DESIGN INTELLIGENCES: A CASE FOR MULTIPLE INTELLIGENCES IN ARCHITECTURAL DESIGN

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Abstract

The complexity of design tasks today requires individuals with a wide array of skill sets - for example, spatial visualization, problem solving, verbal skills, communication skills, interpersonal skills and so on. Yet design education today seems to limit skills to form manipulation and graphical skills. These latter skill sets, although essential to design, predict only a part of a designer's application in the real-world contexts. Identifying and recognizing multiple intelligences then becomes important for architects and researchers to value and nurture diversity in architecture, empathize with the variations of individual cognitive strengths, and implement diverse tools to evaluate different areas of design thinking. In essence, the paper proposes a multiple intelligence approach to architecture design in the studio environment using educationist and cognitive psychologist Howard Gardner's multiple intelligence theory.

Keywords

Design skills; design ability; multiple intelligences; studio teaching.

All diagrams were developed by the author unless otherwise noted

Introduction

The Multi-Skilled Architect

The idea of a multi-skilled architect is not new. In Vitruvian time, architects were multi-skilled to fit into the role of *master-builders.* But what place does such a multi-skilled architect have today? According to Barrow (2000), the current day practice is observing a re-emergence of the master-builder concept, where architects are challenged of integrative project leadership in dealing with a dynamically networked team of consultants in the design process. This means that architects have fallen back into the role of a master-builder, perhaps as an 'integrator' of various skills and knowledge. A designer could then be considered analogous to a decathlon athlete, who needs not be specialized in a particular track and field event, but needs to perform consistently in a diverse set of events. Understanding design as a composite of different design intelligences could then allow for inclusive ways of learning and thinking. In this regard recent studies have outlined that architectural pedagogy and practice need to be considered from a diverse performance criteria (See NAAB report for 34 performance criteria in design, 2004: Groat & Ahrentzen, 2001; Robinson, 2001).

Yet the current design education and practice seem to focus on limited skills and in some cases, caught up in the early 20th century structure of architectural inquiry. The primary means of education, the architectural studio is built on an apprenticeship model, where learning is heavily based on the pedagogical focus of the instructors. On one hand architectural education, by nature and tradition, holds vast potential as a model for the integration in the discipline (Boyer & Mitgang, 1996). On the other hand, by assuming that student skills and learning in architecture are broadly homogenous, the studio system privileges a narrow section of students, ones who know how to play the game (Stevens, 1984). Importance to individual differences and diversity of skills are rather an accidental outcome than a deliberate pedagogical strategy.

To this effect I will introduce the theory of 'multiple intelligences' in design studio first proposed by psychologist and educationist Howard Gardner. Gardner's multiple intelligence theory published in his book, *Frames Of Mind* (1983), was influenced mainly by his study of cognitive problems in people suffering brain damage. He was intrigued by patients who had lost ones ability, such as *spatial* thinking, but retained another, such as *linguistic* ability. The fact that two abilities could operate independently of one another suggested the existence of separate intelligences. Note that Gardner's use of the term 'intelligence' was meant to be provocative than literal, and the term 'intelligence' is more akin to abilities and skills than anything else.

Gardner contends that a true intelligence will have a distinct faculty associated in the brain and outlines eight forms of intelligences: *Verbal/linguistic, Logical/mathematical, Musical, Spatial, Bodily-kinesthetic, Intrapersonal, Interpersonal* and *Naturalistic intelligences* (see table 1 for brief descriptions). According to Gardner, every individual can be considered intelligent in a variety of ways and could develop each aspect of intelligence to an average level of competency. The multiple intelligence theory has become an accepted model in educational settings, where the appeal of diverse abilities has become immediate.

Overview of Architectural Design Inquiry Relating to Design Intelligence

Before understanding how multiple intelligence theory fits into architectural design a brief overview of architecture design inquiry is presented. Historically, one of the first attempts in formulating rules for design and thereby explicitly proposing corresponding design skills could be attributed to the *functionalist movement of* the 1930's. Backed by the scientific outlook toward design, it was argued that tradition and intuition had been successful in the past because problems were simple. The present era needed tangible tools and description of the design process. Viewing traditional architecture as equivalent to *disorder* and *irrationality*, architects such as Corbusier, asserted a rational use of rules that created machine-like quality of buildings.

Parallel to the advances of functionalism and the rapid advancement in technology, *the design methods movement* came in vogue, working toward planned decision making rather

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than the process of trial and error. The emphasis was on efficiency and the belief that design problems could be quantifiable and worked as stage phases such as *analysis, synthesis* and *evaluation.* In other approaches such as *cybernetics and systems theory, problems were seen as an organization or system rather than individual components.* Alexander (1964) and later Bijl (1989) explored these systems theories in design and regarded them as important problem solving tools.

The later paradigm, namely, the *organic style,* propagated by the works of Wright (1955), dismissed the rigid functionalistic dictum of *form follows function* to a new philosophy that considered *form and function as one*. The focus during this time shifted to tactile issues such as expressive forms of nature and materials. There was also a renewed attention to the complexity of *architectural spaces*. Rowe and Slutzky (1976) for example showed much interest in visual ambiguity and inverted spatial effects influenced by the gestalt studies of visual perception. Preceding works by Schon (1988) and Lawson (1997) showed that spatial gestalts were an important aspect of the design process and spatial skills became important.

In the late 60's some design researchers, influenced by linguistic studies from Chomsky and others (1965) conceived design as a form of *language* with a definitive underlying structure. For example, shape grammars (Stiny, 1980) were introduced as formal rules in which design elements must be combined through geometric and visual logic (Mitchell. 1977; Knight, 1994). Others such as Barthes (1967) and Eco (1976) considered design a formal structure made of syntactic and semantic components much like any other language. The belief was that by identifying the structure one could understand the discourse of design. Language narration has also been used as an analogy in design (Isabel, 1997) and to bring in a fictional quality to design inquiry (Hedjuk et al, 1988). Verbal and narrative skills hence became prominent.

Other trends have explored design inquiry in terms of meanings and pluralistic approaches. These include *phenomenological* and *pragmatic* approaches. Phenomenological studies conjure personal and subjective experiences in design (Norberg-Schulz, 1979; Bachelard, 1969). Here intrapersonal skills are given importance. Taking a choreographic view of design, Tschumi (1994) proposes a way in which architecture can be explored as an instrument to express the body's experience of order, movement and temporal dimension, where kinesthetic skills are highlighted. The pragmatist approaches (action research, universal design) emphasize a more collaborative and critical role to the designer where empathy and empowerment of society is considered important (Whyte, 1991; Sanoff, 1989). This role highlights the architects to develop interpersonal skills.

In summary, while '*design intelligences'* as a subject matter has not been explicitly discussed, it has been addressed implicitly at various levels of design inquiry. Starting from epistemological and theoretical influences from philosophy and social sciences (Heidegger, 1927; Popper, 1959; Chomsky, 1965), to examining personality traits of architects (Cross and Nathenson, 1981; Newland et al, 1987; Mackinnon, 1978; Balchin and Coleman, 1965), or studies conducted

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on design process and methods (Jones, 1970; Lawson, 1997; Schon, 1983; Downing, 1989) or the nature of design itself (Cross, 1986; Archer, 1984). Within these bodies of literature one can find an attempt to describe different design skills and intelligences.

Intelligence Type	Characteristics
(i) Verbal/Linguistic	A person with verbal intelligence is sensitive to meaning and order of words. Verbal intelligence involve excellence in activities such as hearing, listening, impromptu or formal speaking, tongue twisters, humor, oral or silent reading, documentation, creative writing, spelling, journal and poetry. Personalities associated with verbal intelligence are poets and journalists.
(ii) Logical-mathematical	A person with logical-mathematical intelligence is able to handle chains of reasoning and recognize patterns, numbering and order. Logical-mathematical intelligence involves excellence in activities such as understanding abstract symbols/formulae, deciphering codes, numerical calculations and problem solving. Personalities associated with logical intelligence are mathematicians and computer programmers.
(iii) Musical	A person with musical intelligence is sensitive to pitch, melody, rhythm, and tone. Musical Intelligence involves excellence in activities such as musical recitals, singing on key and musical compositions. Personalities associated with musical intelligences are composers and conductors.
(iv) Spatial	A person with spatial intelligence can perceive, transform and modify spatial information easily. Spatial intelligence involves excellence in activities such as recreation of images, drawings, sculptures, forms, color schemes and so on. Personalities associated with spatial intelligences are artists, painters and sailors.
(v) Bodily-kinesthetic	A person with bodily-Kinesthetic intelligence is able to use the body, has control over motor actions and the ability to manipulate external objects. Bodily-kinesthetic intelligence involves excellence in activities such as drama, role playing, sports and dancing. Personalities associated with bodily-kinesthetic intelligences are dancers, gymnasts and rock-climbers.
(vi) Intrapersonal	A person with intrapersonal intelligence has the ability to recognize personal feelings and emotions. Interpersonal intelligence involves excellence in activities such as silent reflection, concentration skills and higher order reasoning. Personalities associated with Intrapersonal intelligences are writers and thinkers.
(vii) Interpersonal	A person with interpersonal intelligence has the ability to recognize others feelings, beliefs and intentions and understand people and relationships. Interpersonal intelligence involves excellence in activities such as group projects, counseling and feedback. Personalities associated with Inter personal intelligences are counselors , human resource personnel and teachers.
(viii) Naturalistic	A person with natural intelligence is able to connect with the intricacies and subtleties of nature. Naturalistic intelligence involves excellence in activities such as archeology, paleontology and wildlife watching. Personalities associated with naturalistic intelligences are botanists and archeologists.

Table 1: Multiple Intelligence Theory: Types and Characteristics.

A Loose-Fit Definition of Intelligences for Architecture

Some architectural purists may consider the coupling of the term '*design'* and 'skill,' or as referred in this paper '*design*' and '*intelligence'* as provocative, even antithetical, because traditionally architectural design has connotations of art, while intelligence has connotations of science; architecture design as art is considered subjective and intuitive, intelligence on the other hand is commonly viewed as objective and measurable (Mackinnon, 1978). This reasoning is not unfounded if one examines the definitions of intelligences available in the psychological literature that usually render intelligence as objective and abstract (Freeman, 1955; Sternberg, 1985; Das, 1973). Architectural design researchers hence tend to be more comfortable with the term '*creativity*' to describe inherent abilities of designers (Mackinnon, 1965). Creativity also is a favored term if one assumes that the objective of design process is not simply to *produce*, but also to *produce creatively* (Louridass, 1999).

Other authors have also suggested that architectural design be regarded as a unique form of intelligence which is different from the scientific or scholarly thinking styles, but as powerful (Cross, 1982). Cross observes that even though the criteria to study design as a separate form of intelligence are inconclusive, such a study could be important because it focuses attention on design as a cognitive ability, helps to identify and clarify features of the nature of design ability, and finally clarifies a framework for developing further the case for *designerly* ways of knowing, thinking, and acting.

While Cross's view brings a much needed appeal to the study of design intelligence, the idea of design as a unique form of intelligence could reduce design to another extreme way of defining it (similar to objective notions of intelligence). However, design if described more inclusively allows for a loose-fit definition of intelligence that includes diverse performance criteria.

Furthermore, there seems to be a recent blurring of gap between the construct of *intelligence* and *creativity*. Studies on creativity have shown that the so called rational subjects like science and mathematics can be highly creative (Lawson, 1997). Others like Mackinnon (1978) suggest the definitions of creativity range all the way from the notion of creativity as a simple problem-solving exercise to conceiving it as the full realization and expression of an individual's unique potentialities. Gardner himself does not make a strong distinction between *intelligence* and *creativity*. For Gardner, as long as one can find a culture that values an ability to *solve* a problem or *create* a product in a particular way, then one could strongly consider that ability as intelligence. The blurring of the terms 'intelligence' and creativity' suggests that it is perhaps useful to consider design intelligence as a combination of multiple factors, and examine the components of these factors in much more detail. For the purpose of this paper, hence, a *loose-fit* definition of intelligence is used as a starting point. What this means is that insofar as the study of design intelligence is concerned, it is not restricted to one set of variables but rather considered a flexible framework consisting of multiple intelligences that can be configured or combined.

Multiple Intelligences: Scope and Limitations

Gardner (1993) critiques the current education system that focus on logical and verbal intelligences only and hence fails to serve the academic and career needs of many students whose strengths lay outside of these two intelligences. The appeal of multiple abilities was immediate and a welcome change from IQ in educational circles. However, the use of MI theory in architectural design could be relevant inasmuch as it affords a way to think of architectural designing as a diverse set of intelligences and to understand individual differences among designers. It will also help to explore how these intelligences are learnt and experienced in the studio environment. Finally, it could be potentially useful as a diagnostic or career guidance tool for architectural education and practice. Assuming multiple intelligence theory as an acceptable model for understanding design intelligences in the studio setting, the following research questions are asked in this paper:

(i) What intelligence(s) are important to architectural designing?
(ii) Is there diversity or consistency among architectural designers in their priority of using multiple intelligences?
(iii) If the use of multiple intelligences is substantiated, to what extent can they be used in pedagogy and practice?

Multiple Intelligence Among Architectural Designers

The MIDAS Scales

To measure multiple intelligences among designers a MIDAS questionnaire was used. MIDAS (Multiple Intelligence Development Assessment Scale) was developed by Shearer (1999) to assess multiple intelligence theory of Gardner. The MIDAS profile is intended to give a reasonable estimate of the person's intellectual disposition in each of the eight main intelligence areas (*linguistic, logical-mathematical, spatial, musical, kinesthetic, naturalist, interpersonal and intrapersonal*). There are a total of 119 items within MIDAS, for the eight scales related to the multiple intelligences of Gardner (see table 2 for brief description).

Shearer considers Gardner's following definition of intelligence as an important starting point to construct the scales. '*Intelligence is the ability to solve a problem or create a product that is valued in one or more cultures*.' (Gardner, 1983). Based on this definition the MIDAS is operationalized as follows:

(i) The measurement of *creative, practical* and *hypothetical-abstract* aspects of intellectual abilities.
(ii) Importance of the *person-in-context* and *social influences* that contribute to recognition, activation and development of personal skills.

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MIDAS Scale/TYPE	Description
MUSICAL	To think in sounds, rhythms, melodies and rhymes. To be sensitive to pitch, rhythm, timbre and tone. To recognize, create and reproduce music by using an instrument or voice. Active listening, a strong connection between music and emotions.
Vocal Ability	A good voice for singing in tune and in harmony
Instrumental Skill	Skill and experience in playing a musical instrument
Composer	Makes up songs or poetry and has tunes on her mind
Appreciation	Actively enjoys listening to music of some kind
MIDAS Scale/TYPE	**Description**
KINESTHETIC	To think in movements and to use the body in skilled and complicated ways for expressive and goal directed activities. A sense of timing, Coordination for whole body movement and the use of hands for manipulating objects.
Dexterity	Ability to move the whole body for physical activities such as balancing, coordination and sports
Dexterity	To use the hands with dexterity and skill for detailed activities and expressive moment
MIDAS Scale/TYPE	**Description**
LOGICAL-MATHEMATICAL	To think of cause and effect connections and to understand relationships among actions, objects or ideas. To calculate, quantify or consider propositions and perform complex mathematical or logical operations. It involves inductive and deductive reasoning
Everyday Math:	Used math effectively in everyday life
School Math:	Performs well in math at school
Everyday Problem Solving:	Able to use logical reasoning to solve everyday problems, curiosity
Strategy/Logic Games	Good at games of skill and strategy
MIDAS Scale/TYPE	**Description**
SPATIAL	To think in pictures and to perceive the visual world accurately. To think in three-dimensions and to transform one's perceptions and re-create aspects of one's visual experience via imagination. To work with objects effectively.
Space Awareness	To solve problems of spatial orientation and moving objects through space such as driving a car
Artistic Design	To create artistic designs, drawings, paintings or other crafts
Working with Objects	To make, build, fix, or assemble things
MIDAS Scale/TYPE	**Description**
VERBAL/LINGUISTIC	To think in words and to use language to express and understand complex meanings. Sensitivity to the meaning of words and the order among words, sounds, rhythms, inflections. To reflect on the use of language in everyday life.
Expressive Sensitivity	Skill in the use of words for expressive and practical purposes

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Rhetorical Skill	To use language effectively for interpersonal negotiation and persuasion
Written - academic	To use words well in writing reports, letters, stories, verbal memory, reading / writing
MIDAS Scale/TYPE	**Description**
INTERPERSONAL	To think about and understand another person. To have empathy and recognize distinctions among people and to appreciate their perspectives with sensitivity to their motives, moods and intentions. It involves interacting eff ectively with one or more people
Social Sensitivity	Sensitivity to and understanding of other people's moods, feelings and point of view
Social Persuasion	Ability for influencing other people
Interpersonal Work	Interest and skill for jobs involving working with people
MIDAS Scale/TYPE	**Description**
INTRAPERSONAL	To think about and understand one's self. To be aware of one's strengths and weaknesses and to plan effectively to achieve personal goals. Reflecting on and monitoring one's thoughts and feelings and regulating them effectively. The ability to monitor one
Personal Knowledge / Efficacy	Awareness of one's own ideas, abilities; able to achieve personal goals
Calculations	Meta - cognition, "thinking about thinking'
Spatial Problem Solving	Self awareness to problem solve while moving self or objects through space
Effectiveness	Ability to relate to self and others. Able to get along with people
MIDAS Scale/TYPE	**Description**
NATURALIST	To understand the natural world including plants, animals and scientific studies. To recognize, name and classify individuals, species and ecological relationships. To interact effectively with living creatures and discern patterns of life & natural force.
Animal Care	Skill for understanding animal behavior, needs, characteristics
Plant Care	Ability to work with plants, i.e., gardening, farming and horticulture
Science	Know ledge of natural living energy forces including cooking, weather and physics

Table 2: MIDAS Scales and Descriptors (from the MIDAS Manual, Shearer, 1999)

What Intelligences are Important to Architectural Design?

The measurement of MIDAS among architecture students was conducted among 36 architecture students (18 juniors, 9 seniors and 9 graduate students) distributed among the seven design sections. Note that the later phases of the study included 104 students as a larger part of the item construction process which culminated in the ADIAS (Architecture Design Intelligence Assessment Scales) and is proposed as a forthcoming paper. In psychometrics, *item construction* process refers

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to the construction of reliable scales through repeated testing, refining and improving them. An *item* refers to a single question designed to elicit a response from a test-taker. Items of the same substantive construct are grouped under a common *scale.* Each of Gardner's eight intelligences can be considered as a distinct scale and questions under these scales can be considered as *items.*

When MIDAS scores were calibrated, in the aggregate, mean percentage scores for 36 architecture students ranged from 68% (for *spatial* intelligence) to 50% (for *musical* intelligence). The frequency chart and bar chart for the aggregate mean percentage scores for the various intelligences across student population is shown in table 3 and figure 1. The relatively low difference (of only 18%) between the highest scale (*spatial* intelligence) and the lowest scale (*musical* intelligence), shows that there is a consistency of mean percentage scores of intelligence across student population, demonstrating that architecture students may be good at several different intelligences rather than specialized in one or two. The highest scores were registered for *spatial* intelligence (68%) and *intrapersonal* intelligence (65%). The lowest scores were registered for *musical* (50%) and *kinesthetic* intelligence (50%). The rest of the intelligences registered midlevel scores.

Type	*N*	*Minimum*	*Maximum*	*Mean*	*Standard Deviation*
Spatial	36	21.67	89.23	67.97	17.57
Intrapersonal	36	39.89	91.67	64.76	12.88
Interpersonal	36	16.25	4.72	57.72	16.06
Logical	36	14.00	92.65	56.83	17.76
Linguistic	36	27.50	78.75	54.69	13.00
Natural	36	9.62	92.31	53.39	19.45
Kinesthetic	36	19.23	73.08	50.04	13.94
Musical	36	7.14	73.21	49.76	16.48
Valid (listwise)	36				

Table 2: Descriptive statistics for MIDAS scales for architecture students (n=36) (Mean percentage scores).

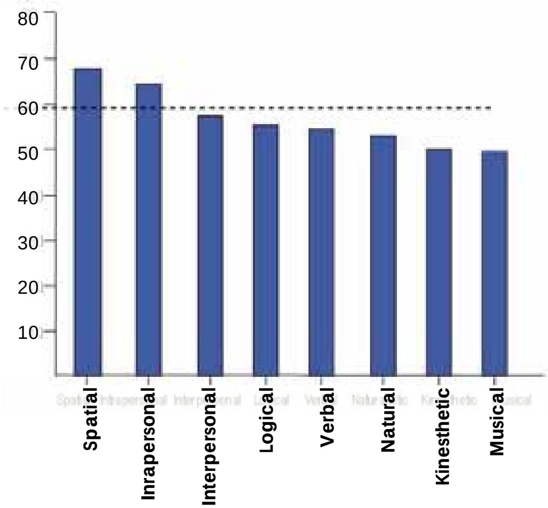

Figure 1: Bar Chart Showing Mean Percentage Scores for MIDAS Among Architecture Students (n=36). Highest Scores Recorded for Spatial Intelligence (68%) and Lowest Scores for Musical Intelligence (50%). Scores Above 60% Score are considered high in MIDAS.

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While the scores for *spatial intelligence* were predictably high, the high scores registered for *intrapersonal* and *interpersonal intelligences* perhaps demonstrate the importance of communication, self reflection and critical thinking that the architectural design studio demands. The aggregate mean scores for the overall student population concur with frequency distribution for each of these intelligences. The histograms in figure 2a are arranged from left to right (left indicating more than 60% scores and right indicating less than 60% scores, with a dashed line indicating the 60% mark). One can see that the histograms are skewed slightly to the right of 60% for *spatial* and *intrapersonal* intelligence and slightly to the left for *musical, kinesthetic* and *natural* intelligence. Other intelligences remain in the middle.

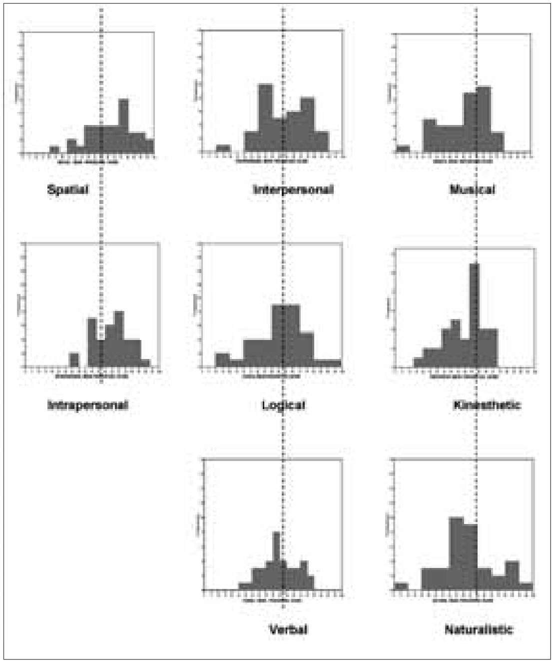

Figure 2a: Frequency Polygons Arranged in Terms of Mean Percentage Score for MIDAS Across Architecture Students (n=36). The Dashed Line Indicates the 60% Mark. Read from Left to Right columns, the Histograms are Skewed Slightly to the Right of 60% for Spatial and Intrapersonal Intelligence and Slightly to the Left for Musical, Kinesthetic and Natural Intelligence. Other Intelligences Remain in the Middle.

The histograms can also be arranged in terms of variation of frequency distribution as arranged in figure 2b (left indicating low variation and right indicating high variation). The histograms reveal a relatively low variation in distribution for *spatial, verbal, intrapersonal* and *logical* intelligence (also refer standard deviation in table 1), indicating that these scales are relatively stable and that architecture students are consistently good at these intelligences. A high variation is found for *kinesthetic*, musical, *naturalistic* and *interpersonal* intelligences indicating that there were high individual differences for these intelligences. In particular, *musical* intelligence was the only intelligence that registered low scores as well as high variation making its validity questionable, or at least making the items for this scale in need of modification insofar as its validity to architectural design is concerned.

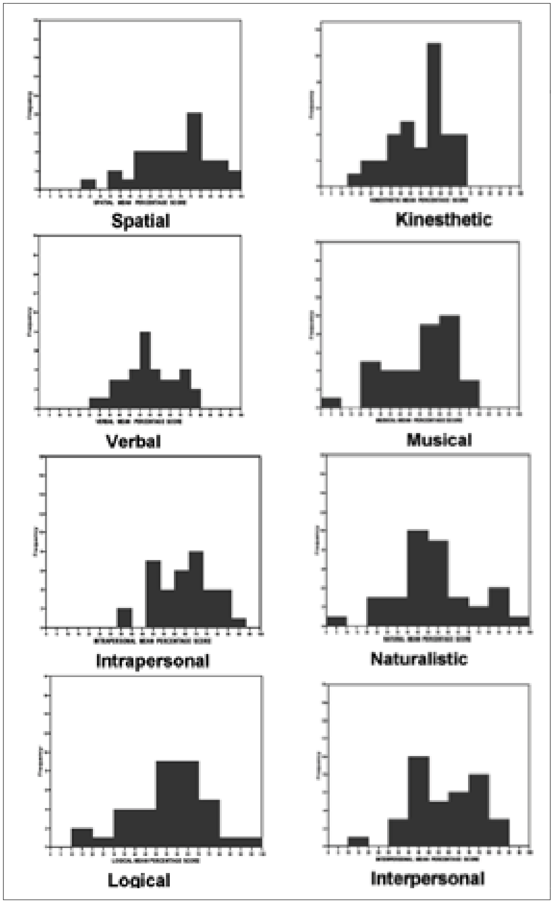

Figure 2b: Frequency Polygons Arranged in Terms of Frequency Distribution for MIDAS Across Architecture Students (n=36). Read from Left to Right, the Histograms Reveal a Relatively Low Variation of Distribution Curve for Spatial, Verbal, Intrapersonal and Logical Intelligence Indicating that these Scales are Relatively Stable and that Architecture Students are Consistently Good at these Intelligences. A High Variation is Found for Kinesthetic, Musical, Naturalistic and Interpersonal Intelligences Indicating that there were High Individual Differences for these Intelligences.

Comparison of MIDAS for Architecture Students with other Domains

To analyze how architectural students stand in the spectrum of other domains, comparisons were made with other groups. The groups were chosen to demonstrate the diverse characteristics of different domains and a sample size that could make a reliable comparison (from studies conducted by Shearer, 2002). These groups included engineering majors (n = 93), psychologists (n=30), arts club (n = 79), naturalists (n=17), music majors (n = 40), and dancers (n=17). Although the sample size for these groups is relatively small and not standardized it can provide an indication of how architecture majors stack up with other groups in terms of multiple intelligences.

As seen in figure 3, the range of scores that architecture majors produced was placed at the center of these groups suggesting that architectural designers had neither too high nor too low scores compared to other domains. This means that architecture students were good at several intelligences at a nominal level. In other words the multiple intelligences of architecture students were found in a well-balanced range (i.e. not very high, nor very low), indicating the characteristics of architecture as an interdisciplinary domain. However, architecture majors were also found to excel in other groups on two intelligences – *spatial* and *intrapersonal* intelligence across domains. This contradictory result points out that, although architecture on one hand is to an extent is interdisciplinary, on the other hand it consists of enough rigor in two intelligences that might suggest the makings of a well-defined domain.

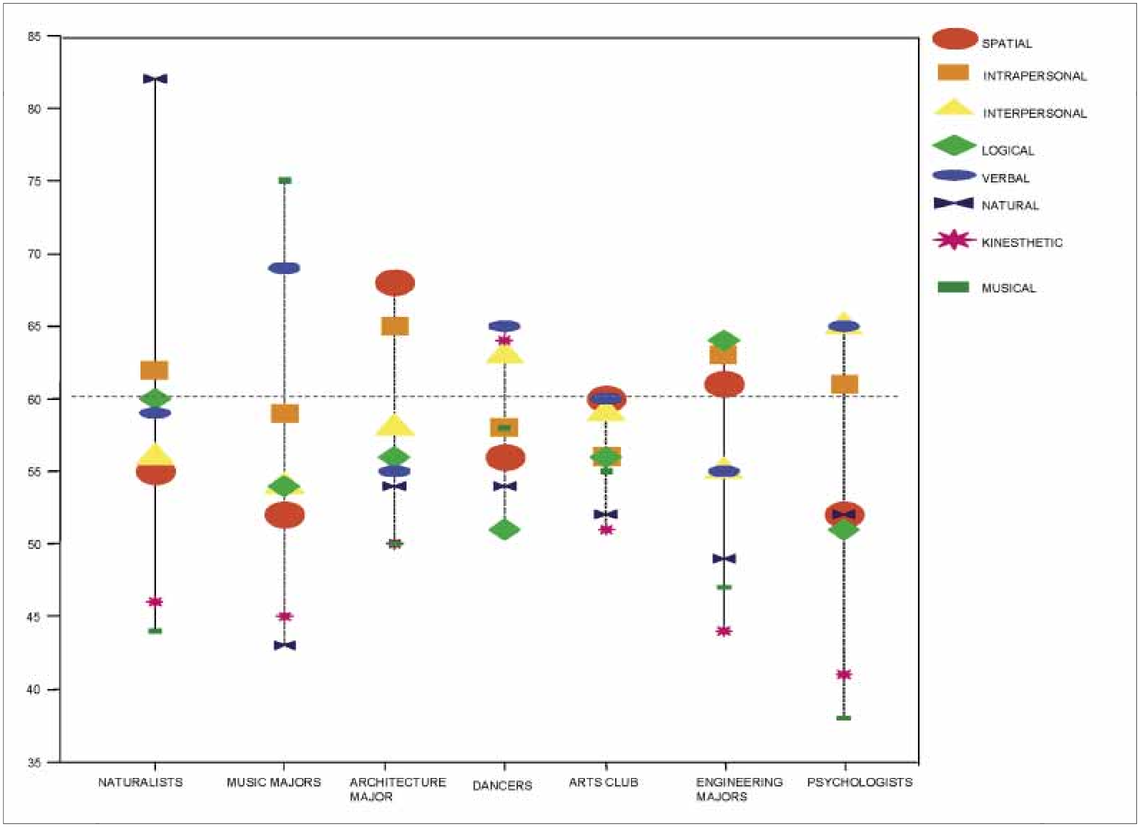

Figure 3: Drop-line Graph Showing Mean Percentage Score distribution for MIDAS Across Well Defined Groups. From Left to Right, Naturalists (n=17), Music Majors (n = 40), Architecture Majors (n=36), Dancers (n=17), Arts Club (n = 79), Engineering Majors (n = 93) and psychologists (n=30). Architecture majors produced were placed at the centre of these groups i.e. in a well-Balanced Range, Suggesting they Had Neither Too High Nor Too Low Scores.

This argument seems apt especially in architecture and it is not surprising that Gardner originally did not associate any of these intelligences with architects or architectural design ability (in his prior edition of *Frames of Mind*). The view provides more traction that architectural design is interdisciplinary (Groat & Ahrentzen, 2001; Robinson, 2001). Hence thinking of design as a domain which consists of interplay of various intelligences may be more plausible, than thinking of design as a separate form of intelligence.

In summary, the study indicates that design intelligence cannot be restricted to one set of variables but rather should be considered as a flexible framework consisting of multiple intelligences that can be adapted to produce desired outcomes. This *loose-fit* definition makes the study more inclusive and open to richer data. It helps to understand that architecture design problems could be solved in a variety of ways and thereby through alternative viewpoints.

Implications

Empathizing with Individual Differences in Learning

MIDAS may help instructors in understanding individual differences among students and make sense of different approaches, so that they can develop a strategy to intervene on the student's behalf. This can be done in different ways. To diagnose a students' performance through MIDAS, first, students can be asked to self-identify their individual capabilities through MIDAS. The instructor can also rate the students using the same instrument. Once a reasonable profile is identified for the student, the differences between the two ratings as well as strengths and weaknesses could be identified and communicated with each other. This will help in a two-way communication between the instructor and the student.

Once a MIDAS profile is established formative questions could be asked. For example, if a student has limited skills, should that student be taught to broaden the repertoire of intelligences? On the other hand, if a student has several skills should that student be instructed to focus on certain skills alone? While these questions are important, they may not always work effectively in all the cases. A student may be narrow and rigid but yet be rigorous and effective in those intelligences, or a student may be able to compensate for scarce abilities in one area by increasing competency in the other. Hence, given these questions ultimately individual differences should be considered on a case-by-case basis. The role of the instructor then would be to recognize the individual strengths and differences in which students operate and provide the necessary flexibility. Identifying and recognizing multiple intelligences then becomes important for instructors and students to value and nurture diversity in design thought, empathize with the variations of individual strengths, and implement diverse tools to evaluate different areas of design thinking.

Rethinking the Experience in the Studio Environment

Assuming that multiple intelligences can be used as an explicit pedagogical tool in design, one may need to re-examine the current studio model. While this studio system has its distinct advantages, the primary problem in such a system is the assumption that learning occurs sequentially from a beginning level to an advanced level and that students absorb the complexity of architectural problems in a cumulative manner and could deter students in dealing with architectural complexity in the later studios. This assumption leads to training in the beginning level studios limited to largely formal issues. If complexity is brought into the system early, students may be willing to regard architectural complexity as a part of the problem rather than something external. A multiple intelligence approach to beginning design studios may be one way of dealing with architectural complexity.

In this context the structure of the studio system is worth examining. Currently, in North America, most architecture schools are structured in such a way that the first two semesters focus on '*architecture fundamentals*.' Design, here, is looked upon as a formal exercise of lines, planes and volumes (where the primary importance is provided for *logical* and *intrapersonal* intelligences). The studios preceding it consist of '*basic architectural design*,' where program and pragmatic issues are brought to bear. These studios usually present a real world problem such as a design of a museum, library and so on (where the importance perhaps shifts to *interpersonal* and *spatial* intelligences). The final sequence of courses allows for '*advanced architectural design*,' either in the form of *specialized* studios (for example exploration of materiality, architectural details, particular building typology and so on) or as *comprehensive* studios that allow developing a broader world view (*microcosm, phenomenology*, *cultural landscapes* and so on). It is only at this stage that a true opportunity for exploring different intelligences is afforded.

The challenge is then to devise architectural problems that afford the use of multiple intelligences, yet maintaining the appropriate degree of difficulty for a specific undergraduate level. What is needed are design problems that test a combination of intelligences based on the degree of difficulty that a particular program needs. This could be done at different scales and different levels of abstraction. Another way to achieve this is to alternate students between specialized and comprehensive studios as students proceed through different levels of architectural school. Perhaps studio 'cross-modules' that allow juniors and seniors to take part in a joint studio could be useful. Other studio such as '*Study Abroad'* studios might help in this regard, because they have the ability to foster the learning of certain intelligences -- such as *interpersonal, kinesthetic* and *intrapersonal* intelligences quicker than in the studio environment—as students are exposed to tacit learning in an external environment. However, the study abroad studios are usually optional and not all students can afford the costs.

Cross-modules can also be considered at a university level. Most universities run courses ranging from pure art colleges to mixed programs of engineering and design. Cross disciplinary courses could be encouraged in which architectural design is seen as a continuum between different design disciplines. One end of the continuum could be occupied by disciplines such as ecological design, urban design, and landscape design and so on, and the other end by industrial design, product design or graphic design. This way translation could occur within the continuum between different design disciplines. Experimental studios could also be conducted, for example, between apparently distant faculties, such as architecture and dance schools, for a design problem that involves a retail design store, as different disciplines bring about different levels of priority and focus of intelligences (for example, *kinesthetic* intelligences in dance).

Another issue in the studio system is the use of support courses. Currently, the support courses such *as environmental systems, human behavior*, *architectural theory* etc., do not necessarily infiltrate the studio system effectively. A curriculum that integrates these support courses in real time with the ongoing studio projects may help to some extent, and thereby encourage lateral thinking between different domain areas.

Multiple Intelligences as a Career Guidance and Achievement Tool

According to Shearer, the MIDAS is designed to provide an objective measure of the multiple intelligences as reported by the person or by a knowledgeable informant and its philosophy is based on a person-centered assessment. In line with Gardner's criticism of psychometric testing, Shearer observes that while traditional psychometric tests serve to mark the limits of the person's *general intelligence*, the MIDAS strives to describe the course and direction of intellectual growth and achievement potential in *specific areas* of *skill* for the eight intelligences.

Compared to other domains (such as engineering, management, medicine) where standardized tests are established, there is very little empirical analysis of architectural design aptitude (Arvola, 2002). In the light of the diagnostic tool outlined in this paper, perhaps the multiple intelligence scales may be helpful in developing these tests. Quite a few schools use intelligences testing in architecture. According to an international survey of 60 schools (Goldschmidt et al, 2001), 55% rely on Scholastic Aptitude Tests and 26% rely on special architectural aptitude tests. Salama (2005) has identified that, by and large, admission policies reflect the tendencies of most schools of architecture to emphasize skills in drawing and form manipulation. Because they test primarily universal and abstract decision making skills, these aptitude tests are often de-contextualized from the naturalized setting of architectural design, and hence limited in testing prospective students who can apply their reasoning to real-world contexts. Moreover, personal intelligences (such as *intrapersonal* and *interpersonal* skills), which stands out as critical in MIDAS are often overlooked in prevailing aptitude testing.

Another area where the MIDAS could be important is to bring clarity to architectural performance criteria and architectural achievement. In North America, the National Architectural Accrediting Board (NAAB) creates and defines performance criteria to help accredited architectural degree programs prepare students for the profession. NAAB has outlined 34 performance criteria for this purpose. While NAAB has been much more forceful in recent years to stress the development of *interpersonal intelligences*, other intelligences such as *intrapersonal, logical,* and *kinesthetic intelligences* are not addressed rigorously. Moreover, NAAB criteria also fail to elaborate on the descriptors for '*fundamental design skills*' needed by students. The multiple intelligence framework – particularly, the *spatial* intelligence category - could help develop this criteria.

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Implications for Architectural Practice

While the measurement of multiple intelligence in this paper was done in an academic setting, the framework of multiple-intelligences may have important implications to practice as well. Of course, the goals and challenges of architectural practice are very much different than a studio. One important difference is that professionals have a greater power in redefining their tasks, while the students are bound more rigidly to the studio system. It may also be the case that students are overtly concerned with the grading criteria while success in practice is more openly defined. Add to the fact that practice involves collaborative design and seldom focuses only on individual acts of designing.

Given the differences, nevertheless, the idea of multiple intelligences could be useful in practice where building design and construction have increased in complexity, products, and project participants. Design practice also needs to be evaluated within its own culture, especially if one considers architects as members of a larger community of practice. The concept of a *community of practice* refers to the process of social learning that occurs when people who have a common interest in some subject or problem collaborate over an extended period to share ideas, find solutions, and build innovations (Lave and Wenger, 1991; Wenger, 1998). Lave and Wenger suggest that while most communities of practice are usually formed within a single discipline in order to focus knowledge sharing, and resources, more recently multidisciplinary participation has become inevitable given the complex nature of the technological and global age in which organizations function. This is perhaps more true to the domain of architecture than any other, and a multiple intelligence approach could help in advancing this idea.

In this context, professional capacities need to be diagnosed perhaps in a different way because practitioners use a high degree of *interpersonal* intelligence, in the form of client interaction, communication skills, as well as associated skills to fit into the process of the larger community of practice. Moreover, understanding and applying the shared repertoire of communal resources that the community of practice develops over time (that include routines, sensibilities, artifacts, vocabulary, styles, etc.) become more important in practice than an academic setting.

Some Limitations

The different scales contained very different content questions, and their testing through a paper format was not always easy. Some scales such as *musical* scales are harder to determine than other scales such as *spatial* scales because architecture students are more comfortable with, or are trained in *spatial* rather than *musical* medium. Moreover, since the MIDAS survey was mainly a self report, it was vulnerable to inaccuracies. To rectify this, some form of aptitude testing could be developed to make sure that the student is indeed competent in a certain field that he/she claims to be.

Because this study was conducted within one school and a studio group, the sample sizes may not be big enough to claim validity for the broader design population and different cultural settings. The MIDAS scales can be further validated by increasing the representation of designers in different groups such as practitioners and students, and standardized norms (performance by a defined group on a particular test) could be set as a guide to measure design intelligence. The study sample is made up of only one level of architecture students (juniors), which could deter understanding the developmental aspects of multiple intelligences in architecture schools. Taking measurements throughout a student's stay in the school may provide this data, and help to understand the process of architectural learning in a much more valid way.

A larger sample could also help to increase the reliability of scales with other statistical devices such as factor analysis. This will allow understanding whether one factor accounts for more of the variance than others. If items do not load on this factor it might be considered for elimination. Factor analysis could also help in the development of subscales. Multiple intelligence theory itself is still under development as Gardner has since considered the existence of other possible intelligences such as *spiritual/existential* and *moral /ethical* intelligences (Gardner, 1999). The further development of MI theory may provide more incentives to understand new descriptors in architectural domain.

Within these limitations, the understanding of multiple intelligences may have wide consequences in the contemporary architectural context in how one values designs in the studio, how one accept students into design schools and how one defines competency in practice.

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