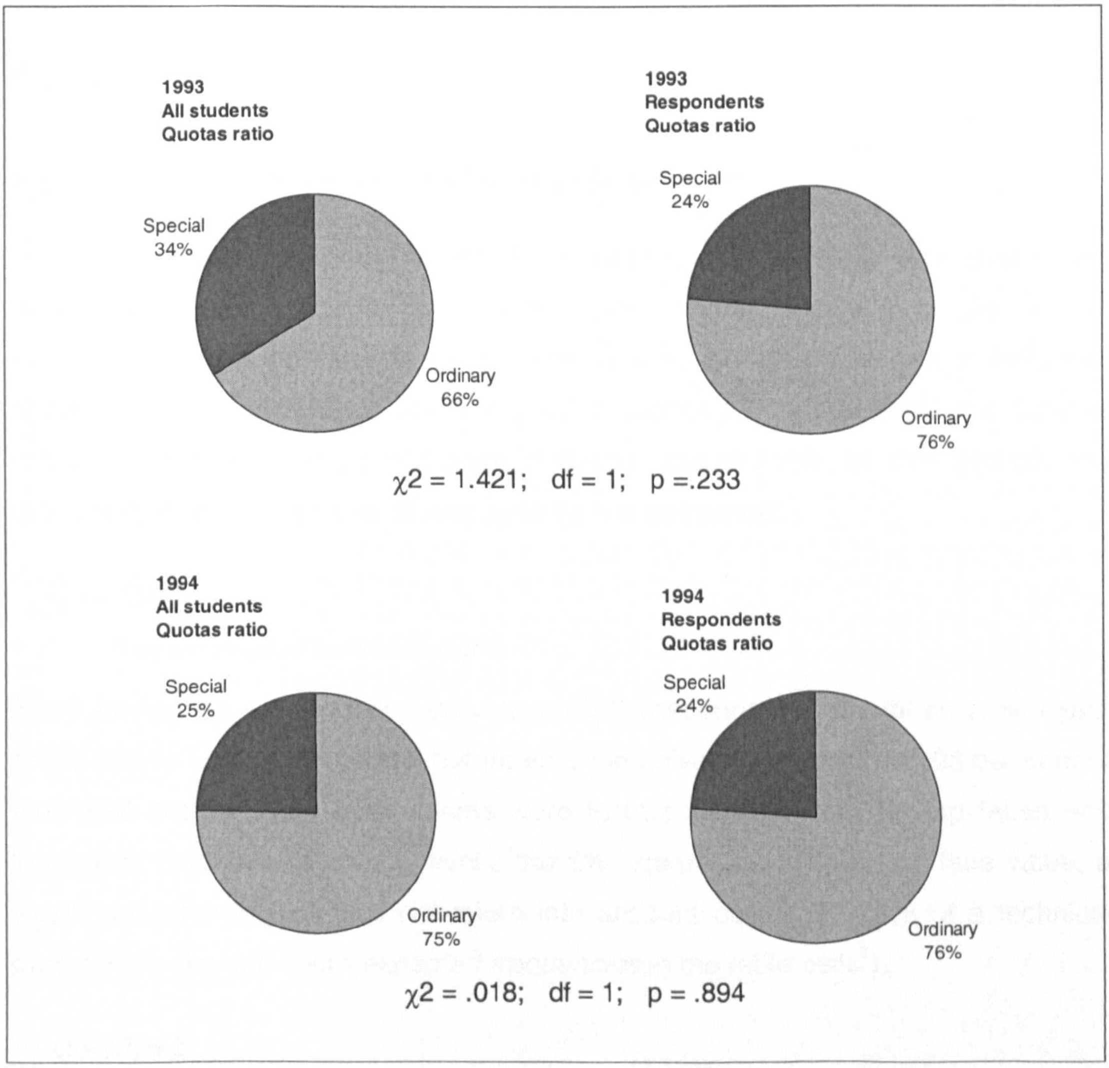

Figure 6.2. Comparison of admission quota proportions in the entire and respondent groups of students

6.2. Results

6.2.1. Comparison of the 1993 and 1994 Groups

- Slightly more than one third of all students under our study took part in the survey and responded to the questionnaire (n=101; Table 6.1). 38 of the respondents were admitted to the schools through the 1993 (i.e. design-inclusive) entrance examination. The remaining 63 respondents had entered the schools through the 1994 (design-exclusive) entrance examination. In this section, the responses of the two groups of respondents are compared.

Question 1

Prior Architectural Technician degree

From among all respondents, only two 1993 respondents had taken a two-year Architectural Technician course before entering university. Therefore, 95 per cent of the 1993 and all 1994 respondents were in fact similar in not having taken any Technician course in advance. While the Chi square test showed, at face value, a significant difference, it was not taken into account due to the lack of a technical prerequisite (i.e. minimum *expected frequencies* in the table cells[7]).

Question 2

Preparatory courses

A significant difference was found between the two year students in terms of taking preparatory courses. While a larger proportion of the 1994 respondents (59%) had not taken *any* preparatory course, the two groups were almost similar in taking 'non-architectural' preparatory courses (around 30 per cent). A noticeably larger percent of 1993 respondents had taken preparatory architectural courses (1993: 29 per cent; 1994: 10 per cent). The differences are statistically significant; p=.036 (Figure 6.3 and Appendix 6-3, Section 1).

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[7] SPSS version 10, Chi-Square Test Data Considerations: The expected frequencies for each category should be at least 1. No more than 20 per cent of the categories should have expected frequencies of less than 5.

Also Cohen & Holliday (1982, p134) claimed that 'the stability of the test is said to be decreased if there are less than 5 expected frequencies in any one category or cell.'

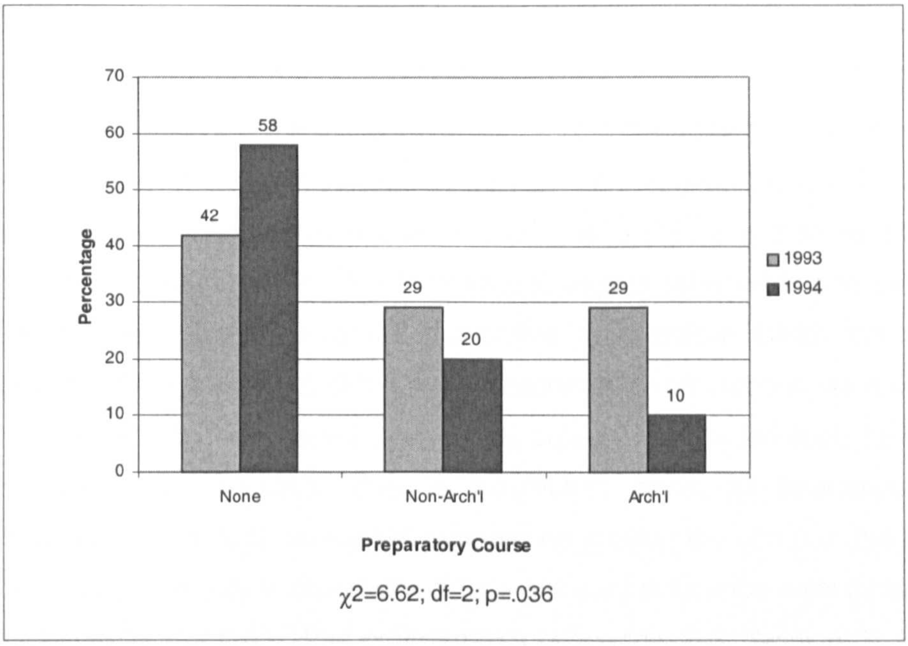


Figure 6.3. Preparatory course attended by entrance year.

Question 3

High school type

There also existed a discernible difference in terms of the high school types at which the two years students had studied (Figure 6.4 and Appendix 6-3, Section 2). While more than 41 per cent of the 1994 students had studied in Special schools, slightly more than 21 per cent of the 1993 students were from the same type of schools. The differences are statistically significant; p=.037.

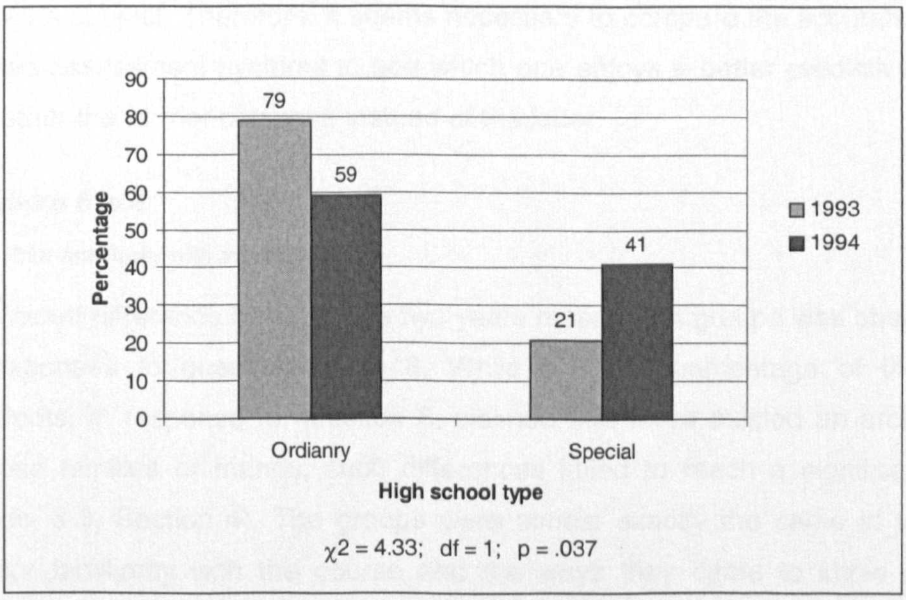


Figure 6.4. High school type attended by entrance year.

Questions 4 and 5

Final Secondary Examination: total average and subjects averages

Responses to question 4 did not appear to be applicable for the purpose of analysis, because a number of respondents gave just their *approximate* Secondary Diploma Average by writing round figures and leaving out the decimals and some others left the answer blank. Maybe it was too optimistic to expect respondents to remember accurately the marks they had gained four or five years before. Giving the range of their marks in different subjects of the Final Secondary Examinations, as reflected in question 5, seems to have been easier. Chi square results for such categories, however, were not applicable due to insufficient *expected frequencies*. The combination of the first four categories together as against the fifth (i.e. the highest) category showed that only in chemistry did a significant difference exist between the 1993 respondents and their 1994 counterparts (Appendix 6-3, Section 3). The last finding contradicts the corresponding differences in the National Entrance Examinations in the same subjects. The Mann-Whitney U test for exactly the same groups shows that significant differences between the 1993 and 1994 respondents are, in ranking order, in physics and maths, and then slightly below a significant level in chemistry. However, according to Final Secondary Examinations results, as stated by the respondents and the mentioned Chi square tests, the only significant difference was in chemistry results. If our respondents did not make mistakes in reporting the range of their marks, it could be suggested that the Final Secondary Examination and National Entrance Examinations do not measure the same abilities in the same subject. Therefore, it seems necessary to compare the accurate results of the two assessment systems to see which one enjoys a better predictive ability, and whether the former can work instead of the latter.

Questions 6 to 8

Prior familiarity with the course

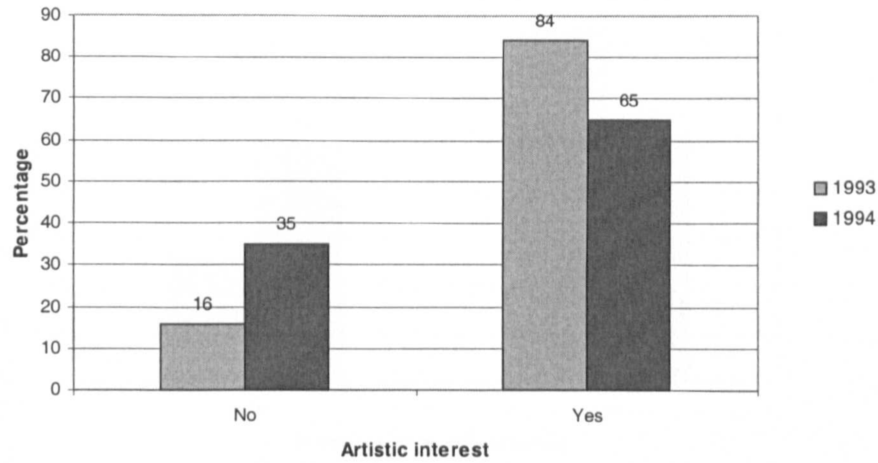
No significant difference between the two years respondent groups was observed in their responses to questions 6 to 8. While a larger percentage of the 1993 respondents, in response to question 6, claimed that there existed an architect in their close families or friends, such differences failed to reach a significant level (Appendix 6-3, Section 4). The groups were almost exactly the same in terms of their prior familiarity with the course and the ways they came to know about it (question 7). Responses to question 7 ranged from as poor as a late and superficial familiarity with the course to as good as a long and realistic familiarity (e.g. continual observation of the work and study circumstances of one's own brother/sister who has been a student of architecture). Both showed proportions of about 15 per cent sufficient and about 40 per cent acceptable prior familiarity, but 45 per cent of no initial familiarity at all (Appendix 6-3, Section 5). As regards the agreement between the students' prior perceptions of the course and the reality they experienced (question 8), only minor differences were observable between the two groups _ Appendix 6-3, Section 6 . For both groups, the discrepancy between their 'previously conceptualised' and 'actually experienced' educational *methods* was lager than that of the educational *contents.*

A five-degree 'Likert scale' measure was provided for responses to question 8, where 1 denoted total disagreement and 5 total agreement between the previous conceptualisation and experienced reality. On average, about 25 per cent of all respondents chose above 3 (mid-point) for *contents*, but only about 10 per cent did so for methods. No single respondent chose 5 for methods. The measures of 'contents conformity' correlated .38 (p=.000) with the measures of 'prior familiarity' (for 97 responses from both groups). Similar correlations were far lower for the measures of 'methods conformity'. These correlations and also the descriptive summaries of all responses to question 8 are displayed in Appendix 6-3, Section 7.

Questions 9 & 10

Familial background

Marked differences were discernible on both 'familial artistic interests' and 'artistic practice' variables. A significantly larger percentage of the 1993 respondents reported their families had some kind of artistic *interests* (p=.037) (Figure 6.5). The same was true in terms of the *practice* of some kind of artistic activity, although mainly as a hobby. A larger percentage of the 1993 respondents reported that themselves and sometimes one or more members of their family were used to practising activities such as painting, pottery, music, etc.. When the responses to question 10, according to the provided details by respondents, are divided into three categories of *none, ordinary* and *remarkable*, the difference between the two groups reaches a 6.3 perc ent level. However, if all positive responses are placed in the same category and negative responses in the other, the difference between the two groups reaches a 2.3 per cent level of significance (Figure 6.6). Cross-tabulation of responses to question 10 are presented in Appendix 6-3, Section 8.



$\chi 2 = 4.33$; df = 1; p = .037

Figure 6.5. Familial interest in artistic issues

Questions 11 to 14

Motives

The two groups showed significant differences in terms of when they had decided to study architecture. Slightly more than 50 per cent of the 1994 entrants claimed that they made their decision just at the time of 'application', while 26.3 per cent of the 1993 group did so. The majority of the latter group claimed that they had decided to study architecture a long time before the entrance examination. As shown in Figure 6.7, when the responses are cast into three categories of 'at the application', 'late high school', or 'long before', the difference between the 1993 and 1994 groups reaches a 5.3 percent level. However, the combination of the two latter categories leads to a statistically significant difference of .016 (Figure 6.8).

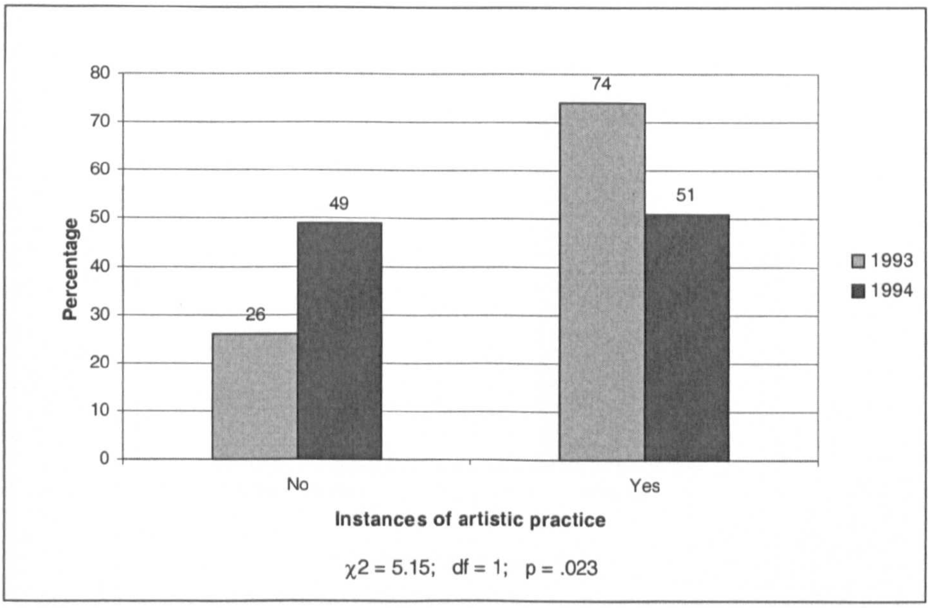


Figure 6.6. Instances of artistic practice

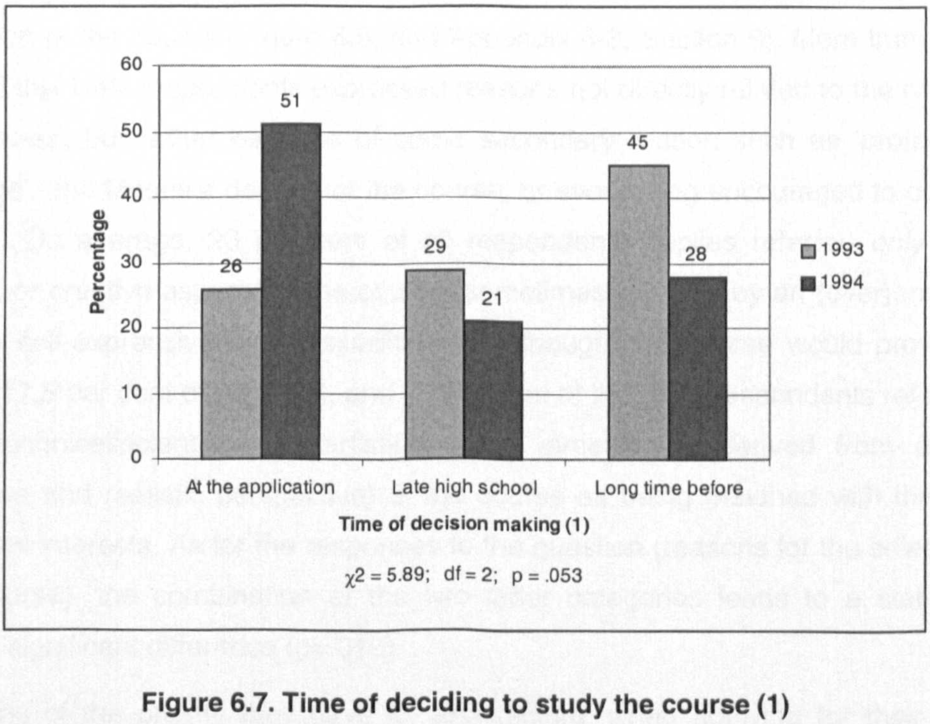


Figure 6.7. Time of deciding to study the course (1)

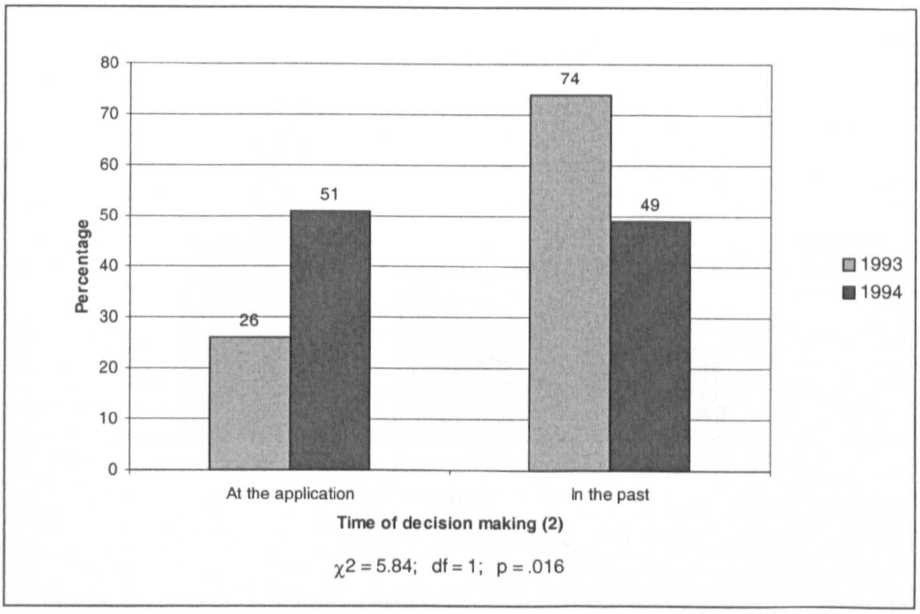


Figure 6.8. Time of deciding to study the course (2)

A significant difference (p=.034) was also observed in the respondents' reasons for selection of the course (Figure 6.9; and Appendix 6-3, Section 9). More than 60 per cent of the 1994 respondents expressed reasons not directly related to the nature of the course, but rather because of some secondary reason such as 'professional prestige', 'the Master's degree' of the course, or even being encouraged to do so by others. On average, 23 per cent of all respondents' replies referred *only* to the artistic or creative aspects of the course, sometimes followed by an (over)emphasis on the self-expressiveness possibilities they thought the course would provide for them. 17.5 per cent of the 1994, and 37 per cent of the 1993 respondents referred to both technical/scientific and artistic/creative dimensions (derived from a more inclusive and realistic perspective) of the course as being matched with their very personal interests. As for the responses to the question (reasons for the selection of the course), the combination of the two latter categories leads to a statistically higher significant difference (p=.015).

In terms of the priority they gave to 'architecture' when applying for their higher education studies, the Chi square test renders a significant difference at above 5 per cent level. However, this figure should be treated with caution, since the requirement of *expected frequencies* was not met. Nearly 82 per cent of the 1993, and 90 per cent of the 1994 respondents were similar in choosing 'architecture' as their first choice but along with other secondary choices (Appendix 6-3, Section 10).

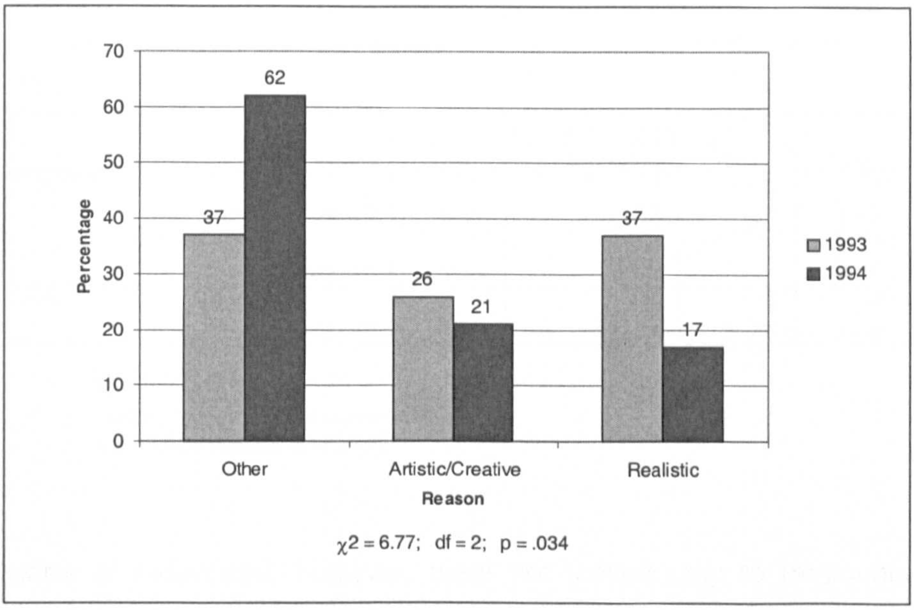


Figure 6.9. Reason for the choice of the course

As regards the respondents' preference for continuing to study architecture or transfer to another course, about 13 per cent of the 1993, and 25 per cent of the 1994 respondents claimed that they would have transferred to some other courses if official/administrative constraints had not affected them. The difference between the groups did not reach a statistically significant level(Appendix 6-3, Section 11a). This matter will be discussed further in the concluding section of this chapter.

A parenthetical point seems worth mentioning here.

The data from our respondents who preferred to transfer to some other courses was examined in detail to see which variable could better account for that preference. Some indications were, unsurprisingly, found under the variables about their familial 'artistic interest', and their 'reason for [the] choice' of the architecture course.

In total, 21 respondents said that they preferred to transfer to other courses (5 from the 1993, and 16 from the 1994 cohorts). When asked why they had originally chosen to study architecture, slightly more than three fourths of these students gave reasons that were secondary and extrinsic rather than for the sake of the course itself; and the remaining students referred solely to their enthusiasm for the artistic and creative aspects of the course without any reference to its scientific and more objective dimensions and attributes (Table 6.2).

Table 6.2. Cross-tabulation:
'preference for transfer' by 'reason for the choice of the course'

			Reason for Choice			
			Other	Artistic/Creative	Real	Total
Transfer	No	Count	37	18	25	80
		% within Transfer2	46.3%	22.5%	31.3%	100.0%
	Yes	Count	16	5		21
		% within Transfer2	76.2%	23.8%		100.0%
Total		Count	53	23	25	101
		% within Transfer2	52.5%	22.8%	24.8%	100.0%

$\chi2$ =9.42; df = 2; p = .01

1 cell (16.7%) has expected count less than 5.

The minimum expected count is 4.78.

These sorts of responses, however, were not limited only to respondents who showed preference for transfer. Therefore, secondary and extrinsic, or solely artistic reasons for studying the course cannot be taken as indicators of subsequent dissatisfaction with the course. But it was observed that those who preferred to transfer gave, without exception, either secondary or non-inclusive reasons for their decision to study the course, and not one among them had mentioned an inclusive reason for studying the course for its own sake.

Likewise, a significant difference (p=.001) was found in the familial artistic interests between students who preferred to transfer and those who did not. A significantly larger percentage of students who were satisfied with their course claimed that their families showed interest in one or more artistic areas (Table 6.3).

Table 6.3. Cross-tabulation:
'preference for transfer' by 'familial artistic interest'

			Fam. Artistic Interest		
			No	Yes	Total
Transfer	No	Count	16	64	80
		% within Transfer2	20.0%	80.0%	100.0%
	Yes	Count	12	9	21
		% within Transfer2	57.1%	42.9%	100.0%
Total		Count	28	73	101
		% within Transfer2	27.7%	72.3%	100.0%

$\chi2$ =11.45; df = 1; p = .001

Questions 15 & 16

Interests and skills

One of the areas where a marked difference emerged between the two groups was the area of personal interests and skills (before starting the course). Corresponding replies were categorised into three classes including 'visio-spacial', non-visio-spacial but artistic referred to as '(other) artistic', and also 'distant', designating any other kind of interest and skill. Drawing or model making; music playing or poetry; and sports or socialising with friends are examples of the categories respectively. About 8 per cent of the 1993 respondents reported 'distant' interests and/or skills, while the same category included more than 36 per cent of the 1994s. Conversely, 58 per cent of the 1993s reported 'visio-spacial' interests/skills, while 40 per cent of their 1994 counterparts narrated such interests/skills (Figure 6.10, and Appendix 6-3, Section 12). The difference between the 1993 and 1994 students is highly significant (p=.006).

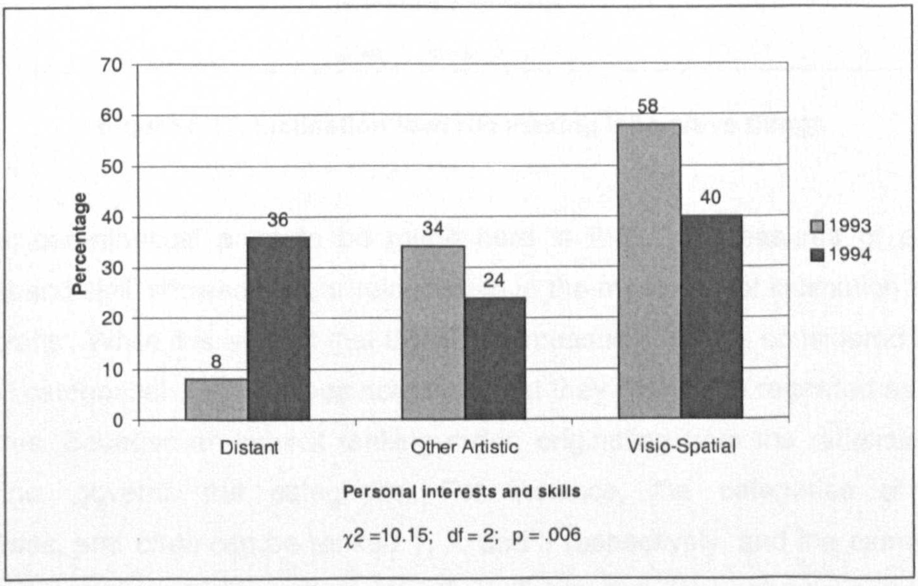


Figure 6.10. Personal interests and skills

Evident differences were also observable between the two groups in their inclination towards making artistic or innovative things (referred to as 'handicrafts'[8]) out of their

[8] No emphasis is intended to be put on the traditionality of the product or methods of making handicrafts, but rather emphasis is put on the interest and involvement in making an object, with some dexterity, and usually with household tools.

volition, not as a required assignment. (Figure 6.11 Appendix 6-3, Section 13). More than half of the 1993 respondents claimed that they *often* engaged themselves in this sort of hobbies. However, one fourth of the 1994s claimed so. Nearly 18 per cent of the 1993 respondents, but 37 per cent of their 1994 counterparts said that they never or seldom made such things. The difference is highly significant (p=.017).

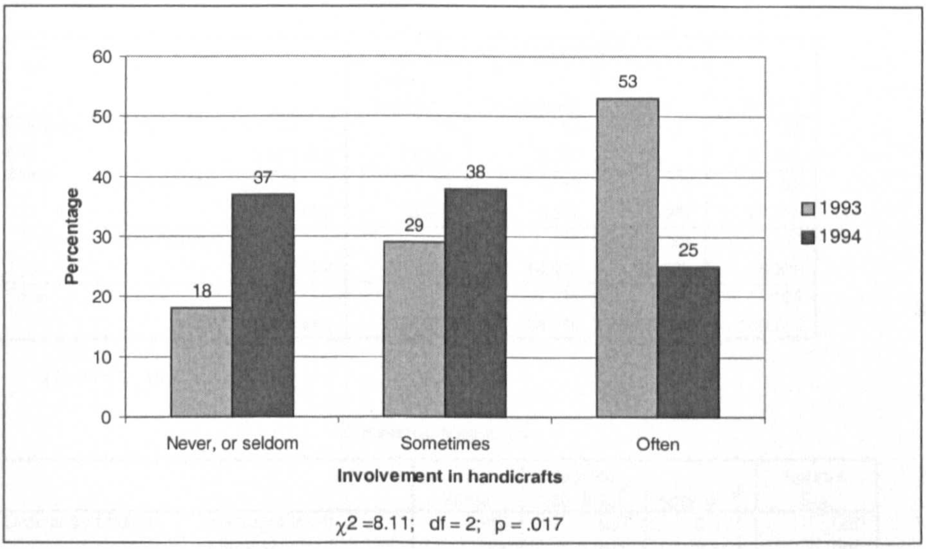


Figure 6.11. Inclination towards making innovative things

Another parenthetical point to be made here is that the measures of personal 'interest and skill' showed a clear relationship to the measures of inclination towards 'handicrafts'. While it is evident that the above measures can be considered to be in nominal/categorical scale, it does not follow that they cannot be regarded as ordinal measures. Because an implicit ranking order, originating from the rationale of the questions, governs the categories. For instance, the categories of *never*, *sometimes*, and *often* can be ranked 1, 2, and 3 respectively, and the same is true for the responses to the other question. Table 6.4 (part a) represents such relationships which are studied through the use of Chi square test to examine the independence of the variables. The Gamma test, Spearman's rho, and Kendall's tau-b were also applied to find out the extent and direction of the relationship (Table 6.4, part b). As shown in the table, all relationships are positive and statistically highly significant. Even the Kendall's tau-b, which is the most stringent of the three, reaches a magnitude of 0.54. This means that there existed a noticeable positive and significant relationship between respondents' visio-spacial interests and skills and their inclination towards handicrafts or innovative activities.

Table 6.4 (a and b). Relationship between 'interests and skills' and 'involvement in handicrafts'

			Involvement in Handicrafts			
			Never, Seldom	Sometimes	Often	Total
Interests and Skills	Distant	Count	16	10		26
		% of Total	15.8%	9.9%		25.7%
	Other artistic	Count	11	10	7	28
		% of Total	10.9%	9.9%	6.9%	27.7%
	Visio-spacial	Count	3	15	29	47
		% of Total	3.0%	14.9%	28.7%	46.5%
Total		Count	30	35	36	101
		% of Total	29.7%	34.7%	35.6%	100.0%

a

$\chi 2 = 37.67$; df = 4; p = .000

Symmetric Measures

		Value	Asymp. Std. Error[a]	Approx. T[b]	Approx. Sig.
Ordinal by Ordinal	Kendall's tau-b	.545	.057	9.417	.000
	Gamma	.754	.062	9.417	.000
	Spearman Correlation	.611	.061	7.672	.000[c]
Interval by Interval	Pearson's R	.607	.060	7.603	.000[c]
N of Valid Cases		101			

a. Not assuming the null hypothesis.

b. Using the asymptotic standard error assuming the null hypothesis.

c. Based on normal approximation.

b

Questions 17 to 19

Students' views

Based on the items our respondents (both years combined) mentioned in their replies to the last three open ended questions, Table 6.5 represents the main recurrent themes or classifying 'categories' and their underlying notions.

Table 6.6 represents most repeated themes and their respective frequencies derived from responses to question 17. Those themes, or categories, represent the abilities or characteristics which, according to their *personal* experience, our respondents found most supportive during their study of architecture. Out of a total of 101 respondents (from both 1993 and 1994 groups), 60 respondents mentioned 92 items altogether. The three most frequent categories were 'drawing abilities', 'artistic interests', and 'perseverance/diligence' each mentioned by 33, 32, and 23 percent of the respondents respectively. Less frequent categories are given in the footnote of the table.

Table 6.5. Categories of response to subjective questoins

Categories	Generic issues mentioned by respondents
Artistic interests	Showing interest in, awareness of, or sensitivity to artistic matters; evidence of such engagements or such knowledge.
Breadth of interests	Showing interest in diverse (dissimilar) fields of knowledge or activity.
Creativeness	Having a creative mind; ability to create original mental imagery; the ability to think independently and find new solutions.
Curiosity/Sensitivity	Being sensitive to physical surroundings and settings; inquisitive attitude towards events, phenomena, or things.
Drawing abilities	Being able to draw communicative sketches from present or absent objects; ability to communicate graphically what is in mind.
Motivation/Interest	Being motivated for or interested in architecture as an education or profession for its own sake.
Perseverance/Diligence	Being able to do repeatedly difficult tasks; ability to concentrate or work for a long time on the same issue.
Prior familiarity	Having a reasonable acquaintance with the course/profession before selecting the course.
Self-confidence	(Mainly stated directly) also the ability to face and endure difficulties.
Self-discipline	Being able to organise one's environment, works, or plans (physically or mentally).
Social interests	Being sensitive to and interested in social matters; participating in social issues; taking into account others' views and feelings.
Technical skills	Technical drawing skills; ability to do daily repairs; familiarity with materials.

Table 6.6. Responses to Question 17 (supportive abilities/characteristics)
respondents: 60 out of 101

Categories	Frequency	Percentage
Drawing abilities	20	33%
Artistic interests	19	32%
Perseverance/Diligence	14	23%
Self-discipline	8	13%
Creativness	7	12%
Technical skills	6	10%
Other*		
Total mentioned points	92	

*: Topics which recurred less than 10%, including:
Curiosity and sensetivity to surrundings; motivation/interest; social interests; ambitious attitude; self-confidence; etc..

The results of question 18, which asked about the potential indicators of a candidate's suitability for studying architecture are displayed in Table 6.7. It seems very likely that responses to this question have been influenced not only by the personal experience of the respondents, but also by what they had witnessed of their peers' experience. In total, 237 items emerged from 88 responses.

Table 6.7. Responses to Question 18
(indicators of a candidate's suitability for the course)
respondents: 88 out of 101

Categories	Frequency	Percentage
Artistic interests	51	**58%**
Motivation/Interest	37	**42%**
Perseverance/Diligence	36	**41%**
Drawing abilities	21	**24%**
Creativness	20	**23%**
Prior familiarity	19	**22%**
Other*		
Total mentioned points	237	

*: Topics which recurred less than 20%, including:
Curiosity/sensitivity; self-discipline; self-confidence; social interests; technical skills; breadth of interest; etc..

In ranking order, the most frequent categories which were mentioned by at least more than 20 per cent of respondents included 'artistic interests', 'motivation/interest', 'perseverance', 'drawing abilities', 'creativeness', and 'prior familiarity'. The recurrence of these themes ranged from 58 per cent to 22 per cent. What is interesting here is the similarity between the views of respondents from the technology-based school and those from the other schools, in particular, concerning their artistic interests. In total, 20 respondents from the technology-based school answered question 18. Eleven of them mentioned 'artistic interests', that is 55 per cent, reasonably comparable to the 58 per cent overall recurrence of the same theme in all 88 responses. However, it is not clear whether for responding to question 18, the latter respondents drew upon what they had experienced *only* in the technology-based school or also reflected what they had learnt about the experiences of those in the other schools.

Responses to question 19 were more similar. A total of 78 respondents gave their suggestions for making improvements to student selection procedures and two main themes emerged from their answers (Table 6.8).

Table 6.8. Students' suggestions concerning selection procedures

Theme	1993 Respondents n = 31 out of 38 Frequency	Percentage	1994 Respondents n = 47 out of 63 Frequency	Percentage	1993 & 94 Respondents n = 78 out of 101 Frequency	Percentage
Special exam	22	**71%**	31	**66%**	53	**68%**
Prior familiarisation	6	**19%**	12	**26%**	18	**23%**
Only scientific exam	1	**3%**	4	**9%**	5	**6%**
etc.*						

*: A small number of non-frequent suggestions, each mentioned only once or twice.

68 per cent of respondents favoured the implementation of a *special* (design-related) examination for student selection for studying architecture. In that regard, the 1993 and 1994 respondent groups were in agreement with 71 per cent and 66 per cent of the responses respectively. 23 per cent called for the introduction of some effective processes of prior familiarisation with the course. A larger proportion of 1994 respondents, as compared to those in the 1993 group, proposed the latter point. Other suggestions fell below a 10 per cent recurrence. Six per cent of respondents opposed the first theme, i.e. a special examination, and were in favour of the new (scientific and design-exclusive) examination. There also existed a small number of non-frequent individual proposals, such as the 'participation of the practice sector for student selection', which are not reflected individually in the table.

6.2.2. Predictive Ability of the Non-Academic Variables

In this part, attention is drawn to the correlation of academic performance of our respondents with the responses they gave to some parts of the questionnaire. If the subject matters of our *non-academic* questions show relationship to the subsequent performance of our students, then it means that they may be of some predictive value. Remember that in the Bartlett study (Abercrombie et al 1969) the combination of 'Candidate Statement' with Academic Record improved on the correlations with performance measures. Also if some of the response variables show better predictions than conventional academic predictors, then it is justifiable to reconsider their significance and seek the proper methods of their incorporation into the selection criteria.

Respondents from university 'A', because of their larger number, were selected for this purpose. It was thought that their numerical superiority meant that they were more suitable for separation into homogeneous samples according to gender and admission quota. This kind of separation reduces the likelihood of extraneous factors affecting the results. However, at the same time it may influence the findings due to a consequent decrease in sample size.

The relationship of response variables to performance variables was examined. As could be expected, not all returned noticeable relations. Thus, a number of the response variables which appeared to be more responsive are described below. However, for the sake of comparison, some other academic (predictor) variables are also included.

Since our response variables are *discrete* and *ordered* variables, and the categories of responses are limited, Kendall's tau-b correlation is used. Kendall's tau-b is a statistical tool for non-parametric correlation which takes ties into account (i.e. corrects for ties).

From among response variables, 'prior familiarity', 'reason for choice', 'interests and skills', and in some cases, 'involvement in handicrafts' showed better correlations. Also, a constructed variable which was, in fact, the sum of values for the former three variables showed noticeable relationships.

Table 6.9 displays the correlations of some Final Secondary Examinations variables, as well as four of the questionnaire response variables with performance variables. The sample was composed of male Ordinary quota respondents who entered university school 'A' in 1993 or 1994 (n=30).

The aggregation of the two years' respondents was for the sake of having a larger sample. The reason that the two groups could be included in the same table was the fact that they had undergone a similar architectural education and were checked against similar assessment criteria for their performance in the same university school in two consecutive courses of no reported change.

Table 6.9. Relationship of academic and non-academic indicators to performance measures,
(School A, n=26-30)

Univ 'A' (1993 and 94), Male respondents, Ordinary quota

		Design Avrg	Technology Avrg	Humanities Avrg	Overall Avrg
		Kendall's tau_b	Kendall's tau_b	Kendall's tau_b	Kendall's tau_b
Secondary Dipl Avrg	Correlation Coefficient	-.122	-.113	.013	-.063
	Sig. (2-tailed)	.458	.489	.939	.701
	N	26	26	26	26
Secondary Dipl Maths	Correlation Coefficient	.219	.288	.240	.301
	Sig. (2-tailed)	.163	.067	.127	.055
	N	29	29	29	29
Secondary Dipl Physics	Correlation Coefficient	.083	.163	.050	.110
	Sig. (2-tailed)	.591	.292	.747	.478
	N	29	29	29	29
Secondary Dipl Chemistry	Correlation Coefficient	.009	.052	.101	.089
	Sig. (2-tailed)	.951	.726	.496	.550
	N	29	29	29	29
Prior Familiarity	Correlation Coefficient	.502**	.310*	.307*	.484**
	Sig. (2-tailed)	.001	.036	.038	.001
	N	30	30	30	30
Reason for Choice	Correlation Coefficient	.489**	.478**	.356*	.495**
	Sig. (2-tailed)	.001	.001	.016	.001
	N	30	30	30	30
Interests and Skills	Correlation Coefficient	.417**	.343*	.228	.352*
	Sig. (2-tailed)	.005	.020	.122	.017
	N	30	30	30	30
Prior Familiarity + Reason for choice + Interests and Skills	Correlation Coefficient	.547**	.421**	.273*	.492**
	Sig. (2-tailed)	.000	.002	.045	.000
	N	30	30	30	30

**. Correlation is significant at the .01 level (2-tailed).

*. Correlation is significant at the .05 level (2-tailed).

Moreover, as regards predictive variables of the table, i.e. *secondary education* and *response* variables, the former group is commonly held as the product of standardised examinations and the latter, by its very nature, is independent of the entrance year. However, inasmuch as those assumptions can be challenged, the finding can be called into question. Therefore, each group is also studied separately (below).

As shown in Table 6.9, among Final Secondary Examination results, only mathematics tended to show a low and almost significant relationship to the measure of 'Overall Average' and then to 'Technology Average'. However, all four questionnaire response variables correlated significantly with 'Overall Average'. Three of the correlations coefficients were larger than .48 and significant at .001 level, at least. The response variables also correlated with 'Technology Average' and 'Design Average', rendering the highest correlations with the latter (max. correlation=.547; p=.000).

Table 6.10 includes only the 1993 segment of the previous table. In addition to the previous variables, some National Entrance Examination variables are included. It should be remembered from the previous chapter that reasonable correlations between the National Entrance Examination and subsequent performance measures were observed in university school 'A' for the 1993 students.

Table 6.10. Relationship of academic and non-academic indicators to performance measures,
(A93, n=12-13)

Cohort A93, Male respondents, Ordinary quota

		Design Avrg	Technology Avrg	Humanities Avrg	Overall Avrg
		Kendall's tau_b	Kendall's tau_b	Kendall's tau_b	Kendall's tau_b
Total Scr, Ent Exm	Correlation Coefficient	.436*	.436*	.308	.462*
	Sig. (2-tailed)	.038	.038	.143	.028
	N	13	13	13	13
Spcl'd Exm Scr, Ent Exm	Correlation Coefficient	.590**	.641**	.462*	.615**
	Sig. (2-tailed)	.005	.002	.028	.003
	N	13	13	13	13
Sci Scr, Ent Exm	Correlation Coefficient	.426*	.606**	.374	.555**
	Sig. (2-tailed)	.044	.004	.076	.009
	N	13	13	13	13
Secondary Dipl Avrg	Correlation Coefficient	-.075	-.149	-.298	-.075
	Sig. (2-tailed)	.794	.602	.296	.794
	N	10	10	10	10
Secondary Dipl Maths	Correlation Coefficient	.435	.653*	.435	.609*
	Sig. (2-tailed)	.089	.011	.089	.017
	N	12	12	12	12
Secondary Dipl Physics	Correlation Coefficient	.414	.611*	.256	.532*
	Sig. (2-tailed)	.097	.014	.304	.033
	N	12	12	12	12
Prior Familiarity	Correlation Coefficient	**.621****	**.458**	**.490***	**.588***
	Sig. (2-tailed)	.009	.054	.039	.013
	N	13	13	13	13
Reason for Choice	Correlation Coefficient	**.748****	**.565***	**.595***	**.718****
	Sig. (2-tailed)	.001	.015	.010	.002
	N	13	13	13	13
Interests and Skills	Correlation Coefficient	**.573***	**.430**	**.465**	**.501***
	Sig. (2-tailed)	.019	.079	.057	.040
	N	13	13	13	13
Prior Familiarity + Reason for choice + Interests and Skills	Correlation Coefficient	**.736****	**.566***	**.566***	**.708****
	Sig. (2-tailed)	.001	.011	.011	.002
	N	13	13	13	13

*. Correlation is significant at the .05 level (2-tailed).

**. Correlation is significant at the .01 level (2-tailed).

As before, Total Score, Specialised Examination Score, and Scientific Score (unweighted sum of chemistry, physics, and Mathematics), all from the entrance examination, showed noticeable significant correlation in the case of this latest sample (upper variables in Table 6.10). Particular attention is drawn to 'Design Average' which correlated best with 'Specialised Examination Score'. Mathematics and physics, from secondary education results (in the middle of the table), showed similar degrees of relationship with 'Technology Average' and 'Overall Average' as did 'Specialised Examination'. However, all three secondary education measures fell short of any noticeable correlation with 'Design Average'. As seen in the bottom of the table (in bold font), all four response variables showed strong and significant correlations, firstly with 'Design Average' and then with 'Overall Average' (min .501; p=.040 and max .748; p=.001).

Table 6.11 represents the correlations of the same variables, as in the previous table, for the 1994 segment of male and Ordinary quota respondents. Contrary to the data for the 1993 section, entrance examination variables failed to show consistent correlations. From a total of 12 such correlations, only two showed some predictive ability which was limited to the variable 'Design Average'.

No noticeable or significant correlation was observed for 'Overall Average', 'Humanities Average', or 'Technology Average'. The results were even worse for secondary education predictors. However, in the case of questionnaire response variables, 9 were statistically significant out of a total of 16 correlations. Magnitudes of the significant cases ranged between .420 to .547. None of the response variables predicted 'Humanities Average' to a significant level. However, 'Design Average', 'Technology Average', and 'Overall Average' were each predicted by two, three, and all four predictors respectively.

Altogether then, our (non-academic) response variables appeared to enjoy a better predictive ability than conventional academic predictors in one of the schools which was based in a comprehensive university.

As could be expected, the examination of the correlations of the above non-academic variables with performance variables in school B, showed comparable results to those of school A. However, this was not the case in the technologically-based school C, for which very poor correlations were found.

Table 6.11. Relationship of academic and non-academic indicators to performance measures,
(A94, n=17)

Cohort A94, Male respondents, Ordinary quota

		Design Avrg	Technology Avrg	Humanities Avrg	Overall Avrg
		Kendall's tau_b	Kendall's tau_b	Kendall's tau_b	Kendall's tau_b
Total Scr, Ent Exm	Correlation Coefficient	.368*	.103	.088	.250
	Sig. (2-tailed)	.039	.564	.621	.161
	N	17	17	17	17
Spcl'd Exm Scr, Ent Exm	Correlation Coefficient	.382*	.176	-.015	.294
	Sig. (2-tailed)	.032	.323	.934	.099
	N	17	17	17	17
Sci Scr, Ent Exm	Correlation Coefficient	.235	-.029	-.191	.088
	Sig. (2-tailed)	.187	.869	.284	.621
	N	17	17	17	17
Secondary Dipl Avrg	Correlation Coefficient	-.033	-.011	.141	.054
	Sig. (2-tailed)	.878	.959	.507	.799
	N	16	16	16	16
Secondary Dipl Maths	Correlation Coefficient	.169	.042	.084	.106
	Sig. (2-tailed)	.421	.841	.688	.615
	N	17	17	17	17
Secondary Dipl Physics	Correlation Coefficient	-.101	-.202	-.243	-.263
	Sig. (2-tailed)	.630	.336	.248	.211
	N	17	17	17	17
Prior Familiarity	Correlation Coefficient	**.455***	**.227**	**.152**	**.436***
	Sig. (2-tailed)	.024	.259	.452	.030
	N	17	17	17	17
Reason for Choice	Correlation Coefficient	**.312**	**.543****	**.358**	**.451***
	Sig. (2-tailed)	.129	.008	.082	.028
	N	17	17	17	17
Interests and Skills	Correlation Coefficient	**.357**	**.453***	**.280**	**.473***
	Sig. (2-tailed)	.082	.027	.173	.021
	N	17	17	17	17
Prior Familiarity + Reason for choice + Interests and Skills	Correlation Coefficient	**.420***	**.452***	**.246**	**.547****
	Sig. (2-tailed)	.026	.016	.192	.004
	N	17	17	17	17

*. Correlation is significant at the .05 level (2-tailed).

**. Correlation is significant at the .01 level (2-tailed).

In order to investigate whether the observed correlations between the non-academic variables and performance variables were independent of the students' academic abilities, partial correlations were applied. For this purpose, correlations shown in the last rows of Table 6.10 and Table 6.11 were controlled for the 'Scientific Score' variable. A noticeable decrease was observed in the correlation of the 'Technology Average' for the 1993 sample. Also, their 'Humanities Average' and 'Overall Average' correlations showed a modest shrinkage. However, a slight reduction was observed in the correlation of the 'Design Average'. As regards the 1994 sample, all correlations remained virtually the same. Details of the partial correlations are given in Appendix 6-4.

6.3. Summary and conclusion

A questionnaire survey was designed and conducted to study the possible non-academic differences between two groups of students who entered university schools of architecture as a result of two different admission systems. The relationship between responses to the questionnaire and the academic performance of students in one of the university schools was also studied to see whether any relation of this kind existed. First, a summary of the main findings are given below, and then two other complementary points are made.

6.3.1. Main findings

Significant differences between the two systems' entrants

Table 6.12 gives a summary of the group differences. As reflected in the table, on eight variables, *significant* differences existed between the two groups (p values ranging from .006 to .037). Collectively, students who were selected through the design-inclusive examination (as compared to the design-exclusive examinees) were from less advantaged high schools, but had taken more preparatory architectural courses. They were more inclined to artistic and visio-spatial activities and also spent more time making handicrafts. Their reasons for choosing to study architecture were more influenced by their interest in the course for its own sake, not because of some extrinsic incentive. Their families were more frequently reported as interested in artistic and creative matters, and themselves or their family members participated more in artistic activities.

It should be remembered that the significant differences between the two entrant groups were associated with alterations in the credits of sub-exams of the entrance examination, not with any other stipulation or requirement. The credit of the physics sub-examination was altered from 1 to 4 and the design-related part of the examination was omitted.

Table 6.12. Areas of difference between the 1993 and 1994 cohorts

	Areas of Difference	level of significance
1	Personal interests and skills	.006
2	Time of deciding to study architecture	.016
3	Involvement in handicrafts	.017
4	Practice of artistic/creative activities	.023
5	Reason for the choice of the course	.034
6	Taking a preparatory course	.036
7	Familial artistic/creative interests	.037
8	Type of high school attended	.037
	Other Areas	
1	Preference for transfer to another course	.142
2	Architect relative(s)	.343
3	Prior conceptions vs actuality of the course (methods of instruction)	.458
4	Prior conceptions vs actuality of the course (content of the course)	.942
5	Prior familiarity with the course	.973
6	Prior Architectural Technician degree	'Expected count' requirement not met
7	Priority given to architecture (among other available courses)	'Expected count' requirement not met

The above differences (along with the academic differences studied in the previous chapter) tend to imply that different admission policies can lead to the attraction of substantially different students. This reminds us of a previously reviewed study.

As mentioned in Chapter 2, through a questionnaire survey on the admission procedures in UK schools of architecture, Gartshore and Mayfield (1988)[9], from Portsmouth school, found that schools requiring high points at A level attracted students with strong Maths and Science backgrounds whilst schools which required low points attracted students with strong Art backgrounds. The Portsmouth

[9] Gartshore, P.J. and Mayfield, J. (1988). Admission Procedures in UK Schools of Architecture. Design information Research Unit: Portsmouth Polytechnic.

researchers, however, remained sceptical as to whether the schools which admitted students with mainly Science A-levels '[did] so directly or as a by-product of a high requirement'. While, in the context of Gartshore and Mayfield's study, it is conceivable that admissions tutors might have selected in that manner *directly*, in the case of our study, no such intervention can be presumed because of the non-existence of any local selection procedure and the absence of any personal intervention after the candidates' applications.

Therefore, to the extent that this part bears resemblance to the Portsmouth study, our finding can be regarded as an answer to an unanswered question. Our finding suggests that even if no local influence is exerted on the selection of students, sets of dissimilar selection criteria lead to the attraction of different breeds of candidates.

Potential non-academic predictors

The second part of our analysis, i.e. correlational study, revealed marked relationships between some prior non-academic factors and the measures of academic performance of students in university. Since the dynamics of education in universities are different from those of the secondary education (especially in settings where traditional models of education are still dominant) prosperity and achievement of students in higher education are very unlikely to rely solely on those abilities which are reflected in their routine prior academic reports. This does not mean to disregard prior or entrance academic qualifications, rather, it is to say that proper associations of academic and non-academic capabilities seem to be more promising. The confines of the present work do not provide the opportunity for a thorough investigation into the identification and role of prior non-academic factors, or the practical methods of their application. However, clear indications were found which justify the necessity of such investigations, and most likely, taking into consideration the role of non-academic factors for student selection purposes.

6.3.2. Complementary points

Consistent findings

As mentioned earlier, only one qualitative survey on entrants to certain Iranian schools of architecture was carried out and published before this work. With a different purpose but in the same context, Nadimi (1996)[10] conducted a questionnaire survey which addressed the 1995 entrants[11] to five Iranian schools of architecture (including the three schools of our study). The main theme of Nadimi's research was, to borrow his own words, 'the integration of knowledge and design, and theoretical understanding of human learning process'. However, the aim of his questionnaire survey was to 'examine the entrants' attitude towards the discipline they had chosen'.

Three out of his six questions concerned issues similar to our survey. In one of the questions, he asked his 207 respondents to show, by choosing from among provided choices, the way in which they had 'come to know about architecture, leading to [their] applying for it'. In another question he asked the students that had they been allowed to change their discipline, to which other course(s) they would have preferred to transfer. He also asked the students what they usually did during their leisure time and holidays in their school years.

Concerning the first question Nadimi reports that a significant percentage of entrants were 'encouraged either by their relatives and friends (some 50%), or through TV programmes (some 30%)'. However, he doubts the relevance of the two incentives to a proper acquaintance with the discipline due to their 'ad hoc and uncontrolled influence'. Moreover, the result of the following question casts serious doubts on the effectiveness of such acquaintance, and the students' motive for studying architecture.

As regards the students' preference for transfer to another course, Nadimi reports that 44 per cent of the total students (equivalent to slightly more that 50 per cent of the 180 responses) preferred to transfer to other courses such as Construction Engineering, Computer Engineering or Mechanical Engineering. Remember that for the previous year's entrants, i.e. our 1994 respondents, the figure was 25.4 per cent. Concerning preference for transfer, not only does a significant difference exist between the 1995 and 1993 respondents who were selected through different systems (p=.000), but also a significant difference holds between the 1994 and 1995 entrants who underwent similar selection systems (p=.001) (Appendix 6-3, Section 11b). If the responses to the previous question of Nadimi (about prior familiarity with the course) had borne relevance to the decision of entrants to study the course, there would have remained

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[10] Nadimi, H. (1996). Conceptualizing a framework for integrity in architectural education with some references to Iran. PhD thesis: York University.

[11] The 1995 entrants had passed a central design-exclusive entrance exam similar to our 1994 cohorts.

no room for such a huge percentage of preference for transfer. Therefore, it seems that for a considerable proportion of entrants the main influence of 'relatives and friends' or 'TV programmes' can hardly be regarded as more than a transient impulse.

Concerning the leisure-time activities of the students, Nadimi reports that only 1 out of 204 mentioned having experienced drawing in a practice office. Sports and recreations (23%), and reading (22%) were the most frequently mentioned activities. Not surprisingly, Nadimi questioned the extent to which the *reading* parts could have included something other than the revision of the high school courses for the entrance examination.

In three areas of 'prior familiarity', 'preference for transfer' and 'leisure time activities' then, our findings and Nadimi's findings, which together include the data of three consecutive years entrants, support each other in showing that there are problematic issues which the admission system disregards.

Latent bias

As mentioned earlier, one of the motives that seemed to have prepared the ground for the entrance examination policy makers to favour the design-exclusive examination was the fact that every year an increasing number of candidates were taking architectural preparatory courses before the examination. Institutions which offered preparatory courses for architecture were mainly located in the capital or main cities of the country. It was thus perceived that those candidates who did not live in major cities were, in effect, deprived of having access to those preparatory courses, and thus denied equal opportunity[12]. From this point of view, the exclusion of the design part of the examination seemed to be a justifiable decision in favour of the less privileged. Our results, however, contradict the stance. To the extent that our studied samples can be regarded to represent our target populations, our finding negates the previous assumption, since the bias has merely shifted from the inequality in having access to preparatory courses to inequality in the attended high school types. Our results showed that a significantly larger proportion of entrants who entered universities through the design-exclusive examination were from 'special' or advantaged high schools which are less available in remote areas. Therefore, it seems difficult to accept that the design-exclusive examination system

[12] For instance, this notion was implied in National Organisation for Academic Assessment (1993).

has provided any more equal opportunities for candidates from remote areas to enter schools of architecture than the previous system.

The findings of this chapter can be summarised as follows.

- Significant non-academic differences were found between the entrants of the two different central methods of admission to schools of architecture.
- Some of the non-academic variables showed statistically significant and considerable relationship to the subsequent academic performance of the studied samples.

Matching findings from the present research and a previous study suggest that:

  - The majority of entrants had very poor prior familiarity with the course they intended to study.
  - The entrants selected by the new method were far more prone to dissatisfaction with their course.
  - The entrants selected by the new method were less likely to have engaged in the type of activities in which they would become involved during their study of architecture.

- Despite its ostensible provision of equal access to the course, the new (design-exclusive) admission method tends to be biased towards candidates from the advantaged high schools.

In this and previous chapters we addressed diverse aspects of our research questions through different (theoretical, academic, and non-academic) approaches. Thus we arrived at a number of separate findings which need to be brought together to form a coherent conclusion. The next and final chapter of the thesis is allocated to this purpose.

CHAPTER 7

Discussion and Conclusion

Chapter 7

Discussion and Conclusion

Introduction

This chapter brings together the diverse results of the literature review and our surveys. Different sections of this chapter are as follows.

Firstly, an account is given of the consecutive steps of the thesis.

Secondly, the outcomes of the first part of the thesis (literature review, and survey of admissions tutors) are briefly reported.

Thirdly, the findings of the second part of the thesis (empirical studies) are explained and discussed. An attempt is made to show that the consequences of the application of each method are more mixed and multi-dimensional than initially perceived, and that, despite the intention of the policy maker, the new method is not unqualifiedly preferable to the old method.

Finally, after the summarisation of the strengths and weaknesses of the two methods, a series of recommendations is made, and three issues for further study are suggested.

7.1. Aim and Steps of the Research

The aim of this research was to study the relevance of the two student selection methods for studying architecture in Iran through the comparison of the associated outcomes of the methods; and to make recommendations for the rectification of the possible shortcomings in the methods.

Before 1994, the National Entrance Examination for all (unified) architectural courses included design-related sub-exams which were later omitted and a heavier weight was given to scientific sub-exams. Differing views emerged, however, among the educators about the advantages and disadvantages of this change. The present author thought that it was worth making an attempt to clarify the issue through a systematic research. Fortunately, three factors created an opportune situation in which to compare the outcomes of the alternative selection methods both within and among the university schools: (1) the unified programmes of secondary education, (2) identical architectural education curriculum and syllabi, and (3) identical and centrally-administered entrance examinations for all schools of architecture.

In order to achieve that goal, a series of interrelated steps was taken throughout this research which can be divided into two parts (i.e. parts one and two of the thesis).

The purpose of the first part was to gain knowledge of the related studies and their findings, and to provide methodological insight. It included two main phases.

- In the first phase (Chapters 1 and 2), a literature review on student selection and its related matters, with particular emphasis on architecture and its cognate courses, was conducted. Frequent searches for that literature showed that despite numerous general sources on student selection and access to higher education, only a very limited number of sources have addressed the particular case of architecture. Apart from some very old American studies, which were unobtainable, only a limited number of directly related and disseminated studies were thus identifiable and accessible.
- In the second phase, therefore, a questionnaire was designed and sent to a number of admissions tutors to learn more about the current methods of student selection and their relevance to students' performance during the course; and also to locate more sources of systematic research into the subject. This survey was expected to provide additional up-to-date information and insight into the subject.

Among the findings, however, two things were more conspicuous than anything else: (1) the presence of contrasting views, and dissimilar methods of selection, and (2) the lack of systematic and objective evidence in that regard. This showed that the subject matter of our research must have been far more than a local problem or a personal question, although it was not addressed or attended to adequately in the schools.

Since indications were found in the literature about the intervening effects of non-academic factors, it was decided to broaden the scope of our second (and specific) part of the research to include investigations into both academic and non-academic issues and their consequences.

The second part developed around the design and implementation of two in-depth surveys of the two methods of student selection in Iran.

- In the first survey, quantitative investigations were carried out to compare the two methods from two viewpoints.

    1. 'Predictive ability' or the relationship of each method's selection criteria to the subsequent academic performance of the selected students[1].
    2. 'Economy' or the collective performance of each method's selected students.

    None of the identified previous studies had studied the relationships from the latter viewpoint.

    Our samples were from the 1993 and 1994 cohorts in the three longest established university schools of architecture in Tehran.

- The second survey was designed to identify non-academic differences between the students who were selected through the two alternative methods, and also to investigate the relationship of the non-academic factors to academic performance. A questionnaire was formulated to gather information about students' familial backgrounds; prior familiarity with the course; personal interests; etc..

[1] Also referred to as 'fairness' of the selection method.

7.2. Outcome of the First Part:
Literature Review and Survey of Admissions tutors

The reviewed literature on student selection and its related matters provided useful (especially methodological) hints for the present research. On a broader scale, however, the critical items that the admissions tutors' survey and the reviewed literature revealed were as follows.

- Generally, contrasting views existed about the usefulness of academic qualifications alone for the prediction of future performance.
- Commonly used academic predictors do not show similar predictive abilities for basically different disciplines.
- Despite the application of different methods for the selection of the students of architecture, little was 'systematically' known about the relevance of the selection criteria (to the subsequent performance of the students).
- The main difference between student selection methods was either in their inclusion or exclusion of non-academic factors, or in their required level of entry qualifications (high or low).
- For architecture courses, poor relationships were usually observed between the selection criteria and measures of academic performance of the selected students.
- Previous studies were more in agreement in terms of the types of data they had employed than in their analytical methods. In other words, no specific and consensual analytical method seemed to exist for studies similar to the present work. However, as regards statistical tools, the use of tests of independence, and tests of correlation were more frequent than other tests.
- Evidence existed for psychological and cognitive differences between students of design and non-design disciplines. Also, modest evidence was found about the relationship of non-academic factors to academic performance.

A parenthetical word of caution

Before dealing with the outcomes of the case studies, it seems necessary to reiterate three cautionary points here.

Firstly, in the area of studies similar to the present study, the establishment of a confident cause and effect relationship between selection criteria and subsequent performance is an almost impossible task, simply because it is not possible to apply any control sample or experimental condition. Neither is it possible to monitor all the mediating factors and take them into consideration. Therefore, we inevitably draw on a number of findings which cannot be regarded as fully definitive. Nevertheless, they are comparable to small and isolated signs in a mainly untrodden terrain for which no clear map exists.

Secondly, as was the case with similar studies, it was not possible to select our samples through a 'simple random sampling' procedure which is ideal for inferential studies. However, there is no strong reason to assume that our samples are far from what a 'cluster sampling' would return.

Thirdly, to control the effect of latent factors our initial samples were reduced to more homogeneous but rather small samples in size, and this may limit the generalisation of the findings. We could have not excluded heterogeneous segments to have larger samples. In that case, however, the heterogeneity of the sub-samples would have led to distorted results. Altogether then, the application of the findings to less similar settings should be conducted with proper caution.

7.3. Findings of the Second Part: (Empirical Studies)

The major findings of the empirical part were as follows.

- Dissimilar predictive results were found for the two selection methods.
- The General part of the entrance exams appeared to be superfluous.
- Candidates had a very poor prior familiarity with the course.
- Relationships were found between non-academic factors and academic performance.
- The 'First Year Average' showed the best predictions of the subsequent performance.
- Both positive and negative aspects were associated with the alteration in the selection method.

Each of the above items is discussed in more detail below.

7.3.1. Dissimilar Predictive Results of the Two Selection Methods

The entrance examinations did not work alike in all the universities. The predictive ability of the design-inclusive, and design-exclusive entrance examinations was dissimilar for the schools which were based in different types of universities. On the whole, the design-inclusive entrance examination returned far better predictions than did the other examination, for students in the schools which were based in the comprehensive universities. The latter universities are also known to give equal importance to both the scientific/technological and artistic dimensions of the course. The design-exclusive examination, however, appeared to work better for the technologically-based school. (For this school, it was the Specialised part of the examination which showed some moderate predictions.)

Discussion:

Our data did not include consecutive cohorts under the same admission criteria, therefore, we cannot say how consistent the predictive ability of the selection criteria will be over the years in the same school and under the same method. Among the reviewed literature, the only research which studied this subject (i.e. the Bartlett study, Chapter 2) did not find a consistent result. This, however, should have been expected, because during the course of the Bartlett study, the school had been experiencing radical educational changes (Nuttgens 1988; Symes 1989). Evidently, this was not the case with the schools of our study. Nevertheless, if such results are susceptible to high variation in the same school, then it is more likely to arrive at dissimilar results among different schools. The above finding, therefore, seems sufficient to question the use of identical entrance exams for entrance to all university schools of architecture. Moreover, apart from the matter of different predictive results, evidence was found that the new selection method was associated with contrasting (ascending or descending) performance trends in the Design area in different schools. (Chapter 5, Section 5.4.1)

7.3.2. Superfluous Part of the Entrance Exams

The Specialised stage of the entrance examination on its own showed a comparable predictive ability to that of the entire examination (which consists of General and Specialised stages). This was true for both design-inclusive and design-exclusive methods of student selection. This tends to call into question the implementation of the General stage which involves a great expenditure of time, energy, and other expenses on the part of both administrators and candidates.

Discussion:

This finding is comparable to what was found earlier in the Bartlett and Kansas schools of architecture (Abercrombie et al, 1969; Domer and

Johnson, 1982): the combination of two or three predictors returned better predictions than those of a single predictor, but the inclusion of more predictors hardly made any further improvements. If further research (on a larger number of cohorts) corroborates this finding, then little academic justification can be found for the implementation of the General part of the entrance examinations.

7.3.3. Lack of Prior Familiarity of Candidates with the Course

Our survey of students revealed a poor average of prior familiarity with the course among the students, irrespective of the method through which they were selected. Only about 15 per cent of our respondents showed they had sufficient familiarity with the course before starting it. Nearly half of the remainder had just acceptable prior familiarity, and the other half had no prior acquaintance at all. Evidence was also found that students' previous conceptions of the course were farther from their real experience of the course in terms of educational methods than was the case with the contents of the course. (Chapter 6, Section 6.2.1, Questions 6 to 8).

Discussion:

The problem of poor prior familiarity is a subject that was also clearly reflected in the Bartlett and Kansas experiences (Abercrombie et al, 1969; Domer, 1980). The studies, however, did not investigate the possible relationships of different levels of prior familiarity to academic performance. Our survey of admissions tutors did not show a better prediction of students' performance in the schools which employed a process of prior familiarisation with the course. It should be noted, however, that this finding relied on the subjective views of the admissions tutors, and not systematic investigations. We examined the relationship of prior familiarity to subsequent performance for two of our samples (which were sufficiently large) and found modest to large and significant correlations with Design and Overall Average.

7.3.4. Relationship of Non-academic Factors to Academic Performance

The survey of students also showed that, apart from prior familiarity, non-academic variables which tended to gauge students' motivation and interests correlated with the major measures of subsequent performance. Because of the limitations of our work, it was not possible to examine this finding for large samples in different university schools. Nor was it possible to prove a causal relationship. Nevertheless, this finding is strongly supported by educational psychology literature which, along with cognitive factors, gives substantial importance to motivational and interest factors (see for example the work of Schiefele et al 1992, which reviewed a large number of studies on the relationship between interest and academic achievement and concluded the existence of such a relationship).

7.3.5. 'First Year Average': the best predictor

Similar to the findings of Domer and Johnson (1982), the 'First Year Average' variable returned the strongest correlations with subsequent performance. This should have been expected at the outset, because the variable consists of a generic scoop of whatever comes later (although in larger extent and complexity) during the course. The general superiority of 'First Year Average' has practicable implications which are discussed below.

7.3.6. Positive and Negative Aspects of the Alteration in Selection Method

The comparison of the two selection methods showed that, on the one hand, the new method was associated with the following positive outcomes.

- A statistically significant rise in the entrance examination scores.
- Evidence of a corresponding (significant) rise in the collective performance of students in *only* 'non-design' areas of the course (isolated cases).
- A decrease in the rates of fail (and resit) during the course.

On the other hand, several problematic issues were found to exist concurrently with the new method.

- A considerable fall was found in the relationship of the new entrance examination scores to the subsequent academic performance of the selected students (in the schools which were based in comprehensive universities).
- Despite the lower rates of failure, those who failed in one or more courses of the Calculative area (which has the closest link with the scientific and mathematical qualifications) had significantly higher entrance scores than

those who were selected through the old method and had successfully passed all the course subjects in the area.

- Evidence was found that the new method of admission selected students who, not only in terms of academic qualifications but also in terms of personal backgrounds, differed from the otherwise selected students.

  On the whole, those students who were selected through the new method had studied in more advantaged high schools, but (1) were less interested in the artistic and visio-spatial subjects, and less frequently involved in such tasks/activities, and (2) they had also decided later, and more incidentally or because of secondary reasons, to study architecture.

- An increasingly larger proportion of the students who were selected through the new method showed a preference for a transfer to other courses. Such differences between the 1995 students and their 1993 and 1994 fellow students, respectively, reached a statistically significant level.

Discussion:

Should our attention be drawn to the full or empty half of the glass? Taking all the above findings into consideration, it does not seem easy to prefer one methods over the other. Evidently, if we focus only on the (first three) positive aspects, we will, no doubt, prefer the new method because, from that perspective, it can be claimed that the collective performance of those who are selected through the new method is comparable to that of the otherwise selected students in the Design area, and yet, often better in other areas. Moreover, what supports the preference of the new method is the lower rate of failure among the students who are thus selected. This, however, constitutes only one side of the coin. In the case of preference for the new method, a number of serious questions remain to be answered. We return to the above 'problematic' issues to discuss them in more detail below.

Firstly, how can the fall in relationships between the 'final selection criterion' and measures of subsequent performance be justified? We saw that between only 2 to 10 per cent of the variation in students' Overall Average (over the course) could be accounted for by variation in the final selection criterion (the average of 45 cases of predictive correlations in three university schools was 0.11). This seems to be too small to justify the predictive relevance of the selection criterion for the interested applicants or an independent observer.

It might be argued that, in view of the higher entrance scores, the small size of the correlations should be attributed to a ceiling effect, i.e. the small variations of the predictor variable(s) at the 'right tail' of the distribution curve of abilities. The answer is that: while such small variations are likely to have some suppressing effect, they cannot be held responsible for the entire observed falls. The main explanation seems to be a plateau or peak effect: where above a certain level the influence of the independent variable tends to flatten or even change direction. We saw that 'First Year Average' had a far less relative variation than did the entrance score variables. The former variable, nevertheless, returned larger and more consistent correlations with its subsequent performance measures than did the latter variables.

Secondly, the instances of failure in the Calculative area despite higher entrance scores (than those of otherwise selected students who passed the area without any fail) suggests that the new method's high entrance scores on their own cannot guarantee uninterrupted and smooth completion of even a closely related area.

Thirdly, a non-intellective problem seems to have emerged (or intensified) among the students who were selected through the new method. Because, apart from the above problem of unexpected failures among the high scorers, evidence was found for (1) a rise in the share of more incidental and secondary reasons for the choice of the course, and (2) a rise in the proportion of the students who preferred to transfer to other courses. These three converging pieces of evidence tend to suggest the existence of a mismatch between personal inclinations/dispositions of these students and the characteristics of the course. (This reminds us of what was observed in the Kansas School's study where withdrawers from the course had higher mean high school GPA than graduates. See the Chapter 2, Section 2.3.2).

Drawing on Theories for Further Clarification

The above problems seem to be explicable in the light of some psychological theories and findings. Literature on educational psychology emphasises the positive effect of motivation, and match between a learner's dispositions and the characteristics of the subject and environment of learning, on the learner's performance.

It was mentioned earlier that a number of independent studies have found evidence for a relationship between students' interests and their academic performance (Schiefele et al, 1992). It is also opportune to make a short detour here to briefly introduce a theory which seems helpful for the explanation of the above problems.

Proposing a new theory of thinking styles, Sternberg's (1997) main contention is that 'thinking styles are as important as, and arguably more important than, abilities, no matter how broadly abilities are defined.' To borrow the theoretician's exact words, a short definition of a style is 'a preferred way of thinking'. The explanation of about a dozen styles proposed by the new theory is beyond the scope of the present work. Suffice it to say that, for example, one of the styles involves preference for making one's own rules and ways; another one deals with the preference for being 'given guidance as to what to do or how to do'; another style has to do with tendency to 'evaluate rules and procedures and to judge things'; and so on. A number of principles govern the theory. Some of them which represent a broad perspective of the theory are as follows.

- *Styles are preferences in the use of abilities, not abilities themselves.*
- *People have profiles (or patterns) of styles, not just a single style.*
- *A match between styles and abilities creates a synergy that is more than the sum of its parts.*
- *Life choices need to fit styles as well as abilities.* (Sternberg, 1997; pp79-99).

Equally importantly, Sternberg also maintains that in our social life we tend to 'confuse stylistic fit with levels of abilities'.

In essence, the theory has some similarities to the Personality Types theory on the basis of which the Myers-Briggs Type Indicator has been developed. Remember that on the latter tool, Durling (1998) found significant differences between designer (professionals and students) and non-designer samples in their cognitive styles, but his study did not expand on the relation between the styles and academic achievement (see Chapter 2, Section 2.2.5).

If the theory corresponds to real life experiences, then it will have significant implications for education.

This has been one of the theory's aims at the outset, and has materialised to some extent. The theory is still young, and has not been examined on a wide and inclusive scale. Nevertheless, the theoretician and his co-workers have tried it in a number of educational settings and have found modest but significant links between the styles and academic achievement, after the relations were controlled for abilities (Sternberg, 1997; pp 123-132).

7.3.7. Revisiting the Cases

To return to the main thread of our discussion, if the actual circumstances of our student selection are seen in the light of the 'thinking styles' theory and the findings of the 'interests' research, then the most likely reasons behind the observed drawbacks become explicable.

We saw that secondary education does not provide students with sufficient opportunities for systematic familiarity with Art and Design, and the identification and development of their related abilities. Therefore, no formal appraisal of students' abilities in those areas is available to them before the entrance examination. Moreover, candidates are generally very unfamiliar with both the content and delivery methods of the course. No open day or other effective processes provide a *tangible* prior familiarisation with the course for the candidates. In this situation, the configuration and credits of the entrance sub-exams, which are officially declared before the entrance examination, have a substantial implication. In the highly competitive circumstances of the entrance examinations, those who are strong in maths and sciences show reluctance to apply for architecture when design/drawing tasks are included and given a heavy weight. In fact, due to the lack of familiarity with the course, such candidates may think that the course is overly artistic and they cannot benefit from their strengths in maths and sciences. Moreover, because of the lack of any comparable index of their artistic abilities (even for those who have such backgrounds) they cannot estimate their chances of success in the design related sub-exams. Therefore, they prefer not to take the risk in the first place. As a consequence, candidates with lower levels of maths and science abilities are attracted to the course, and this leads to a generally higher rate of failure and resits during the course. It should also be noted that in our entrance examinations no minimum requirement in any sub-exam was stipulated. Therefore, it was possible for a candidate to compensate for his/her weakness in maths or sciences by his/her strength in the design related sub-exams.

The inclusion of the design related sub-exams, however, appears to have a major benefit which is the communication of a more realistic image of what goes on in the course to the minds of the candidates. In one way or another, it transfers the message that the course does not rely solely on the didactic methods of secondary education, and it welcomes the candidates who are also prepared to switch to other modes of reasoning, learning, communication, etc.. Therefore, despite their relatively lower maths and sciences abilities, candidates who are thus attracted appear to be better attuned to the course and lower rates of dissatisfaction are observed.

Conversely, when the design/drawing sub-exams are omitted and physics is given a heavy weight, candidates may think that creative and artistic matters (if existing at all) are trivial issues in the course, and they can safeguard their access to a higher education course by investing in their confident strengths in maths and sciences.

Superior academic background in maths and sciences is very likely to be indicative of the sorts of reinforced cognitive abilities, thinking styles, and/or strategies which suit 'well-defined' problem solving situations. However, if those kinds of abilities and styles are not coupled with some other complementary kinds, a successful performance in 'ill-defined' problem solving circumstances cannot be warranted. Evidently, generic programmes of architectural education involve both the ill- and well-defined problem areas (e.g. building sciences, and design studios respectively). Therefore, candidates need a profile of abilities and styles which is responsive to both circumstances.

When the entrance examination checks only for maths and sciences abilities, other rudimentary abilities and inclinations remain unidentified and unmeasured. In that case, some entrants may and others may not have adequately developed such qualities. Those entrants who also have the advantage of having complementary abilities and styles are very likely to manage a good performance during the course. Others, however, may fall into one of the two following categories.

Firstly, those who have not sufficiently developed complementary qualities but have competent study skills, flexible thinking styles, strong 'achievement' motivation, etc.. These students are also very likely to gradually adapt to the course and do well.

The second category consists of those students who are chiefly adjusted to the logical methods of mathematical reasoning, are happier to deal with determinative formulae, seek definite and right answers to all kinds of problems and are not happy with uncertainty. These students are very likely to find it difficult to adjust to the educational methods of the course, especially in the design area which has a central role and almost dominates other areas. As a consequence they may lose their motivation to make an effort even in the areas which match their abilities. Hence are the cases of failure despite high entrance ranks. We found evidence that in some cases, top rankers of the new selection method failed to perform any better than their otherwise selected peers. We also found evidence for clear differences between those who preferred to transfer and those who did not, in their familial artistic inclinations, and reason for the choice of the course (Chapters 5 and 6).

7.4. Proposal

Positive and negative aspects of the alterations made to the Iranian student selection method for studying architecture were discussed above. It seems clear that despite the drawbacks of the new method, it is not defensible to ignore its advantages. However, at the same time it is unjustifiable to overlook its shortcomings, and not to think of remedies.

Is it possible then to think of a third selection method which enjoys the positive aspects of the old and new methods and circumvents the negative sides? The present author believes that a better selection method is attainable. However, this does not mean that a straightforward and detailed solution is available. The main effort made in this research was focused on the identification of the consequences of the two methods, and the available data was not sufficient for further inference.

More information is needed to be able to go into all administrative details of a new method. With the benefit of our findings and the insight gained through this research, we can now propose a number of suggestions for improvements to the current method of student selection for studying architecture.

7.4.1. School oriented sets of selection criteria

Instead of unified sets of selection criteria which are administered through central examinations for all schools of architecture, each school needs to have its own particular set of criteria for student selection (except for schools which prove to be similar in their orientation, preferences, and methods).

The reasons behind this recommendation are as follows.

1. Dissimilar patterns of correlation (between selection criteria and subsequent performance) were found for schools of dissimilar orientation.
2. The schools showed different responses to the inclusion or exclusion of design-related sub-exams.
3. The rise in the entrance scores was associated with different effects in different schools.

The above items suggest that despite the application of a unified curriculum and syllabus, each school has its own interpretations of the programme and applies its particular preferences.

These preferences and the application of a unified curriculum and syllabus are not mutually exclusive in practice. The concept of 'hidden curriculum' is a familiar notion in (the sociology of) education[2]. Rowentree (1994, p48) defines it as a 'range of implicit demands that often runs counter to the explicit aims of the official curriculum' in an educational setting, and Anthony (1991, p12) interprets it as 'the values, virtues, and desirable ways of behaving that are communicated in subtle

[2] The first use of the term 'hidden curriculum' is attributed to Philip W. Jackson (1968) in his criticism of the negative sociological consequences of schooling. The term has been widely used in the subsequent works of other authors who take a critical view of the 'hidden' norms which mass education cultivates (see Snyder, 1971; Lynch, 1989; for example).

ways in every field.' She goes on to comment that the effect of hidden curriculum is often stronger than that of the official curriculum.

Design situations are fraught with inevitable incidents of subjective decision making and value judgement. Therefore, architecture is one of the fields in which plenty of room remains for hidden curricula or agendas, and this is a very tangible experience for those who are closely involved in the course and/or profession.

Further Considerations:

The exercise of school oriented selection criteria involves two prerequisites.
Firstly, it necessitates that schools identify and communicate their particular goals and preferences as clearly as possible to be able to portray the qualities they seek in their ideal products (i.e. students and graduates). Because of a wide range of uncontrollable mediating factors, selection assessments are bound to be inaccurate processes. What seriously aggravates the situation is equivocalness about the end product of education. How can we decide on our selection *means* without a clear image of the *end* for the fulfilment of which we are going to select?

Secondly, continual monitoring and study is necessary to identify the best predictors of the desirable qualities and abilities. Previous and present students' records in each school are potentially illuminating sources in this regard, and correlation and regression techniques provide helpful tools for that purpose. Undoubtedly, no perfect result will emerge. However, conventional predictors may show, as they did, different effects in dissimilar schools.

When these two requirements are met, it is possible for each individual school to apply its particularly fashioned admission equation through a centralised entrance examination. One school may give a specific weight to a sub-exam, another school may give higher or lower, and a third school may require another subject instead, depending on the patterns of performance the schools have observed among their students. Since chemistry and physics sub-exams showed trivial relationships to performance during the course, it is very likely that they may be replaced with other science or humanities subjects.

7.4.2. Reintroduction of a Design-related Sub-exam

It is advantageous to reintroduce drawing and design tasks into the entrance examinations for those schools which give equal importance to scientific and artistic aspects of the course. As regards schools with scientific and technological inclinations, no firm recommendation can be made before further evidence is found.

The reasons behind this recommendation are as follows.

1. The design-inclusive entrance examination showed stronger relationships (than those of the design-exclusive examination) to the subsequent performance of students in the schools which fell in the middle of the art-science range.
2. The proportion of students who felt dissatisfied with the course was smaller among the students who were selected through the design-inclusive examination.
3. Several non-academic characteristics which correlated with performance during the course were more frequent among the students who were selected through the design-inclusive examination.
4. Our survey of the fourth and fifth year students showed that students believed 'drawing abilities' and 'artistic interests' were the two 'supportive abilities or characteristics' they had most benefited from during the course. About 70 per cent of the respondents also believed that the inclusion of a design-related sub-exam would improve the selection, while only 6 per cent held the opposite view.
5. From among all the predictors, 'First Year Average' returned the strongest and most consistent correlations with subsequent performance (this was also true for the technologically based school). The plausible explanation for this is the fact that constituents of the variable bore close resemblance to the ingredients of the course. This is in tune with the implications of the theories of transfer of learning which suggest that (especially for the novice) what has been learned in a task is less likely to be transferred to a dissimilar task, than is the case with a similar task (Weisberg, 1993). Therefore, the more similar the components of the entrance examination with the constituents of the course and the processes involved, the more likelihood of reliable predictions of students' future performance.

6. Little evidence was found to support the view that a significant rise in scientific entrance scores would lead to a better performance in the Design area of the course. We checked a series of null hypotheses of no difference between the collective performance of students who were selected through the design-inclusive, or the purely scientific entrance examination in the Design area. It was not possible to reject any of the hypotheses.

Further Considerations:

We saw in Gartshore and Mayfield's (1988) study that the stipulation of high or low A-level points for entrance to British schools of architecture would attract students with strong maths and sciences, or art backgrounds respectively. Correspondingly, we saw that emphasis on scientific, or drawing sub-exams in the National Examination for entrance to Iranian schools of architecture would attract different kinds of students. Emphasis on mathematical and scientific sub-exams only was associated with significantly lower levels of artistic backgrounds and interests among the students thus selected. Do such experiences imply then that being strong in both scientific and artistic areas are mutually exclusive? The answer is definitely negative. While the proportion of such candidates is conceivably smaller than those who are strong in only one of the two areas, the dominance of the scientific or artistic background in schools should be attributed to their selection criteria. Because, in the same study, Gartshore and Mayfield showed that despite the majority of schools which required only high or low A-level points, there existed a number of schools which, in addition to high points, required evidence of artistic abilities and did attract candidates with both scientific and artistic strengths. Likewise, our survey of students showed that such students also existed among our samples and performed well. However, because of the applied methods of selection, they did not constitute a large proportion.

But how can it be ascertained that the reintroduction of design-related tasks will also attract the candidates who are also sufficiently strong in maths/sciences, and it will not lead to the reappearance of the drawbacks of the previous design-inclusive entrance exams? The answer to this question involves a new requirement which is introduced below.

7.4.3. Implementation of Threshold Scores

A candidate's weakness in a part of the entrance examination which shows a noticeable correlation to a particular area of the course should not be compensated for by a high score in another part which is poorly related to the same area of the course.

For instance, where a Maths sub-exam shows a relationship to the Calculatives area of the course, but a Drawing sub-exam does not, and evidence is found that below a certain score in Maths the probability of failure in the Calculatives area is high, a candidate's strength in Drawing should not compensate for his/her weakness in Maths, in the entrance examination. In such cases, a minimum level of a Maths score (or a threshold) should be stipulated.

In practice, however, no such control has been exercised in any of our two studied methods, because importance has been given only to the (weighted) average of the various sub-scores in each entrance examination.

The reasons behind this recommendation are as follows.

1. Our findings indicated that from among students who had entered the course through the design-inclusive examination, those who successfully passed the entire Calculatives area had significantly higher scientific scores than students who faced fail(s) and resit(s) in the area.
2. We also observed that a collective rise in Scientific scores (in the entrance examination) was associated with fewer cases of fails and resits in the Calculatives area of the course.

Further Considerations:

Students' records of entrance scores and their course marks in each school provide the data for deciding on the limits of the thresholds. The larger the number of cohorts (and students) taken into consideration for setting the thresholds, the more confidence in their accuracy and relevance.

If, through the study of previous records and results, such necessary thresholds begin to emerge, this would be a major step towards the establishment of a 'criterion-referenced'student selection method.

7.4.4. Provision of Prior Familiarisation with the Course

Opportunities for gaining tangible familiarity with the course are necessary before a hopeful candidate finalises his/her application. Often, candidates' conceptions of the course are superficial and built around biased and inadequate information. Such information usually stems from the stereotypical images of the architects and the profession which are different from the *education* (contents and processes) with which the new students will have to engage. We saw that the majority of students had a poor prior familiarity with the course, and this was worse regarding the educational methods of the course than it was with the course content.

A booklet with properly fashioned information may satisfy the minimum requirement of familiarisation. However, it may not be as useful as visits to schools and hearing about the course from one or more experienced educators. What would be more helpful would be to provide the hopeful candidates with opportunities of direct contact with live educational incidents, both in lectures and especially in studios. It is also advisable to give these candidates the chance to meet present students to learn about their actual experiences of the course as against their preconceptions. These complementary steps of familiarisation are also helpful to communicate to the prospective students the ethos and preferences of the schools.

7.4.5. Promotion of Diversity, and Facilitation of Transfer between schools

Due to the breadth of the discipline, it is advantageous to promote diversity of focus within and among the schools of architecture. This will provide opportunities for both schools and students to direct various abilities and talents to their favourable environments. There exists an administrative prerequisite to the fulfilment of this aim, however. That is the facilitation of the regulations of transfer between schools which have been rather too strict.

Selective admissions are not flawless processes. There are always segments of intakes who begin to feel dissatisfaction with their course after a while, despite their academic abilities. We saw in our case studies that despite a rise in academic abilities at entrance, the percentage of the students who preferred to transfer to other courses increased. This kind of student suffers a sort of mismatch between his/her inclinations, and the modes and habits which the course favours. They will be more successful in environments which are more in tune with their cognitive abilities and preferences.

This reminds us of a subtle point raised by Lavin (1965) after his review of about 300 studies on selective admissions. Stating his doubt about the possibility of arriving at a reliable predictive model, Lavin maintained that 'admission decisions are not the only use to which predictive models can be put'. But rather, he proposed them as 'a basis for modifying organisational structure, thus aiding the attainment of educational goals.'

7.4.6. Complementary Issues

During the course of this research we also arrived at a number of secondary findings and issues which do not fall into the main focus of our study. However, since their implications bear relevance to the matter of student selection processes they are worth taking into consideration.

- More attention should be paid to art and design education in secondary education. Not only does this introduce the students to a separate field of knowledge and inquiry, but it also provides them with the opportunity to learn about their potential and inclinations in those areas. The understanding of their artistic and design-related abilities will be a key aid to them in decisive moments of decision making about their further education and career choices.

- Little evidence was found to support the use of student selection interviews.

Selection interview is one of the constituents of student selection procedures in many universities world-wide. However, among the tools of selective admissions, interviews have generally proved to be poor instruments, if they are intended for the prediction of subsequent performance (Lavin, 1965; Abercrombie et al, 1969; Trost, 1979; Klitgaard, 1985). Little is known about the cases for which a relationship is reported between interview and performance, as to how the interview would do if other ability factors were controlled. The maintenance of objectivity and standardisation of the interview situations is extremely difficult and this is worse when the number of applicants is high. Relatively reliable interviews need a high level of expertise on the part of the interviewers.

For the purpose of guidance and counselling, however, interviews are regarded as useful. Limited use of interview is recommended for selection from among extreme segments (e.g. a limited number of top rankers or borderline cases) and for gauging the qualities which more objective methods (e.g. written exams and tests) fail to detect.

- No recommendation can be made about the use of psychological tests at present, despite the fact that some evidence was found in their favour.

From among 28 admissions tutors who responded to our survey about their student selection processes, only one referred to the application of some psychological tests (such as 'spatial skills, 3D visualisation, divergent thinking') among their admission criteria, and the application of a personality test for none-selective purposes. He did not comment on the specific effect of such tests, but rather, he reported that it was the combined score of a series of predictors (including the tests) which showed correlations to performance measures.

In relation to selection purposes, psychological tests can be classified into two broad categories. One, the tests which deal with personality; and two, the tests which take a narrower scope and deal with limited areas of a person's potential or abilities (e.g. divergent thinking, spatial abilities, etc.).

- Empirical evidence was found that designers/artists and other groups of people responded differently to personality tests (see Chapter 2; and Coghill, 1992). However, there is a general disapproval of the application of personality tests for the purpose of selection for various reasons, including the fact that one should not be penalised or rewarded for qualities beyond his/her will and control (Mitter, 1979). Moreover, little is known about the extent of the academic influence of such differences.

- The use of the second type (i.e. non-personality) of tests is regarded as legitimate in selection purposes. This relies on the assumption that key abilities required for a reasonable performance in a field are identifiable, and that these tests can return acceptable measures of those abilities. Tests of divergent thinking, and spatial ability, for instance, are generally believed to be related to performance in design courses. McFarlane Smith (1964) and Stringer (1971) found relationships between spatial ability and academic performance in technology and architecture courses, and more recently Clausen-May and Smith (1998) re-emphasised the significance of such abilities in earlier educational stages.

However, no firm recommendation can be made regarding the application of these aptitude tests in the Iranian student selection processes for studying architecture. Direct use of these tests is not common in Iran and we do not know about their results. A thorough investigation is needed to examine their applicability in a culturally different context, and to see whether they add to the efficiency of the presently available predictors.

Nevertheless, it seems feasible to design a kind of design-related sub-exam which is able to imitate some of the functions of the above tests. Greenway (1990) showed that it was quite possible to devise tests to model the decision-making process of a selection panel for selecting landscape architecture students.

On the whole, the use of neither interviews, nor psychological tests can be recommended in Iranian student selection processes for studying architecture. However, their use will most probably be helpful for the guidance of the applicants.

- In view of the strong relationship of 'First Year Average' to performance measures, one may argue in favour of large numbers of intake at the beginning of the course and deferral of selection until the end of the first year (as is practised in many places). This, however, is not practicable in our cases for two reasons. Firstly, it demands many more facilities and resources than is practically available in the university schools. It is not possible to provide for this excess load in the short term. Secondly, a large number of drop-outs at the end of the first year is an unprecedented issue in the country's higher education and would most likely provoke social reactions.

7.4.7. Summary of the Proposal

- Instead of a unified entrance examination for all schools, each school should identify and apply its own selection criteria.
- A design-related sub-exam should be reintroduced in the examinations for entrance to those schools which give equal importance to scientific and artistic aspects of the course.
- Threshold entrance scores should be identified and introduced for dissimilar areas of the entrance examination.
- Processes of prior familiarisation with the course should be introduced.
- A variety of educational foci should be promoted (within and among the schools), and processes of transfer should be facilitated for students.
- Art and design education in pre-university stages should be developed.

7.5. Further Study

Among the very few systematic studies on Iranian architectural education, the present study was the first to address the subject of student selection. During this research an attempt was made to unfold various aspects of the subject. However, this area is too complicated and multi-faceted to be covered thoroughly in a single study, and many angles remain to be explored.

After the completion of this research the present author is now interested in learning more about several topics related to this work, and would like to suggest them for further study.

Before the introduction of the topics, however, it is necessary to emphasise the need for the extension of our study to a larger number of samples to see how consistent the results remain. Extra investigation is needed for the smaller sub-groups of students (e.g. female and Special quota students) who were not included in all parts of our study for technical reasons. This a prerequisite to the practical application of the outcomes of this research. Equally importantly, richer data is now available. Our case studies dealt with the 1993 and 1994 cohorts (i.e. the only pairs of cohorts whose information was available at the time of the data collection). However, one of the author's colleagues, who is very attentive to both the backgrounds and academic growth of her students, stressed that she witnessed stronger differences between the 1993 and 1995 cohorts. She believed that the swift access of the maths and science-oriented candidates to the course in 1994 had attracted more candidates of that kind who otherwise would have had to compete harder for entering courses such as electronic engineering. Therefore, it seems opportune to replicate the present study with the data of the newer cohorts.

Proposed topics for further study

1. Consistency of the Educators' Assessment of Students' Work

One of the assumptions in the present study was that educators apply consistent standards for the assessment of students' academic performance. This is not limited to our study, and without this assumption both pooling and comparison of students' marks/grades are impossible. Even in studies which cover a long period of time and a large number of subsequent samples such assumption is held.

It is plausible to hold such an assumption for large scale assessments (e.g. public testing, or national examinations) because monitoring and standardisation processes are applied. However, it is not necessarily true about the assessment of students' performance and progress in the schools, especially over long periods of time. Yet, the maintenance of consistency of assessment may be easier in one subject, and difficult in another. The prospective study may include investigations into the: (1) consistency of individual educators' marking standards over time, (2) degree of agreement among different educators' assessments of the same work, (3) relative consistency of assessment in different areas of the course, etc..

2. Graduates' Patterns of Activity in Practice

We found indications that both academic and non-academic differences existed between the students who were selected through one of the alternative selection methods. A question comes to mind as to whether these differences are also reflected in the patterns of careers the students join or take up during or after the completion of their course. The findings of such a study would broaden our understanding of the possible influences of the selection methods on profession.

3. Relevance of Graduates' Abilities to Practice

It is important to investigate the graduates' real life abilities when they join the architectural profession. No such study has been carried out in Iran relating to architecture graduates. However, the findings of such a study, which highlights the areas of students' strength or weakness, could contribute to the rectification of the curriculum. In this way, such findings could indirectly influence the student selection criteria.

EPILOGUE

What was presented in the preceding pages was the product of a four year endeavour which benefited from diverse sources of information and inspiration to exhibit and investigate a perennial problem right at the beginning of architectural education: justifiable selection of students from among large numbers of candidates.

Having the opportunity of tackling such a multi-dimensional, and very occasionally-addressed problem is rewarding in itself. However, what has been similarly valuable to the present author, is what could be referred to as a sense of evolution in his view on the problem and its study, during the course of this research.

Not only did the research require the analysis of sets of quantitative data and the study of related empirical evidence, but also it demanded on the part of the author to familiarise himself with various interdisciplinary theoretical arguments and experts' views (which were elicited from literature, interview, etc; and) without which it was not possible to delve into the diverse aspect of the problem.

Drawing on this accumulated understanding, and with the advantage of hindsight, it is now timely to reflect on the study and view it in a wider perspective; because the combination of, at least, two sorts of constraints, namely time, and methodological considerations, imposed limitations to the present work.

It is hoped that the following reflection will inform the prospective reader/researcher of those aspects of the present work which, circumstances permitting, could have been improved, or investigated in more depth as a separate research.

First, two methodological, and then, a broader and more important point are made below.

1. The first issue concerns the exclusion of female students from parts of the research which involved correlational or comparative analysis of performance measures. Convincing evidence for dissimilar characteristic patterns of academic significance between male and female groups of students has been demonstrated in educational studies (e.g. Abercrombie et al, 1969; Schiefele et al, 1992; Gipps and Murphy, 1994; Doan and Stiftel, 1995; Sheridan and Bowe, 1996). Therefore, it was argued, in Chapter 5, that because of methodological reasons it was decided to limit our study samples to their largest homogeneous segments, i.e. male students. This segregation would minimise the undetectable effect of extraneous factors which could have distorted the results. However, this technical advantage was at the expense of females' results.

It should also be noted that the number of female students in our samples was too small to be amenable to corresponding quantitative analyses. Were data for larger number of female students available, we could examine how similar or different the results were for the two genders.

In case of the similarity of prospective results for the female and male groups of students, our reported findings and conclusions would be corroborated more strongly. The existence of a significant difference between the two groups' results, however, would imply the bias of the selection criteria, hence the need for the identification and application of alternative gender-neutral selection criteria. In any case, due to the stereotypical bias of the discipline towards the male gender, a thorough examination of the females' admissions, progress, and development over the course seems to be imperative.

2. The second issue concerns our data collection, and in particular our survey of non-academic factors. While the sorts of our collected academic data and their sources are well in tune with the standards of valid educational studies, it would be more advantageous if data for larger numbers of (contrasting) cohorts were obtainable. The (practical) reasons behind this limitation were described in Chapter 5. Nevertheless, the possible shortcomings of small samples should not be overlooked; the larger our prospective samples, the smaller the chance of sampling errors, and the more confidence we can have in our results.

As regards our survey of non-academic factors, the results (specially responses to questions 4 and 5) showed that a larger pilot study had been very advisable to see how well respondents could have responded to particular questions which demanded accurate recall of numeric information. Moreover, as Oppenheim (1994) emphasises, the carrying out of a number of interviews, as a preliminary stage in the design of a questionnaire, is a practical tool for throwing light on the potentially important factors which may otherwise escape the researchers notice.

Another point to mention in connection with data collection (and locating sources) involves the importance of the identification of those experts whose experience and view can make significant contribution to the respective research. In a well-communicated field of knowledge it is easy to identify such experts. However, this is not the case for the poorly communicated areas. The researcher should devise his/her ways of locating the experts of the field. In our case, for instance, the patterns of admissions tutors' responses to the present author's questionnaire were good indicators of further contributions which each respondent could make to our research. This is the special area in which the author would not compromise quality in favour of quantity.

It is also timely here to call the prospective researchers' attention to a couple of current studies whose forthcoming results appear to provide useful stepping-stones in this field. Research has been recently carried out in the University of Oxford, University College, and King's College on admission processes (see McDonald et al, 2001b). The focus of these studies is not necessarily on architecture or design courses, but rather they pursue broader aims, and the third institution focuses on access to medicine. Nevertheless, the findings will be the latest, and worth paying attention to. The (interim) findings of these investigations were not available at the time of the present study. It is hoped that we can benefit from the published reports of these studies in a near future.

3. During this study, the author made his best effort to stay as impartial as possible to observe the requirements of a scholarly research. A problem focused approach was adopted at the outset; and for the sake of objectivity, after the initial theoretical discussions, quantitative investigations formed the major part of our case studies. Likewise, the generalisation of the findings of a certain context to another was kept to a minimum. All these, however, should not preclude the potential implications of the present study for a wider context.

As it was shown in Chapter 4, the structure of the studied (Iranian) architectural curriculum was not different from what can be called a generic model of architectural education. Even the comparison of the studied programme with those of 15 European schools of architecture showed that the share of design area in the Iranian programme was the same as average share of design in the European schools. This, together with the fact that our pivotal findings were in connection with the design area of the course, lend support to the applicability of our findings to other settings of architectural education.

Previous studies on architectural courses have usually evidenced a lack of relationship between didactic student selection criteria and performance results. This, together with our findings reminds us of the point Daley (1984) raised about the nature of design thinking when she proposed that our 'conscious propositional knowledge' occurs at the small junction of (at least) three large systems of 'value structures'; 'linguistic schema'; and 'visual schema'. She claimed that 'conscious mental activity, with its language-based emphasis on propositional knowledge may be the area in which these systems intersect with that of verbal discourse' (p299). According to her model, design thinking mostly relies on visual schemata, then value structures, and just partly on linguistic schemata. Later she said:

> *Only a relatively small (and perhaps insignificant) area of that system of knowing and conceiving which makes designing possible may be amenable to verbal description. To talk of propositional knowledge in this area, or to make knowledge claims about the thinking processes of designers, may be fundamentally wrong-headed.*

For that reason she concludes that:

> *The way designers work may be inexplicable, not for some romantic or mystical reason, but simply because these processes lie outside the bounds of verbal discourse: they are literally indescribable in perceptual terms. (Daley 1984, p300)*

Daley's argument relied on her philosophical and theoretical contemplation. Corresponding evidence from other fields, however, tends to support her view. Take the two following points for instance.

- Methodological investigations into the design thinking processes date back to the early 1960s. It did not take a long while when linear (and ostensibly scientific) models which tended to (over-) rationalise design processes gave way to the 'conjecture - refutation' models. Despite this significant shift, and in spite of voluminous studies on design thinking processes what we know now is still far from an all-encompassing, and descriptive understanding of the phenomenon, let alone a prescriptive model, if plausible at all. However, one of the most recurrent themes reflected in the design studies is the reliance of the designers on non-verbal media to develop and communicate their design ideas.

- Despite the efforts of psychologist, still we know little about the nature of intelligence and its development. What is evident though, is the fact that psychologists can be categorised into two broad camps. Those who believe in and give importance to 'General' intelligence (or *g* factor); and others who believe in the modularity of intelligence (or multiple intelligence). One of the well known proponents of the latter view is Howard Gardner who proposes that visio-spatial, linguistic, logical-mathematical, and several other types of intelligence should be distinguished from each other. According to the latter theory 'each of the proposed intelligences should have some core information processing operations'; and what is more important to our present discussion is that each type of intelligence relies on a certain notation system. It should also be noted that all normal people can draw, to a lesser or greater degree, on all these intelligences, and what differentiates one from another is each individual's particular 'profile of intelligences'.

  Even Mike Anderson, one of the recent theoreticians of the field who supports the notion of General intelligence, proposes that there are at least two 'distinct abilities', one involves propositional thought (e.g. employed in language and mathematical expression), and the other for dealing with visual and spatial functioning (Gardner et al, 1996).

The above points (and similar evidence) lend support to Daley's argument; and this has a marked educational implication for design-centred courses such as architecture. All these suggests that the expectation of a noticeable relationship between solely didactic academic qualifications and performance in courses such as architecture may be unjustifiable in the first place, simply because they rely, to a considerable extent, on discrepant mental abilities and notation systems. Remember that according to our findings, it was the 'first year average' variable which showed the strongest and most consistent relationships with other performance measures, not the entrance exam scores which require more academically laborious and concentrated effort. Our 'first year average' variable was well polluted with the sort of material which is barely detectable in didactic qualifications. Therefore, is not it true, as McFarlane Smith (1964) evidenced long time ago, that conventional student selection criteria are biased towards propositional-knowledge-related abilities, not giving due importance to other abilities of practical significance in real life circumstances.

Some of the classic aphorisms about education seem still alive and applicable. John Dewey's notion of *playful seriousness* is an example. He held the view that ideal mental condition for learning required being 'playful and serious at the same time' (Dewey 1933, p286), and empirical evidence has confirmed the view (e.g. Rathunde and Csikszentmihalyi, 1993). This notion can take two interpretations. One, concerning the provision of favourable circumstances, on the part of the teacher and learning environment, for that combination to happen; the other, capability or inclination of the learner to assume the two moods simultaneously. It is quite conceivable that conventional academic qualifications may indicate a candidate's capacity for *serious* academic behaviour. However, it does not seem plausible to take them for a candidate's capacity for *playful* thinking which appears to be equally important and necessary for (creative) 'designerly' knowing and producing. This is one of the reasons behind the necessity of 'divergent assessment' methods to compensate for the shortcomings of 'convergent' or the-one-and-only-right-answer methods.

Altogether then, both qualitative and quantitative evidence seem to support the need for taking into consideration of certain non-academic factors along with conventional academic qualification for admission to architectural courses. Yet, another point remains to be raised.

It was mentioned that, according to the Universal Declaration of Human Rights, having access to education is an undeniable right for each and every individual. The same document also emphasises that *merit* should be the only stipulation for having *equal* access to higher education. We saw, however, that the definition and indication of merit is a complicated undertaking; let alone the intervention of external bodies such as those responsible for higher education funding which, according to the circumstances, tend to favour and draw towards an 'elite', or 'mass' education. Remember the passage, quoted in the preface, from a well-experienced Admissions Dean in a prestigious university who made an attempt over his long period of career to 'master the art of human assessment', and did not. Literature on education shows that this is a frequently reported experience. Where do all these take us then?

The present author believes that he has found clear answers to his specific questions. However, a broader lesson he has learnt from this research is that 'human assessment' for access to higher education (not necessarily to architecture courses) has no straightforward solution. Lenient methods are susceptible to compromise and high cost (unless accurately monitored and adjusted accordingly), and stringent methods tend to polarise the society; decision between them involves a political or value judgement.

The undeniable fact is that any human selection method, by its nature and the nature of its subjects, is far from being perfect, and this seems to be a significant implication that educational studies like ours can have for educators. The imperfection of student selection methods lends support to other reasons (given in the recent theories of education) why educators should attend to the diversity of their students minds and to take into consideration each students' relative strengths and weaknesses, to help them actualise their potential.

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APPENDICES

Appendix 1

Correlation descriptors

The following table shows the descriptors which the present author used to report his findings in common language, and Figure A1.1 is a graphical comparison of the author's scale with those of two statistical sources.

Table A1.1. Correlation Descriptors

Correlation coefficient range	Descriptor
0.00 - 0.19	Very Low
0.20 - 0.39	Low
0.40 - 0.64	Modest
0.65 - 0.84	High
0.85 - 1.00	Very High

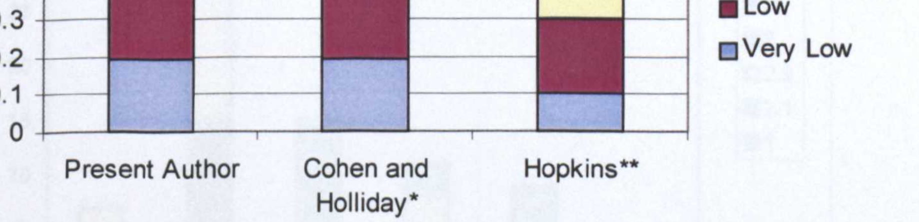

Figure A1.1. Comparison of descriptors' range

*: Cohen, L. and Holliday, M. (1982). Statistics for Social Scientists. London: Harper and Row.
**: Hopkins, W.G. (1997). A Scale of Magnitudes for Effect Statistics [online].
Available: http://www.sportsci.org/resource/stats/effectmag.html [18 May 2001].

Appendix 2 .1

The relation of mean mark in written examinations to studio work:

Bartlett cohorts 1960-64

Cross-tabulation used by Abercrombie et al (1969) to study the relation of mean mark on written examinations to studio work grade in Third Year is shown below (Table A2.1.1). Grey lines represent the cut-off points used for the Chi square test which returned a significant result.

Exams rank	Design work grade					Row total
	1	2.1	2.2	3	F	
1	2	3	2	0	0	7
2	6	9	12	4	0	31
3	2	0	3	10	0	15
4	2	2	4	3	0	11
5	0	2	0	4	3	9
6	0	0	0	2	1	3
Column total	12	16	21	23	4	76

Table A2.1.1. cross-tabulation of design grades and exam ranks
Adapted from Abercrombie et al (1969)

Figure A2.1.1 is a graphical representation of the above table. Group ranks on written examinations are shown on the horizontal axis, and each group's grades in studio work are shown in the bars. As seen in the figure, the design profile of students in exam category 4 is better than that of their preceding category (3), and comparable to the design profile of category 2.

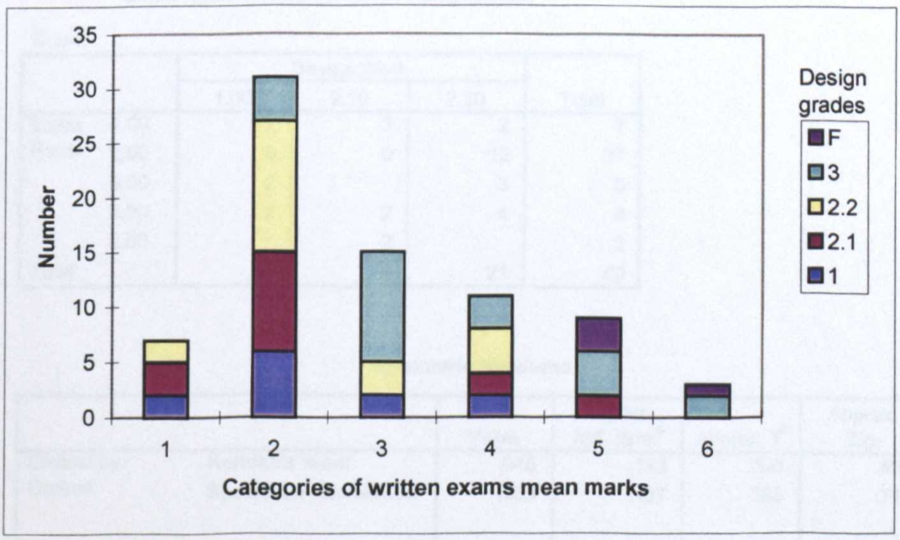

Figure A2.1.1. Distribution of studio work grades on six categories of written examination mean marks *
Cohorts 1960-64, Third Year
*: 1: 70-100; 2: 60-69; 3: 55-59; 4: 50-54; 5: 40-49: 6: 0-39.

On the basis of the data in Table A2.1.1, ordinal correlations were calculated to be able to obtain a comparable measure of relationship between the two variables. The results are reflected below.

Exam * Design Crosstabulation

Count

		Design Work		Total
		High	Low	
Exam Rank	High	39	14	53
	Low	10	13	23
Total		49	27	76

Symmetric Measures

		Value	Asymp. Std. Error[a]	Approx. T[b]	Approx. Sig.
Ordinal by Ordinal	**Kendall's tau-b**	.289	.115	2.439	.015
	Spearman Correlation	.289	.115	2.597	.011[c]
N of Valid Cases		76			

a. Not assuming the null hypothesis.

b. Using the asymptotic standard error assuming the null hypothesis.

c. Based on normal approximation.

A significant but low correlation (.29) was observed between performance in studio and written examinations.

A second test was carried out to study similar correlations for nearly two thirds of the sample (n=49) who had gained above a third class grade in their design work.

Exam Rank * Design Work Crosstabulation

Count

		Design Work			Total
		1.00	2.10	2.20	
Exam Rank	1.00	2	3	2	7
	2.00	6	9	12	27
	3.00	2		3	5
	4.00	2	2	4	8
	5.00		2		2
Total		12	16	21	49

Symmetric Measures

		Value	Asymp. Std. Error[a]	Approx. T[b]	Approx. Sig.
Ordinal by Ordinal	**Kendall's tau-c**	.045	.113	.398	.691
	Spearman Correlation	.053	.137	.363	.718[c]
N of Valid Cases		49			

a. Not assuming the null hypothesis.

b. Using the asymptotic standard error assuming the null hypothesis.

c. Based on normal approximation.

As shown in the above table, no correlation held between studio grade and examinations mean mark for a large majority of the third year students, i.e. those who had gained above third class in their studio work. This implies that the initially observed relationship did not hold evenly among the whole sample.

Appendix 2 .2

The relationship of predictors to performance categories:

Bartlett cohorts 1964-66

In addition to the data about mean scores which were also displayed in the corresponding section, the bottom row of the table (below) shows the 'Spearman rho' correlation coefficients between performance ranks (or performance categories) and the ranks of each category's mean scores on predictor variables (to the left of the means scores).

Table A2.2.1. Mean scores of cohorts 1964-66 on selection criteria, and intelligence test, by degree performance category *

Adapted from Abercrombie et al (1972, p78)

Performance		n	Academic Record		Referee's Report		Candidate's Statement		Interview		AH5 I		AH5 II		AH5 Total	
Categories [a]	1	27	1	7.03	1	7.63	1	7.07	2	5.96	1	19.63	2	24.85	1	44.48
	2	24	4	5.67	5	5.88	3	6.71	4.5	5.45	4	18.46	1	24.92	3	43.38
	3	11	2	6.36	3	6.82	4	6.45	4.5	5.45	5	17.09	4	23.27	5	40.36
	4	9	5	5.33	2	7.11	2	7.00	1	6.11	2	19.56	3	24.44	2	44.00
	5	8	3	6.00	4	6.62	5	5.50	3	5.62	3	18.62	5	21.75	4	40.37
Level of significance of mean score differences [b]				n.s.		p<.05		n.s.		n.s.		n.s.		n.s.		n.s.
Rank order correlation coefficient [c]			.50		.30		.70		-.15		.20		.80		.50	

*: Figures to the left of the mean scores represent the rank of each group mean in the corresponding column.
a: Performance Categories: 1: Class 1 or 2.1 Honours Degree or excellent; 2: class 2.2 or good; 3: class 3 or average; 4: those who took more than three years to gain the degree or weak; 5: failed or drop-outs.
b: As measured by F test (one-way analysis of variance).
c: Correlation between ranks of mean scores and ranks of performance (i.e. categories).

As shown, the largest correlations are observed between Performance Categories and the ranks of mean scores on the diagrammatic part of the intelligence test (AH5-II) followed by similar correlation with Candidate's Statement. The lowest corresponding correlation is found for Interview, followed by AH5-I (the verbal and numerical part of the test) and then Referee's Report. Therefore, despite the significance of difference among the five classes of Referee's Report, the relation of the latter variable with Performance Categories is far smaller than that of the AH5-II which showed no significant difference among its category mean scores.

Appendix 3.1

Admissions Tutors' Questionnaire

1. Covering letter

2. The questionnaire

THE UNIVERSITY OF SHEFFIELD

School of Architecture

Date

Name and Address

Dear ......

With a background of fifteen years of experience in architectural tutoring, at the moment, I am conducting my PhD research on admission procedures for studying architecture. My main interest is the relevance of student selection criteria in terms of the students' subsequent academic performance during their undergraduate course of study.

Since there is a very limited number of empirical evidences or published studies on this theme, I am inquiring about the subject by asking questions from a number of schools of architecture. Evidently, admission criteria could be a factor of preferences and attitudes of schools towards architecture. However, I am sure, any information you (and any of your colleagues involved in this matter) can provide will be of great help in throwing light on the problem and I would be very grateful for your response to the attached questions.

Please send your response to the following postal address or email. Due to the usual time constraint involved in PhD research, your quick response will be greatly appreciated.

If you are interested, it will be a pleasure for me to send you the findings when the research is completed. And finally, I would like to thank you in advance for your kind help in this regard.

Yours sincerely

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QUESTIONNAIRE

NB:

- This questionnaire deals with the <u>first degree</u> of architectural education, which students can apply for after finishing their higher secondary education *(usually about the age of 18)*.
- Identical copies of this questionnaire are also being sent to a number of schools of architecture in different countries. Since the questionnaire is addressing a wide range of respondents, you may find a couple of questions inapplicable to your school. Please ignore inapplicable question(s) while you are kindly requested to answer as many questions as possible.
- If provided spaces are not enough for your answers, please write overleaf or add an extra piece of paper.
- If it is more convenient for you to send your response by email, please send it to the following address, making sure that you mention each question number before its respective answer.

Email: a.izadi@sheffield.ac.uk

1. If we assume that schools of architecture fall within a range of orientation from 1 to 7, where 1 represents the extreme technical orientation and 7 represents the extreme artistic orientation, at which point of the range do you locate your school? *Please indicate by an integer of the range or describe below if you find the range inapplicable.*

Technical orientation						Artistic orientation
☐	☐	☐	☐	☐	☐	☐
1	2	3	4	5	6	7

Other descriptions:

2. Do you screen your candidates <u>mainly</u> before or during the course? *(e.g. selection before the course or first year drop-outs)*

3. Are the student selection criteria completely at the discretion of your school or are they partly/entirely the responsibility of an external body (e.g. a national organisation)? *Please describe briefly the intervening bodies and their respective roles if applicable.*

4. Is there any systematic procedure by which the candidates are familiarised with the course prior to final admission? *(e.g. open day, orientation program, etc.)*
If yes, describe briefly please.

5. What are the main parts of the student selection procedure for entering your school? *(e.g. national examinations or special architectural entrance examination/competition, interview, candidate's statement about their reasons for deciding to study architecture, high school grade point average, etc.)*

6. Do candidates who best meet your admissions criteria significantly turn out to be the best students during the course or is there considerable evidence of inconsistency?

7. Which one of the student selection criteria do you find the best in terms of the predictability of the students' academic performance during the course? And how do you rank the other criteria? *It is quite acceptable that there may be some combined sets of criteria that can serve.*

8. Apart from the conventional requirements against which candidates are checked, are there any other indicators that, if easily accessible, would have enhanced your prediction of candidates' future performance?
NB: If possible, please answer this question 1) regarding overall academic performance in school of architecture and 2) as regards to performance just in design area, i.e. architectural design projects.

9. Are your answers to question 6, 7, and 8 based on overall impressions or have you conducted systematic research on your student selection criteria?

10. If any research has been conducted on the subject in your school, has it been disseminated or is it available in a written format? *Please give details if possible.*
If you could send a copy of any such research that you might have done in your school, it would be greatly appreciated and acknowledged.

11. Bearing in mind that students develop (mentally, intellectually, etc.) at different rates as a result of complex sets of factors, and on the basis of your experience, with which of the following options do you most agree?

☐ a) Admissions criteria, at best, can have the function of checking candidates against some necessary threshold.

☐ b) Admissions criteria are mainly suitable for checking candidates against necessary thresholds; however, they may additionally render modest predictions of candidates' future performance.

☐ c) Admissions criteria can render reliable predictions of candidates' future performance.

12. Could you suggest any source providing further information on student selection criteria and its relationship to the future academic performance of the admitted students, either in architecture or other courses?

Contact details please:

Your personal details:

- Name: ....
- Qualification(s): ....
- Academic title (e.g. Professor): ....
- Contact address and/or email: ....

....

....

....

Your faculty/school/department name and address if different from the above:

....

....

Appendix 3.2

Schools addressed in the survey

British Universites	Response	*International Universities*	Response
1. Aberdeen	✓	1. Algeria, Biskra	
2. Bartlett		2. Algeria, Ecole Polytechnique D' Architecture	
3. Bath	✓	3. Bangladesh, Ahsanullah	✓
4. Belfast		4. Bangladesh, Bangladesh	
5. Brighton	✓	5. Bangladesh, khulna	✓
6. Cardiff	✓	6. Brazil, Alagoas	✓
7. Derby		7. Cyprus, Eastern Mediterranean	✓
8. Dundee	✓	8. Egypt, Assuit	
9. East London		9. Greece, Thessaloniki Aristotle	✓
10. Edinburgh	✓	10. Kuwait, Kuwait	✓
11. Heriot-Watt		11. Lebanon, Beirut American	
12. Glasgow	✓	12. Lebanon, Beirut Arab	✓
13. Greenwich		13. Malaysia, Perancangan dan Ukur	
14. Huddersfield	✓	14. Pakistan, Dawood	
15. Kent Institute of Art and Design		15. Pakistan, Engineering and Technology	
16. Kingston	✓	16. Pakistan, Mehran	
17. Leeds Metropolitan		17. Saudi Arabia, King Fahad	✓
18. Liverpool		18. Saudi Arabia, King Abdul Aziz	
19. Liverpool John Moores		19. Saudi Arabia, King Faisal	
20. Luton	✓	20. Saudi Arabia, King Saud	
21. Manchester	✓	21. South Korea, Kyungpook	✓
22. Newcastle		22. South Korea, Seoul	✓
23. Nottingham	✓	23. Thailand, Chulalongkorn	✓
24. Nottingham Trent		24. Thailand, Silpakorn	✓
25. Oxford Brooks	✓	25. Turkey, Bilkent	
26. Plymouth		26. Turkey, Middle East Technical	
27. Portsmouth			
28. South Bank	✓		
29. Strathclyde			
30. UCE	✓		
31. Westminster	✓		

Appendix 5.1

Closer examination of a correlation: A94 sample

17 students from the A94 sample (N = 19) responded to our questionnaire survey of non-academic factors (described in Chapter 6 of the thesis). The first pair of the following tables show the (Pearson, and Spearman's rho) correlations of Total Score with Design Average for the mentioned (17) students. As seen in the tables the results are comparable to the result of the A94 sample (i.e. .47; p<.05).

Correlations

		Dsgn avrg
Total Scr	Pearson Correlation	.436
	Sig. (2-tailed)	.080
	N	17

Correlations

			Dsgn avrg
Spearman's rho	Total Scr	Correlation Coefficient	.512*
		Sig. (2-tailed)	.036
		N	17

*. Correlation is significant at the .05 level (2-tailed).

The findings of the survey of non-academic factors showed that a number of individual or composite variables of the questionnaire correlated significantly with some of the performance measures. The next pair of tables show the correlations of a 'composite' variable (an unweighted sum of three individual variables[1]) with the Design Average variable. As shown in the tables the 'composite' variable returned better correlations than that of the Total Score variable.

Correlations

		Dsgn avrg
Prior Familiarity + Reason for Choice + Interests and Skills	Pearson Correlation	.607**
	Sig. (2-tailed)	.010
	N	17

**. Correlation is significant at the 0.01 level

Correlations

			Dsgn avrg
Spearman's rho	Prior Familiarity + Reason for Choice + Interests and Skills	Correlation Coefficient	.568*
		Sig. (2-tailed)	.017
		N	17

*. Correlation is significant at the .05 level (2-tailed).

---

[1] The variables included: 'Prior Familiarity' (with the course); 'Reason for Choice' (of the course); and (prior) 'Interests and Skills'. For more details see Chapter 6

Correlations

		Prior Familiarity + Reason for Choice + Interests and Skills
Total Scr	Pearson Correlation	.531*
	Sig. (2-tailed)	.028
	N	17

*. Correlation is significant at the 0.05 level (2-tailed).

Correlations

			Prior Familiarity + Reason for Choice + Interests and Skills
Spearman's rho	Total Scr	Correlation Coefficient	.525*
		Sig. (2-tailed)	.030
		N	17

*. Correlation is significant at the .05 level (2-tailed).

Moreover, as the last pair of tables show, the Total Score variable and the 'composite' non-academic variable are modestly correlated ($p<.05$).

It might be doubted, however, that the correlation between the Total Score and Design Average variables has been due to the effect of the third variable (i.e. 'composite' variable) which is correlated to both of the former variables. There is some evidence to support this contention.

By the use of partial correlation the possible effect of the 'composite' variable was controlled. The result is reflected below. (It should be noted that, due to the SPSS programme's limitations, only the eight-character names of the variables are shown not the user friendly labels, as in the tables above).

```
- - -  P A R T I A L   C O R R E L A T I O N   C O E F F I C I E N T S -

Controlling for..    COMPOSIT

                DSGNAVR

TOTALSCR          .1699
                (    14)
                P= .529

(Coefficient / (D.F.) / 2-tailed Significance)
```

COMPOSIT = Composite Variable

TOTALSCR = Total Score

DSGNAVR = Design Average

As illustrated above, the correlation between Total Score and Design Average falls markedly when controlled for the 'composite' variable, suggesting the marked effect of the latter variable in the initial correlation between the former variables.

Appendix 5.2

Correlations of Diploma Average, Total Score, and Specialised Exam Score with Performance Variables*

* Only those students for whom the 'Diploma Average' variable was available are included in the samples.

A94

			1st Yr Avrg	2nd Yr Avrg	3rd Yr Avrg	4th Yr Avrg	1st Yr Studio	2nd Yr Studio	3rd Yr Studio	4th Yr Studio	Studios Avrg	Dsgn avrg	Tech Avrg	Bldng Sci Avrg	Calc Avrg	Hmn Avrg	Overall Avrg
Spearman's rho	Dipl Avrg	Correlation Coefficient	.169	.273	.328	.364	.318	.438	.507	.328	.378	.378	.141	.292	.080	.692*	.342
		Sig. (2-tailed)	.620	.416	.325	.270	.341	.177	.112	.325	.252	.252	.679	.384	.815	.018	.304
		N	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11
	Total Scr	Correlation Coefficient	.300	.182	.364	.336	.400	.164	.542	.336	.436	.436	.182	.273	.146	.055	.309
		Sig. (2-tailed)	.370	.593	.272	.312	.223	.630	.085	.312	.180	.180	.593	.417	.669	.873	.355
		N	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11
	Spcl'd Scr	Correlation Coefficient	.509	.391	.564	.391	.520	.296	.606*	.327	.491	.491	.373	.391	.469	.118	.427
		Sig. (2-tailed)	.110	.235	.071	.235	.101	.377	.048	.326	.125	.125	.259	.235	.145	.729	.190
		N	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11

*. Correlation is significant at the .05 level (2-tailed).

B94

			1st Yr Avrg	2nd Yr Avrg	3rd Yr Avrg	4th Yr Avrg	1st Yr Studio	2nd Yr Studio	3rd Yr Studio	4th Yr Studio	Studios Avrg	Dsgn avrg	Tech Avrg	Bldng Sci Avrg	Calc Avrg	Hmn Avrg	Overall Avrg
Spearman's rho	Dipl Avrg	Correlation Coefficient	.291	-.035	.112	-.088	.021	-.348	.170	-.158	-.015	-.112	.335	.421	.208	.056	.085
		Sig. (2-tailed)	.274	.897	.680	.745	.940	.186	.529	.559	.957	.680	.204	.104	.441	.837	.753
		N	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16
	Total Scr	Correlation Coefficient	.103	.112	-.029	-.021	-.094	.021	-.084	-.137	-.056	-.121	.050	.125	.132	.085	.068
		Sig. (2-tailed)	.704	.680	.914	.940	.728	.939	.757	.612	.837	.656	.854	.644	.625	.753	.803
		N	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16
	Spcl'd Scr	Correlation Coefficient	.003	.188	-.088	-.088	-.084	-.184	-.174	.061	-.103	-.071	.088	.241	.019	-.053	.056
		Sig. (2-tailed)	.991	.485	.745	.745	.757	.494	.519	.824	.704	.795	.745	.368	.944	.846	.837
		N	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16

C94

			1st Yr Avrg	2nd Yr Avrg	3rd Yr Avrg	4th Yr Avrg	1st Yr Studio	2nd Yr Studio	3rd Yr Studio	4th Yr Studio	Studios Avrg	Dsgn avrg	Tech Avrg	Bldng Sci Avrg	Calc Avrg	Hmn Avrg	Overall Avrg
Spearman's rho	Dipl Avrg	Correlation Coefficient	.238	.277	.235	.082	.084	.198	-.032	.074	.076	.100	.317	.407*	.366	.070	.164
		Sig. (2-tailed)	.223	.154	.229	.679	.672	.313	.870	.707	.702	.614	.100	.032	.055	.724	.404
		N	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28
	Total Scr	Correlation Coefficient	.321	.287	.256	.203	.264	.328	.122	.015	.209	.161	.200	.161	.297	.130	.230
		Sig. (2-tailed)	.096	.139	.189	.300	.174	.088	.537	.938	.287	.412	.308	.412	.124	.511	.239
		N	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28
	Spcl'd Scr	Correlation Coefficient	.443*	.385*	.355	.450*	.300	.313	.477*	.235	.426*	.382*	.330	.262	.385*	.474*	.442*
		Sig. (2-tailed)	.018	.043	.064	.016	.120	.105	.010	.229	.024	.045	.087	.179	.043	.011	.019
		N	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28

*. Correlation is significant at the .05 level (2-tailed).

Appendix 5.3

Mann-Whitney test results:

Rank tables and Test Statistics tables for Performance Variables of paired samples from each school.

Ranks (A93 and A94)

	Univ/Cohort	N	Mean Rank	Sum of Ranks
4th Yr Studio	A-93	24	20.15	483.50
	A-94	19	24.34	462.50
	Total	43		
Studios Avrg	A-93	24	20.13	483.00
	A-94	19	24.37	463.00
	Total	43		
Dsgn avrg	A-93	24	20.94	502.50
	A-94	19	23.34	443.50
	Total	43		
Tech Avrg	A-93	24	19.19	460.50
	A-94	19	25.55	485.50
	Total	43		
Bldng Sci Avrg	A-93	24	19.60	470.50
	A-94	19	25.03	475.50
	Total	43		
Calc Avrg	A-93	24	18.85	452.50
	A-94	19	25.97	493.50
	Total	43		
Hmn Avrg	A-93	24	18.21	437.00
	A-94	19	26.79	509.00
	Total	43		
Overall Avrg	A-93	24	19.21	461.00
	A-94	19	25.53	485.00
	Total	43		

Test Statistics (A93 and A94)[a]

	4th Yr Studio	Studios Avrg	Dsgn avrg	Tech Avrg	Bldng Sci Avrg	Calc Avrg	Hmn Avrg	Overall Avrg
Mann-Whitney U	183.500	183.000	202.500	160.500	170.500	152.500	137.000	161.000
Wilcoxon W	483.500	483.000	502.500	460.500	470.500	452.500	437.000	461.000
Z	-1.089	-1.101	-.624	-1.651	-1.406	-1.847	-2.226	-1.639
Asymp. Sig. (2-tailed)	.276	.271	.533	.099	.160	.065	.026	.101
Exact Sig. (2-tailed)	.282	.280	.541	.100	.163	.065	.025	.104
Exact Sig. (1-tailed)	.141	.140	.270	.050	.082	.033	.013	.052

a. Grouping Variable: Univ/Cohort

Appendix 5.3: continued

Ranks (B93 and B94)

	Univ/Cohort	N	Mean Rank	Sum of Ranks
4th Yr Studio	B-93	17	21.00	357.00
	B-94	21	18.29	384.00
	Total	38		
Studios Avrg	B-93	17	19.44	330.50
	B-94	21	19.55	410.50
	Total	38		
Dsgn avrg	B-93	17	19.74	335.50
	B-94	21	19.31	405.50
	Total	38		
Tech Avrg	B-93	17	15.09	256.50
	B-94	21	23.07	484.50
	Total	38		
Bldng Sci Avrg	B-93	17	9.85	167.50
	B-94	21	27.31	573.50
	Total	38		
Calc Avrg	B-93	17	16.41	279.00
	B-94	21	22.00	462.00
	Total	38		
Hmn Avrg	B-93	17	14.00	238.00
	B-94	21	23.95	503.00
	Total	38		
Overall Avrg	B-93	17	16.47	280.00
	B-94	21	21.95	461.00
	Total	38		

Test Statistics (B93 and B94)[b]

	4th Yr Studio	Studios Avrg	Dsgn avrg	Tech Avrg	Bldng Sci Avrg	Calc Avrg	Hmn Avrg	Overall Avrg
Mann-Whitney U	153.000	177.500	174.500	103.500	14.500	126.000	85.000	127.000
Wilcoxon W	384.000	330.500	405.500	256.500	167.500	279.000	238.000	280.000
Z	-.750	-.029	-.117	-2.202	-4.815	-1.542	-2.745	-1.512
Asymp. Sig. (2-tailed)	.453	.977	.906	.028	.000	.123	.006	.130
Exact Sig. [2*(1-tailed Sig.)]	.467[a]	.977[a]	.908[a]	.026[a]	.000[a]	.128[a]	.005[a]	.136[a]
Exact Sig. (2-tailed)	.462	.983	.913	.027	.000	.126	.005	.134
Exact Sig. (1-tailed)	.231	.491	.457	.013	.000	.063	.003	.067

a. Not corrected for ties.

b. Grouping Variable: Univ/Cohort

Appendix 5.3: continued

Ranks (C93 and C94)

	Univ/Cohort	N	Mean Rank	Sum of Ranks
4th Yr Studio	C-93	20	23.08	461.50
	C-94	35	30.81	1078.50
	Total	55		
Studios Avrg	C-93	20	24.52	490.50
	C-94	35	29.99	1049.50
	Total	55		
Dsgn avrg	C-93	20	24.08	481.50
	C-94	35	30.24	1058.50
	Total	55		
Tech Avrg	C-93	20	20.25	405.00
	C-94	35	32.43	1135.00
	Total	55		
Bldng Sci Avrg	C-93	20	13.32	266.50
	C-94	35	36.39	1273.50
	Total	55		
Calc Avrg	C-93	20	25.00	500.00
	C-94	35	29.71	1040.00
	Total	55		
Hmn Avrg	C-93	20	14.30	286.00
	C-94	35	35.83	1254.00
	Total	55		
Overall Avrg	C-93	20	19.73	394.50
	C-94	35	32.73	1145.50
	Total	55		

Test Statistics (C93 and C94)[a]

	4th Yr Studio	Studios Avrg	Dsgn avrg	Tech Avrg	Bldng Sci Avrg	Calc Avrg	Hmn Avrg	Overall Avrg
Mann-Whitney U	251.500	280.500	271.500	195.000	56.500	290.000	76.000	184.500
Wilcoxon W	461.500	490.500	481.500	405.000	266.500	500.000	286.000	394.500
Z	-1.727	-1.216	-1.374	-2.712	-5.135	-1.050	-4.794	-2.896
Asymp. Sig. (2-tailed)	.084	.224	.169	.007	.000	.294	.000	.004
Exact Sig. (2-tailed)	.085	.228	.172	.006	.000	.299	.000	.003
Exact Sig. (1-tailed)	.042	.114	.086	.003	.000	.149	.000	.002

a. Grouping Variable: Univ/Cohort

Appendix 5.4

Study of academic differences between paired half-samples

Section 1a:

Study of initial differences between paired '<u>High-scorer</u>' samples in each school: Mann-Whitney Test results

1. School A:

Ranks

	Univ/Cohort	N	Mean Rank	Sum of Ranks
Total Scr	A-93	12	6.92	83.00
	A-94	10	17.00	170.00
	Total	22		
Sci Scr	A-93	12	6.92	83.00
	A-94	10	17.00	170.00
	Total	22		
Physics	A-93	12	7.75	93.00
	A-94	10	16.00	160.00
	Total	22		

Test Statistics[b]

	Total Scr	Sci Scr	Physics
Mann-Whitney U	5.000	5.000	15.000
Wilcoxon W	83.000	83.000	93.000
Z	-3.627	-3.628	-2.972
Asymp. Sig. (2-tailed)	.000	.000	.003
Exact Sig. [2*(1-tailed Sig.)]	.000[a]	.000[a]	.002[a]
Exact Sig. (2-tailed)	.000	.000	.002
Exact Sig. (1-tailed)	.000	.000	.001
Point Probability	.000	.000	.000

a. Not corrected for ties.

b. Grouping Variable: Univ/Cohort

2. School B:

Ranks

	Univ/Cohort	N	Mean Rank	Sum of Ranks
Total Scr	B-93	9	5.22	47.00
	B-94	11	14.82	163.00
	Total	20		
Sci Scr	B-93	9	7.39	66.50
	B-94	11	13.05	143.50
	Total	20		
Physics	B-93	9	6.22	56.00
	B-94	11	14.00	154.00
	Total	20		

Test Statistics[b]

	Total Scr	Sci Scr	Physics
Mann-Whitney U	2.000	21.500	11.000
Wilcoxon W	47.000	66.500	56.000
Z	-3.609	-2.128	-2.928
Asymp. Sig. (2-tailed)	.000	.033	.003
Exact Sig. [2*(1-tailed Sig.)]	.000[a]	.031[a]	.002[a]
Exact Sig. (2-tailed)	.000	.033	.002
Exact Sig. (1-tailed)	.000	.016	.001
Point Probability	.000	.001	.000

a. Not corrected for ties.

b. Grouping Variable: Univ/Cohort

3. School C:

Ranks

	Univ/Cohort	N	Mean Rank	Sum of Ranks
Total Scr	C-93	10	5.50	55.00
	C-94	18	19.50	351.00
	Total	28		
Sci Scr	C-93	10	8.75	87.50
	C-94	18	17.69	318.50
	Total	28		
Physics	C-93	10	8.30	83.00
	C-94	18	17.94	323.00
	Total	28		

Test Statistics[b]

	Total Scr	Sci Scr	Physics
Mann-Whitney U	.000	32.500	28.000
Wilcoxon W	55.000	87.500	83.000
Z	-4.315	-2.757	-2.976
Asymp. Sig. (2-tailed)	.000	.006	.003
Exact Sig. [2*(1-tailed Sig.)]	.000[a]	.004[a]	.002[a]
Exact Sig. (2-tailed)	.000	.005	.002
Exact Sig. (1-tailed)	.000	.002	.001
Point Probability	.000	.000	.000

a. Not corrected for ties.

b. Grouping Variable: Univ/Cohort

Section 1b:

Study of initial differences between paired '<u>Low-scorer</u>' samples in each school: Mann-Whitney Test results

I. School A:

Ranks

	Univ/Cohort	N	Mean Rank	Sum of Ranks
Total Scr	A-93	12	6.58	79.00
	A-94	9	16.89	152.00
	Total	21		
Sci Scr	A-93	12	6.50	78.00
	A-94	9	17.00	153.00
	Total	21		
Physics	A-93	12	6.63	79.50
	A-94	9	16.83	151.50
	Total	21		

Test Statistics[b]

	Total Scr	Sci Scr	Physics
Mann-Whitney U	1.000	.000	1.500
Wilcoxon W	79.000	78.000	79.500
Z	-3.767	-3.838	-3.735
Asymp. Sig. (2-tailed)	.000	.000	.000
Exact Sig. [2*(1-tailed Sig.)]	.000[a]	.000[a]	.000[a]
Exact Sig. (2-tailed)	.000	.000	.000
Exact Sig. (1-tailed)	.000	.000	.000
Point Probability	.000	.000	.000

a. Not corrected for ties.

b. Grouping Variable: Univ/Cohort

2. School B:

Ranks

	Univ/Cohort	N	Mean Rank	Sum of Ranks
Total Scr	B-93	8	4.50	36.00
	B-94	10	13.50	135.00
	Total	18		
Sci Scr	B-93	8	4.63	37.00
	B-94	10	13.40	134.00
	Total	18		
Physics	B-93	8	4.50	36.00
	B-94	10	13.50	135.00
	Total	18		

Test Statistics[b]

	Total Scr	Sci Scr	Physics
Mann-Whitney U	.000	1.000	.000
Wilcoxon W	36.000	37.000	36.000
Z	-3.554	-3.465	-3.558
Asymp. Sig. (2-tailed)	.000	.001	.000
Exact Sig. [2*(1-tailed Sig.)]	.000[a]	.000[a]	.000[a]
Exact Sig. (2-tailed)	.000	.000	.000
Exact Sig. (1-tailed)	.000	.000	.000
Point Probability	.000	.000	.000

a. Not corrected for ties.

b. Grouping Variable: Univ/Cohort

3. School C:

Ranks

	Univ/Cohort	N	Mean Rank	Sum of Ranks
Total Scr	C-93	10	7.20	72.00
	C-94	17	18.00	306.00
	Total	27		
Sci Scr	C-93	10	6.60	66.00
	C-94	17	18.35	312.00
	Total	27		
Physics	C-93	10	6.00	60.00
	C-94	17	18.71	318.00
	Total	27		

Test Statistics[b]

	Total Scr	Sci Scr	Physics
Mann-Whitney U	17.000	11.000	5.000
Wilcoxon W	72.000	66.000	60.000
Z	-3.414	-3.716	-4.018
Asymp. Sig. (2-tailed)	.001	.000	.000
Exact Sig. [2*(1-tailed Sig.)]	.000[a]	.000[a]	.000[a]
Exact Sig. (2-tailed)	.000	.000	.000
Exact Sig. (1-tailed)	.000	.000	.000
Point Probability	.000	.000	.000

a. Not corrected for ties.

b. Grouping Variable: Univ/Cohort

Section 2a:

Study of academic performance differences between paired '<u>High-scorer</u>' samples in each school: Mann-Whitney Test results

1. School A:

Ranks

	Univ/Cohort	N	Mean Rank	Sum of Ranks
4th Yr Studio	A-93	12	10.29	123.50
	A-94	10	12.95	129.50
	Total	22		
Studios Avrg	A-93	12	11.33	136.00
	A-94	10	11.70	117.00
	Total	22		
Dsgn avrg	A-93	12	11.33	136.00
	A-94	10	11.70	117.00
	Total	22		
Tech Avrg	A-93	12	12.04	144.50
	A-94	10	10.85	108.50
	Total	22		
Bldng Sci Avrg	A-93	12	11.67	140.00
	A-94	10	11.30	113.00
	Total	22		
Calc Avrg	A-93	12	12.00	144.00
	A-94	10	10.90	109.00
	Total	22		
Hmn Avrg	A-93	12	11.42	137.00
	A-94	10	11.60	116.00
	Total	22		
Overall Avrg	A-93	12	11.33	136.00
	A-94	10	11.70	117.00
	Total	22		

Test Statistics[b]

	4th Yr Studio	Studios Avrg	Dsgn avrg	Tech Avrg	Bldng Sci Avrg	Calc Avrg	Hmn Avrg	Overall Avrg
Mann-Whitney U	45.500	58.000	58.000	53.500	58.000	54.000	59.000	58.000
Wilcoxon W	123.500	136.000	136.000	108.500	113.000	109.000	137.000	136.000
Z	-.957	-.132	-.132	-.429	-.132	-.396	-.066	-.132
Asymp. Sig. (2-tailed)	.338	.895	.895	.668	.895	.692	.947	.895
Exact Sig. [2*(1-tailed Sig.)]	.346[a]	.923[a]	.923[a]	.674[a]	.923[a]	.722[a]	.974[a]	.923[a]
Exact Sig. (2-tailed)	.354	.923	.923	.688	.923	.722	.960	.923
Exact Sig. (1-tailed)	.178	.461	.461	.344	.461	.361	.480	.461
Point Probability	.009	.026	.026	.013	.026	.024	.012	.026

a. Not corrected for ties.

b. Grouping Variable: Univ/Cohort

2. School B:

Ranks

	Univ/Cohort	N	Mean Rank	Sum of Ranks
4th Yr Studio	B-93	9	13.50	121.50
	B-94	11	8.05	88.50
	Total	20		
Studios Avrg	B-93	9	11.72	105.50
	B-94	11	9.50	104.50
	Total	20		
Dsgn avrg	B-93	9	12.22	110.00
	B-94	11	9.09	100.00
	Total	20		
Tech Avrg	B-93	9	7.00	63.00
	B-94	11	13.36	147.00
	Total	20		
Bldng Sci Avrg	B-93	9	5.11	46.00
	B-94	11	14.91	164.00
	Total	20		
Calc Avrg	B-93	9	8.11	73.00
	B-94	11	12.45	137.00
	Total	20		
Hmn Avrg	B-93	9	8.33	75.00
	B-94	11	12.27	135.00
	Total	20		
Overall Avrg	B-93	9	8.78	79.00
	B-94	11	11.91	131.00
	Total	20		

Test Statistics[b]

	4th Yr Studio	Studios Avrg	Dsgn avrg	Tech Avrg	Bldng Sci Avrg	Calc Avrg	Hmn Avrg	Overall Avrg
Mann-Whitney U	22.500	38.500	34.000	18.000	1.000	28.000	30.000	34.000
Wilcoxon W	88.500	104.500	100.000	63.000	46.000	73.000	75.000	79.000
Z	-2.064	-.836	-1.179	-2.393	-3.686	-1.633	-1.481	-1.178
Asymp. Sig. (2-tailed)	.039	.403	.238	.017	.000	.102	.138	.239
Exact Sig. [2*(1-tailed Sig.)]	.038[a]	.412[a]	.261[a]	.016[a]	.000[a]	.112[a]	.152[a]	.261[a]
Exact Sig. (2-tailed)	.039	.423	.252	.016	.000	.112	.152	.261
Exact Sig. (1-tailed)	.019	.212	.126	.008	.000	.056	.076	.130
Point Probability	.002	.011	.008	.002	.000	.008	.011	.016

a. Not corrected for ties.

b. Grouping Variable: Univ/Cohort

3. School C:

Ranks

	Univ/Cohort	N	Mean Rank	Sum of Ranks
4th Yr Studio	C-93	10	10.75	107.50
	C-94	18	16.58	298.50
	Total	28		
Studios Avrg	C-93	10	9.30	93.00
	C-94	18	17.39	313.00
	Total	28		
Dsgn avrg	C-93	10	9.40	94.00
	C-94	18	17.33	312.00
	Total	28		
Tech Avrg	C-93	10	11.60	116.00
	C-94	18	16.11	290.00
	Total	28		
Bldng Sci Avrg	C-93	10	6.95	69.50
	C-94	18	18.69	336.50
	Total	28		
Calc Avrg	C-93	10	14.50	145.00
	C-94	18	14.50	261.00
	Total	28		
Hmn Avrg	C-93	10	7.20	72.00
	C-94	18	18.56	334.00
	Total	28		
Overall Avrg	C-93	10	9.05	90.50
	C-94	18	17.53	315.50
	Total	28		

Test Statistics[b]

	4th Yr Studio	Studios Avrg	Dsgn avrg	Tech Avrg	Bldng Sci Avrg	Calc Avrg	Hmn Avrg	Overall Avrg
Mann-Whitney U	52.500	38.000	39.000	61.000	14.500	90.000	17.000	35.500
Wilcoxon W	107.500	93.000	94.000	116.000	69.500	261.000	72.000	90.500
Z	-1.802	-2.493	-2.447	-1.390	-3.621	.000	-3.500	-2.614
Asymp. Sig. (2-tailed)	.072	.013	.014	.164	.000	1.000	.000	.009
Exact Sig. [2*(1-tailed Sig.)]	.072[a]	.012[a]	.014[a]	.175[a]	.000[a]	1.000[a]	.000[a]	.007[a]
Exact Sig. (2-tailed)	.073	.012	.013	.175	.000	1.000	.000	.008
Exact Sig. (1-tailed)	.037	.006	.006	.087	.000	.505	.000	.004
Point Probability	.002	.001	.000	.007	.000	.009	.000	.000

a. Not corrected for ties.

b. Grouping Variable: Univ/Cohort

Section 2b:

Study of academic performance differences between paired '<u>Low-scorer</u>' samples in each school: Mann-Whitney Test results

1. School A:

Ranks

	Univ/Cohort	N	Mean Rank	Sum of Ranks
4th Yr Studio	A-93	12	10.04	120.50
	A-94	9	12.28	110.50
	Total	21		
Studios Avrg	A-93	12	9.25	111.00
	A-94	9	13.33	120.00
	Total	21		
Dsgn avrg	A-93	12	10.08	121.00
	A-94	9	12.22	110.00
	Total	21		
Tech Avrg	A-93	12	7.42	89.00
	A-94	9	15.78	142.00
	Total	21		
Bldng Sci Avrg	A-93	12	8.13	97.50
	A-94	9	14.83	133.50
	Total	21		
Calc Avrg	A-93	12	7.75	93.00
	A-94	9	15.33	138.00
	Total	21		
Hmn Avrg	A-93	12	7.58	91.00
	A-94	9	15.56	140.00
	Total	21		
Overall Avrg	A-93	12	8.08	97.00
	A-94	9	14.89	134.00
	Total	21		

Test Statistics[b]

	4th Yr Studio	Studios Avrg	Dsgn avrg	Tech Avrg	Bldng Sci Avrg	Calc Avrg	Hmn Avrg	Overall Avrg
Mann-Whitney U	42.500	33.000	43.000	11.000	19.500	15.000	13.000	19.000
Wilcoxon W	120.500	111.000	121.000	89.000	97.500	93.000	91.000	97.000
Z	-.818	-1.492	-.782	-3.056	-2.453	-2.772	-2.915	-2.487
Asymp. Sig. (2-tailed)	.413	.136	.434	.002	.014	.006	.004	.013
Exact Sig. [2*(1-tailed Sig.)]	.422[a]	.148[a]	.464[a]	.001[a]	.012[a]	.004[a]	.002[a]	.012[a]
Exact Sig. (2-tailed)	.432	.148	.464	.001	.012	.004	.002	.012
Exact Sig. (1-tailed)	.216	.074	.232	.001	.006	.002	.001	.006
Point Probability	.010	.010	.021	.000	.001	.001	.000	.001

a. Not corrected for ties.

b. Grouping Variable: Univ/Cohort

2. School B:

Ranks

	Univ/Cohort	N	Mean Rank	Sum of Ranks
4th Yr Studio	B-93	8	8.06	64.50
	B-94	10	10.65	106.50
	Total	18		
Studios Avrg	B-93	8	8.50	68.00
	B-94	10	10.30	103.00
	Total	18		
Dsgn avrg	B-93	8	8.06	64.50
	B-94	10	10.65	106.50
	Total	18		
Tech Avrg	B-93	8	8.69	69.50
	B-94	10	10.15	101.50
	Total	18		
Bldng Sci Avrg	B-93	8	5.50	44.00
	B-94	10	12.70	127.00
	Total	18		
Calc Avrg	B-93	8	8.69	69.50
	B-94	10	10.15	101.50
	Total	18		
Hmn Avrg	B-93	8	6.25	50.00
	B-94	10	12.10	121.00
	Total	18		
Overall Avrg	B-93	8	8.25	66.00
	B-94	10	10.50	105.00
	Total	18		

Test Statistics[b]

	4th Yr Studio	Studios Avrg	Dsgn avrg	Tech Avrg	Bldng Sci Avrg	Calc Avrg	Hmn Avrg	Overall Avrg
Mann-Whitney U	28.500	32.000	28.500	33.500	8.000	33.500	14.000	30.000
Wilcoxon W	64.500	68.000	64.500	69.500	44.000	69.500	50.000	66.000
Z	-1.025	-.711	-1.022	-.578	-2.843	-.578	-2.310	-.889
Asymp. Sig. (2-tailed)	.305	.477	.307	.563	.004	.563	.021	.374
Exact Sig. [2*(1-tailed Sig.)]	.315[a]	.515[a]	.315[a]	.573[a]	.003[a]	.573[a]	.021[a]	.408[a]
Exact Sig. (2-tailed)	.325	.500	.327	.588	.003	.587	.021	.395
Exact Sig. (1-tailed)	.162	.250	.164	.294	.002	.293	.010	.198
Point Probability	.011	.013	.012	.016	.001	.015	.002	.012

a. Not corrected for ties.

b. Grouping Variable: Univ/Cohort

3. School C:

Ranks

	Univ/Cohort	N	Mean Rank	Sum of Ranks
4th Yr Studio	C-93	10	12.00	120.00
	C-94	17	15.18	258.00
	Total	27		
Studios Avrg	C-93	10	13.80	138.00
	C-94	17	14.12	240.00
	Total	27		
Dsgn avrg	C-93	10	13.45	134.50
	C-94	17	14.32	243.50
	Total	27		
Tech Avrg	C-93	10	9.30	93.00
	C-94	17	16.76	285.00
	Total	27		
Bldng Sci Avrg	C-93	10	6.70	67.00
	C-94	17	18.29	311.00
	Total	27		
Calc Avrg	C-93	10	11.30	113.00
	C-94	17	15.59	265.00
	Total	27		
Hmn Avrg	C-93	10	7.80	78.00
	C-94	17	17.65	300.00
	Total	27		
Overall Avrg	C-93	10	11.45	114.50
	C-94	17	15.50	263.50
	Total	27		

Test Statistics[b]

	4th Yr Studio	Studios Avrg	Dsgn avrg	Tech Avrg	Bldng Sci Avrg	Calc Avrg	Hmn Avrg	Overall Avrg
Mann-Whitney U	65.000	83.000	79.500	38.000	12.000	58.000	23.000	59.500
Wilcoxon W	120.000	138.000	134.500	93.000	67.000	113.000	78.000	114.500
Z	-1.009	-.100	-.276	-2.360	-3.665	-1.356	-3.113	-1.281
Asymp. Sig. (2-tailed)	.313	.920	.782	.018	.000	.175	.002	.200
Exact Sig. [2*(1-tailed Sig.)]	.334[a]	.941[a]	.786[a]	.018[a]	.000[a]	.187[a]	.001[a]	.204[a]
Exact Sig. (2-tailed)	.325	.931	.796	.018	.000	.183	.001	.209
Exact Sig. (1-tailed)	.163	.465	.398	.009	.000	.092	.001	.105
Point Probability	.006	.009	.010	.001	.000	.005	.000	.005

a. Not corrected for ties.

b. Grouping Variable: Univ/Cohort

Appendix 5.5

Difference between 'Pass' and 'Fail' groups[1] in their Scientific Score at entry

(Mann-Whitney U Tests)

Section 1
Across University Schools

A: Comparison of the 1993 'Pass' and 'Fail' groups

Ranks

	Calcs Pass/Fail	N	Mean Rank	Sum of Ranks
Sci Scr	Pass	35	36.06	1262.00
	Fail	26	24.19	629.00
	Total	61		

Test Statistics[a]

	Sci Scr
Mann-Whitney U	278.000
Wilcoxon W	629.000
Z	-2.581
Asymp. Sig. (2-tailed)	.010
Exact Sig. (2-tailed)	.009
Exact Sig. (1-tailed)	.005
Point Probability	.000

a. Grouping Variable: Calcs Pass/Fail

B: Comparison of the 1994 'Pass' and 'Fail' groups

Ranks

	Calcs Pass/Fail	N	Mean Rank	Sum of Ranks
Sci Scr	Pass	57	37.67	2147.00
	Fail	18	39.06	703.00
	Total	75		

Notice that the 'mean rank' of the 'Fail' group is higher.

Test Statistics[a]

	Sci Scr
Mann-Whitney U	494.000
Wilcoxon W	2147.000
Z	-.236
Asymp. Sig. (2-tailed)	.814
Exact Sig. (2-tailed)	.818
Exact Sig. (1-tailed)	.409
Point Probability	.003

a. Grouping Variable: Calcs Pass/Fail

---

[1] 'Pass' group: those students who completed the Calculatives Area without any failure.
'Fail' group: those students who had to resit some subjects to complete the Calculatives Area.

C: Comparison of the 1993 'Pass' and 1994 'Fail' groups

Ranks

	Calcs Pass/Fail	N	Mean Rank	Sum of Ranks
Sci Scr	Pass	35	23.63	827.00
	Fail	18	33.56	604.00
	Total	53		

Test Statistics[a]

	Sci Scr
Mann-Whitney U	197.000
Wilcoxon W	827.000
Z	-2.216
Asymp. Sig. (2-tailed)	.027
Exact Sig. (2-tailed)	.026
Exact Sig. (1-tailed)	.013
Point Probability	.000

a. Grouping Variable: Entrance year

Section 2
University School 'A' only

A: Comparison of the 1993 'Pass' and 'Fail' groups

Ranks

	Calcs Pass/Fail	N	Mean Rank	Sum of Ranks
Sci Scr	Pass	12	16.92	203.00
	Fail	12	8.08	97.00
	Total	24		

Test Statistics[b]

	Sci Scr
Mann-Whitney U	19.000
Wilcoxon W	97.000
Z	-3.061
Asymp. Sig. (2-tailed)	.002
Exact Sig. [2*(1-tailed Sig.)]	.001[a]
Exact Sig. (2-tailed)	.001
Exact Sig. (1-tailed)	.001
Point Probability	.000

a. Not corrected for ties.

b. Grouping Variable: Calcs Pass/Fail

B: Comparison of the 1994 'Pass' and 'Fail' groups

Ranks

	Calcs Pass/Fail	N	Mean Rank	Sum of Ranks
Sci Scr	Pass	13	9.08	118.00
	Fail	6	12.00	72.00
	Total	19		

Notice that the 'mean rank' of the 'Fail' group is higher.

Test Statistics[b]

	Sci Scr
Mann-Whitney U	27.000
Wilcoxon W	118.000
Z	-1.052
Asymp. Sig. (2-tailed)	.293
Exact Sig. [2*(1-tailed Sig.)]	.323[a]
Exact Sig. (2-tailed)	.323
Exact Sig. (1-tailed)	.161
Point Probability	.021

a. Not corrected for ties.

b. Grouping Variable: Calcs Pass/Fail

C: Comparison of the 1993 'Pass' and 1994 'Fail' groups

Ranks

	Calcs Pass/Fail	N	Mean Rank	Sum of Ranks
Sci Scr	Pass	12	7.75	93.00
	Fail	6	13.00	78.00
	Total	18		

Test Statistics[b]

	Sci Scr
Mann-Whitney U	15.000
Wilcoxon W	93.000
Z	-1.968
Asymp. Sig. (2-tailed)	.049
Exact Sig. [2*(1-tailed Sig.)]	.053[a]
Exact Sig. (2-tailed)	.050
Exact Sig. (1-tailed)	.025
Point Probability	.003

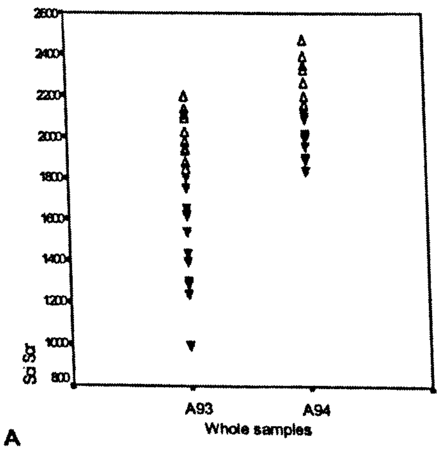
a. Not corrected for ties.

b. Grouping Variable: Calcs Pass/Fail

Appendix 5.6

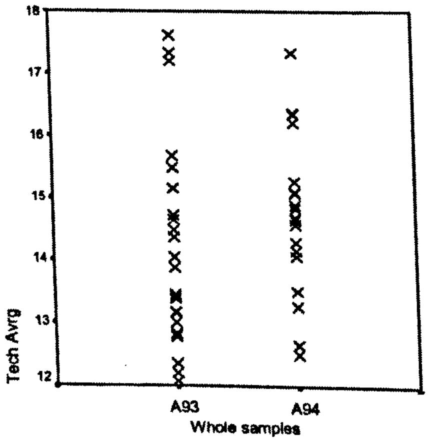
Representation of the local effect of rise in the entrance score

The following scattergraphs show the rise in the Scientific (entrance) Scores for two samples of students, and the associated effect in their performance in the Technology area of the course. High-scorer and low-scorer sub-samples are shown separately.



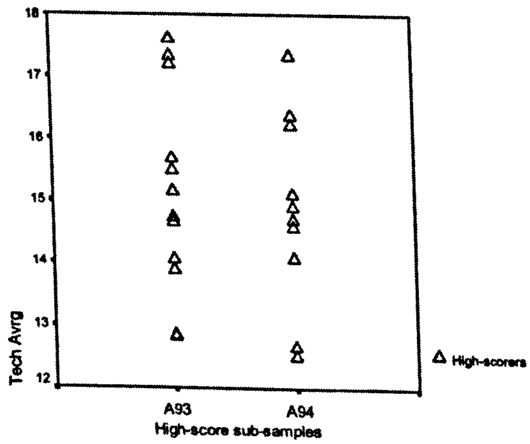
A

Mann-Whitney U test: p=.000
For both the whole samples, and similar half samples



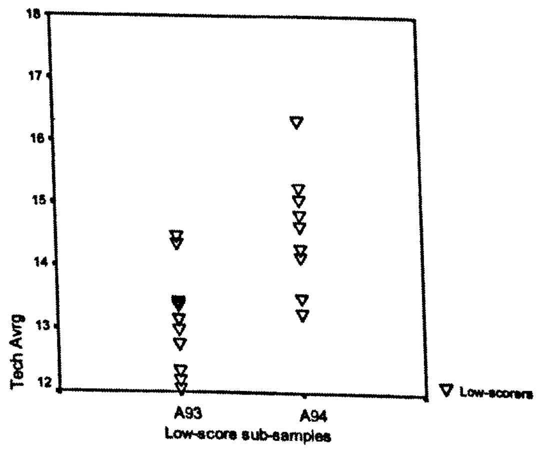
B

Mann-Whitney U test: p=.100
Higher mean rank: A94



C

Mann-Whitney U test: p=.688
Higher mean rank: A93



D

Mann-Whitney U test: p=.001
Higher mean rank: A94

The upright triangles in Chart A show the high-scorer sub-samples, and the up-side-down triangles represent the low-scorer (i.e. those who scored above or below median respectively) in Scientific Score. As Chart A shows, the difference between the A93 and A94 in their entrance Scientific Score is highly significant. Likewise, the difference between the similar sub-samples (i.e. A93 and A94 high-scorer, or A93 and A94 low-scorers) on the same variable is highly significant.

As shown in Chart B, the difference between the two samples fails to reach a significant level. However, the mean rank of the whole A94 sample in the Technology area is higher than that of A93.

When we look at the difference between the performance of the high-scorer sub-samples in the Technology area (Chart C), again no significant difference is observed between the two high-scorer sub-samples. However, this time, the mean rank of A93 high-scorers is slightly higher. For the low-scorer sub-samples a different pattern, which was previously concealed, is observed. Chart D shows that the difference between the low-scorer sub-samples in the Technology area is highly significant.

Altogether, this suggests that the rise in the minimum level of the Scientific Scores at entrance has improved the performance of the low-scorers in the Technology area, but it has hardly ever benefited the performance of the high-scorers.

Appendix 6.1

Translation of Students' Questionnaire

Surname and Name... ....

University...**Year of Entrance to University**......................

---

1. Did you have an Architectural Technician degree when you started your continuos MArch course?

   No ☐ Yes ☐

2. Did you take any informal preparatory course(s) before the National Examination for Entrance to Universities?

   No ☐ Yes ☐ If yes, please state which kind:

   Architectural ☐

   Other ☐

3. In which of the following school types did you do most of your middle and secondary education?

   Ordinary 'State' schools (including colleges) ☐

   Special schools (including private and other fee-paying schools) ☐

4. What was the Total Average of your Secondary Education Final Examinations Certificate (Secondary Diploma)? ....

5. Please indicate the ranges which best describe your Secondary Certificate marks in the following subjects.

Maths	10-11.99	12-13.99	14-15.99	16-17.99	18-20
Chemistry	10-11.99	12-13.99	14-15.99	16-17.99	18-20
Physics	10-11.99	12-13.99	14-15.99	16-17.99	18-20
Humanities	10-11.99	12-13.99	14-15.99	16-17.99	18-20
Life and Natural Sciences	10-11.99	12-13.99	14-15.99	16-17.99	18-20

6. Before you started to study architecture, was anyone in your family or amongst your close relatives/friends an architect?

   No ☐ Yes ☐ If yes, please state the relation ....

7. How did you come to know about the architecture course before you chose to study it? In case of any prior familiarity please state:

From whom or by which means?..

Approximately how long before you chose to study architecture?.....................

How was this knowledge gained? ....

....

....

8. How realistic was your awareness about the course? In other words, how did your conceptions of the *subjects* of the course, and *methods* of instruction conform to the reality? Check one of the boxes from each of the following ranges.

Subjects: not conforming at all ☐ ☐ ☐ ☐ ☐ completely conforming

Methods: not conforming at all ☐ ☐ ☐ ☐ ☐ completely conforming

9. Was there any interest in artistic/creative issues in your family before you started the course?

No ☐ Yes ☐

10. Did you or any members of your family used to practise artistic or creative activities before you started the course? (whether as a job or merely as a hobby)

No ☐ Yes ☐ If yes, please give details.

Who (relationship)?	In which field?	At which level?	Ordinary	Advanced
....	....		☐	☐
....	....		☐	☐
....	....		☐	☐

11. When did you first consider studying architecture?

Not until the time of application ☐

During the last years of high school ☐

Mid–high school or before ☐

12. What were the main reasons for your decision to study architecture?

....

....

13. Did you apply for any other course(s) besides architecture?

No ☐ Yes ☐ If yes, which priority did you give architecture? ....

14. Provided there was no loss of course units/credits, would you have transferred to another course?

No ☐ Yes ☐ If yes, to which course? ....

15. Before you started the course,

a. In what kind(s) of activities did you have a personal interest? (Please state in order of preference)

....
....

b. Were you considered to have had particular skill(s), as compared to your age group?

No ☐ Yes ☐ If yes, in what area(s)?

....
....

16. Did you produce artistic or creative handicrafts during your prior studies? (on your own volition/initiative, not as school assignments)

No, or very occasionally ☐ Yes, sometimes ☐ Yes, often ☐

17. Which of your personal attributes (including skills, knowledge, traits, etc.) would you say have played the most effective role during your study of architecture? (Please state in order of importance)

....
....

18. If you were to find out how apt a candidate would be for studying architecture by asking three or four questions, what would be the key issues you would ask about?

....
....
....

19. Please suggest the ways by which you would improve the procedures for student selection for studying architecture.

....
....
....

Thank you for taking part in the survey.

Appendix 6.2

Representativeness of the Respondent Groups

Cross-tabulation and Chi square test

1993 Students Group by Gender

Group * Gender Crosstabulation

			Gender		
			Female	Male	Total
Group	Respondents	Count	12	26	38
		% within Group	31.6%	68.4%	100.0%
	Entire	Count	37	108	145
		% within Group	25.5%	74.5%	100.0%
Total		Count	49	134	183
		% within Group	26.8%	73.2%	100.0%

$\chi^2 = .564$; df = 1; p = .453

1994 Students Group by Gender

Group * Gender Crosstabulation

			Gender		
			Female	Male	Total
Group	Respondents	Count	14	49	63
		% within Group	22.2%	77.8%	100.0%
	Entire	Count	43	107	150
		% within Group	28.7%	71.3%	100.0%
Total		Count	57	156	213
		% within Group	26.8%	73.2%	100.0%

$\chi^2 = .940$; df = 1; p = .332

All students Gender by Entrance Year

Gender * Entrance year Crosstabulation

			Entrance year		
			93	94	Total
Gender	Female	Count	37	43	80
		% within Entrance year	25.5%	28.7%	27.1%
	Male	Count	108	107	215
		% within Entrance year	74.5%	71.3%	72.9%
Total		Count	145	150	295
		% within Entrance year	100.0%	100.0%	100.0%

$\chi^2 = .370$; df = 1; p = .543

All students Quota by Entrance Year

Quota class * Entrance year Crosstabulation

			Entrance year		
			93	94	Total
Quota class	Ordinary	Count	96	113	209
		% within Entrance year	66.2%	75.3%	70.8%
	Special	Count	49	37	86
		% within Entrance year	33.8%	24.7%	29.2%
Total		Count	145	150	295
		% within Entrance year	100.0%	100.0%	100.0%

$\chi^2 = 2.973$; df = 1; p = .085

Questionnaire respondents Gender by Entrance Year

Gender * Entrance year Crosstabulation

			Entrance year		
			93	94	Total
Gender	Female	Count	12	14	26
		% within Entrance year	31.6%	22.2%	25.7%
	Male	Count	26	49	75
		% within Entrance year	68.4%	77.8%	74.3%
Total		Count	38	63	101
		% within Entrance year	100.0%	100.0%	100.0%

$\chi^2 = 1.08$; df = 1; p = .297

Questionnaire respondents Quota by Entrance Year

Quota class * Entrance year Crosstabulation

			Entrance year		
			93	94	Total
Quota class	Ordinary	Count	29	48	77
		% within Entrance year	76.3%	76.2%	76.2%
	Special	Count	9	15	24
		% within Entrance year	23.7%	23.8%	23.8%
Total		Count	38	63	101
		% within Entrance year	100.0%	100.0%	100.0%

$\chi^2 = .00$; df = 1; p = .989

1993 Students Group by Quota

Group * Quota Crosstabulation

			Quota		
			Ordinary	Special	Total
Group	Respondents	Count	29	9	38
		% within Group	76.3%	23.7%	100.0%
	Entire	Count	96	49	145
		% within Group	66.2%	33.8%	100.0%
Total		Count	125	58	183
		% within Group	68.3%	31.7%	100.0%

$\chi^2 = 1.421$; df = 1; p = .233

1994 Students Group by Quota

Group * Quota Crosstabulation

			Quota		
			Ordinary	Special	Total
Group	Respondents	Count	48	15	63
		% within Group	76.2%	23.8%	100.0%
	Entire	Count	113	37	150
		% within Group	75.3%	24.7%	100.0%
Total		Count	161	52	213
		% within Group	75.6%	24.4%	100.0%

$\chi^2 = .018$; df = 1; p = .894

Appendix 6.3

Test of difference between the 1993 and 1994 groups

1. Preparatory course (question 2)

Prep Course2 * Entrance year Crosstabulation

			Entrance year 93	94	Total
Prep Course2	None	Count	16	37	53
		% within Entrance year	42.1%	58.7%	52.5%
	Non-Arch'l	Count	11	20	31
		% within Entrance year	28.9%	31.7%	30.7%
	Arch'l	Count	11	6	17
		% within Entrance year	28.9%	9.5%	16.8%
Total		Count	38	63	101
		% within Entrance year	100.0%	100.0%	100.0%

$\chi 2 = 6.62$; df = 2; p = .036

2. High school type (question 3)

High School Type. * Entrance year Crosstabulation

			Entrance year 93	94	Total
High School Type.	Ordinary 'state'	Count	30	37	67
		% within Entrance year	78.9%	58.7%	66.3%
	Special	Count	8	26	34
		% within Entrance year	21.1%	41.3%	33.7%
Total		Count	38	63	101
		% within Entrance year	100.0%	100.0%	100.0%

$\chi 2 = 4.33$; df = 1; p = .037

3. Chemistry results: secondary education (question 5)

Chemistry (Secondary Diploma) by Entrance Year

			Entrance year 93	94	Total
Chemistry: mark category	<18	Count	32	40	72
		% within Entrance year	86.5%	65.6%	73.5%
	18-20	Count	5	21	26
		% within Entrance year	13.5%	34.4%	26.5%
Total		Count	37	61	98
		% within Entrance year	100.0%	100.0%	100.0%

$\chi 2 = 5.16$; df = 1; p = .023

Chemistry results (continued)

Mann-Whitney Test: Comparison of Entrance Exam Scores by Entrance Year

	Entrance year	N	Mean Rank	Sum of Ranks
Maths score	93	38	40.49	1538.50
	94	63	57.34	3612.50
	Total	101		
Physics score	93	38	34.88	1325.50
	94	63	60.72	3825.50
	Total	101		
Chemistry score	93	38	44.11	1676.00
	94	63	55.16	3475.00
	Total	101		

Test Statistics[a]

	Maths score	Physics score	Chemistry score
Mann-Whitney U	797.500	584.500	935.000
Wilcoxon W	1538.500	1325.500	1676.000
Z	-2.801	-4.295	-1.837
Asymp. Sig. (2-tailed)	.005	.000	.066

a. Grouping Variable: Entrance year

4. Architect relative (question 6)

Architect In Family. * Entrance year Crosstabulation

			Entrance year		
			93	94	Total
Architect in Family	None	Count	25	47	72
		% within Entrance year	65.8%	74.6%	71.3%
	Yes	Count	10	8	18
		% within Entrance year	26.3%	12.7%	17.8%
	First kin	Count	3	8	11
		% within Entrance year	7.9%	12.7%	10.9%
Total		Count	38	63	101
		% within Entrance year	100.0%	100.0%	100.0%

$\chi 2 = 3.22$; $df = 2$; $p = .199$

Architect In Family * Entrance year Crosstabulation

			Entrance year		
			93	94	Total
Architect in Family	No	Count	25	47	72
		% within Entrance year	65.8%	74.6%	71.3%
	Yes	Count	13	16	29
		% within Entrance year	34.2%	25.4%	28.7%
Total		Count	38	63	101
		% within Entrance year	100.0%	100.0%	100.0%

$\chi 2 = .900$; $df = 1$; $p = .343$

5. Prior familiarity with the course (question 7)

Familiarity * Entrance year

			Entrance year		Total
			93	94	
Familiarity	None	Count	17	28	45
		% within Entrance year	44.7%	44.4%	44.6%
	Acceptable	Count	15	26	41
		% within Entrance year	39.5%	41.3%	40.6%
	Sufficient	Count	6	9	15
		% within Entrance year	15.8%	14.3%	14.9%
Total		Count	38	63	101
		% within Entrance year	100.0%	100.0%	100.0%

$\chi2 = .055$; df = 2; p = .973

6. Conformity of prior conceptions to the reality of the course (question 8)

Conformity (contents) * Entrance year

			Entrance year		Total
			93	94	
Conformity (contents)	1[a]	Count	4	8	12
		% within Entrance year	11.1%	13.1%	12.4%
	2	Count	10	19	29
		% within Entrance year	27.8%	31.1%	29.9%
	3	Count	11	20	31
		% within Entrance year	30.6%	32.8%	32.0%
	4	Count	9	12	21
		% within Entrance year	25.0%	19.7%	21.6%
	5	Count	2	2	4
		% within Entrance year	5.6%	3.3%	4.1%
Total		Count	36	61	97
		% within Entrance year	100.0%	100.0%	100.0%

a. Categories 1 to 5: total disagreement to total agreement respectively.

$\chi2 = .776$; df = 4; p = .942
3 cells (30.0%) have expected count less than 5.
The minimum expected count is 1.48.

Conformity (methods) * Entrance year

			Entrance year		Total
			93	94	
Conformity (methods)	1[a]	Count	9	15	24
		% within Entrance year	25.0%	24.6%	24.7%
	2	Count	12	27	39
		% within Entrance year	33.3%	44.3%	40.2%
	3	Count	12	12	24
		% within Entrance year	33.3%	19.7%	24.7%
	4	Count	3	7	10
		% within Entrance year	8.3%	11.5%	10.3%
Total		Count	36	61	97
		% within Entrance year	100.0%	100.0%	100.0%

a. Categories 1 to 5: total disagreement to total agreement respectively.

$\chi2 = 2.59$; df = 3; p = .458
1 cells (12.5%) have expected count less than 5.
The minimum expected count is 3.71.

7. Question 8 (continued)

Descriptive summaries of responses to Question 8

	Count	Mean	Std Deviation	Median
Conformity (contents)	97	2.75	1.06	3.00
Conformity (methods)	97	2.21	.93	2.00

Correlations

			Conformity (contents)	Conformity (methods)
Kendall's tau_b	Prior familiarity	Correlation Coefficient	.331**	.181*
		Sig. (2-tailed)	.000	.044
		N	97	97
Spearman's rho	Prior familiarity	Correlation Coefficient	.380**	.203*
		Sig. (2-tailed)	.000	.046
		N	97	97

**. Correlation is significant at the .01 level (2-tailed).

*. Correlation is significant at the .05 level (2-tailed).

8. Artistic practice (question 10)

Artistic Practice * Entrance year

			Entrance year		Total
			93	94	
Artistic Practice	None	Count	10	31	41
		% within Entrance year	26.3%	49.2%	40.6%
	Ordinary	Count	20	25	45
		% within Entrance year	52.6%	39.7%	44.6%
	Advanced	Count	8	7	15
		% within Entrance year	21.1%	11.1%	14.9%
Total		Count	38	63	101
		% within Entrance year	100.0%	100.0%	100.0%

$\chi 2 = 5.52$; df = 2; p = .063

Artistic practice * Entrance year Crosstabulation

			Entrance year		Total
			93	94	
Artistic practice	None	Count	10	31	41
		% within Entrance year	26.3%	49.2%	40.6%
	Yes	Count	28	32	60
		% within Entrance year	73.7%	50.8%	59.4%
Total		Count	38	63	101
		% within Entrance year	100.0%	100.0%	100.0%

$\chi 2 = 5.15$; df = 1; p = .023

9. Reason for the choice of the course (question 12)

Reason for choice * Entrance year

			Entrance year		
			93	94	Total
Reason for choice	Other	Count	14	39	53
		% within Entrance year	36.8%	61.9%	52.5%
	Artistic/Creative	Count	10	13	23
		% within Entrance year	26.3%	20.6%	22.8%
	Realistic	Count	14	11	25
		% within Entrance year	36.8%	17.5%	24.8%
Total		Count	38	63	101
		% within Entrance year	100.0%	100.0%	100.0%

$\chi 2 = 6.77$; df = 2; p = .034

10. Priority of choice

Priorty of Choice * Entrance year

			Entrance year		
			93	94	Total
Priority of Choice	Secondary	Count	2	6	8
		% within Entrance year	5.3%	9.5%	7.9%
	First along others	Count	31	56	87
		% within Entrance year	81.6%	88.9%	86.1%
	First and Only	Count	5	1	6
		% within Entrance year	13.2%	1.6%	5.9%
Total		Count	38	63	101
		% within Entrance year	100.0%	100.0%	100.0%

$\chi 2 = 6.03$; df = 2; p = .049

4 cells (66.7%) have expected count less than 5.
The minimum expected count is 2.26.

11a. Preference for transfer

Transfer * Entrance year Crosstabulation

			Entrance year		
			93	94	Total
Transfer	Yes	Count	5	16	21
		% within Entrance year	13.2%	25.4%	20.8%
	No	Count	33	47	80
		% within Entrance year	86.8%	74.6%	79.2%
Total		Count	38	63	101
		% within Entrance year	100.0%	100.0%	100.0%

$\chi 2 = 2.15$; df = 1; p = .142

Transfer? * Entrance year Crosstabulation

			Entrance year		Total
			93	94	
Transfer	Different Courses	Count	4	13	17
		% within Entrance year	10.5%	20.6%	16.8%
	Cognate Courses	Count	1	3	4
		% within Entrance year	2.6%	4.8%	4.0%
	No	Count	33	47	80
		% within Entrance year	86.8%	74.6%	79.2%
Total		Count	38	63	101
		% within Entrance year	100.0%	100.0%	100.0%

$\chi2 = 2.15$; df = 2; p = .340

2 cells (33.3%) have expected count less than 5.
The minimum expected count is 1.50.

11b. Preference for transfer (comparison with the 1995 students)

Transfer * Entrance year Crosstabulation

			Entrance year		Total
			93	95	
Transfer	Yes	Count	5	90	95
		% within Entrance year	13.2%	50.0%	43.6%
	No	Count	33	90	123
		% within Entrance year	86.8%	50.0%	56.4%
Total		Count	38	180	218
		% within Entrance year	100.0%	100.0%	100.0%

$\chi2 = 17.32$; df = 1; p = .000

Transfer * Entrance year Crosstabulation

			Entrance year		Total
			94	95	
Transfer	Yes	Count	16	90	106
		% within Entrance year	25.4%	50.0%	43.6%
	No	Count	47	90	137
		% within Entrance year	74.6%	50.0%	56.4%
Total		Count	63	180	243
		% within Entrance year	100.0%	100.0%	100.0%

$\chi2 = 11.49$; df = 1; p = .001

12. Personal interests and skills

Interests and Skills * Entrance year

			Entrance year		Total
			93	94	
Interests and Skills	Distant	Count	3	23	26
		% within Entrance year	7.9%	36.5%	25.7%
	Other artistic	Count	13	15	28
		% within Entrance year	34.2%	23.8%	27.7%
	Visio-spacial	Count	22	25	47
		% within Entrance year	57.9%	39.7%	46.5%
Total		Count	38	63	101
		% within Entrance year	100.0%	100.0%	100.0%

$\chi 2 = 10.15$; df = 2; p = .006

13. Involvement in handicrafts and making objects

handicraft making * Entrance year Crosstabulation

			Entrance year		Total
			93	94	
handicraft making	Never, Seldom	Count	7	23	30
		% within Entrance year	18.4%	36.5%	29.7%
	Sometimes	Count	11	24	35
		% within Entrance year	28.9%	38.1%	34.7%
	Often	Count	20	16	36
		% within Entrance year	52.6%	25.4%	35.6%
Total		Count	38	63	101
		% within Entrance year	100.0%	100.0%	100.0%

$\chi 2 = 8.11$; df = 2; p = .017

Appendix 6.4

Partial correlations

The correlations of the compound non-academic variable with four performance variables are controlled below for the 'Scientific Score' in the entrance examination.

1a. Original correlations for respondents from school A, (1993)

Correlations

		Dsgn avrg	Tech Avrg	Hmn Avrg	Overall Avrg
Prior Familiarity + Reason for Choice + Interests and Skills	Pearson Correlation	.862**	.558*	.640*	.759**
	Sig. (2-tailed)	.000	.047	.018	.003
	N	13	13	13	13

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

1b. Partial correlations for respondents from school A, (1993)

```
- - -  P A R T I A L   C O R R E L A T I O N   C O E F F I C I E N T S  - -

Controlling for..   SCISCR

             DSGNAVR     TECHAVR     HMNAVRG     OVRLAVRG

COMPOSIT       .7902       .2041       .4616       .5915
             (   10)     (   10)     (   10)     (   10)
             P= .002     P= .525     P= .131     P= .043

(Coefficient / (D.F.) / 2-tailed Significance)
```

2a. Original correlations for respondents from school A, (1994)

Correlations

		Dsgn avrg	Tech Avrg	Hmn Avrg	Overall Avrg
Prior Familiarity + Reason for Choice + Interests and Skills	Pearson Correlation	.607**	.502*	.371	.619**
	Sig. (2-tailed)	.010	.040	.142	.008
	N	17	17	17	17

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

2b. Partial correlations for respondents from school A, (1994)

```
- - -  P A R T I A L   C O R R E L A T I O N   C O E F F I C I E N T S  - -

Controlling for..    SCISCR

             DSGNAVR     TECHAVR     HMNAVRG    OVRLAVRG

COMPOSIT       .5888       .5068       .4332       .6105
            (    14)    (    14)    (    14)    (    14)
            P= .016     P= .045     P= .094     P= .012

(Coefficient / (D.F.) / 2-tailed Significance)
```