

How Architectural Students Characterize Design

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Abstract

This study explores how students of architecture characterize design. It focuses on the transformation of students' conception of design as they move from first year to fourth year in their undergraduate education. The study employs surveys and in-depth interviews with selected groups of students from all four levels among the students of architecture in the Department of Architecture in the Faculty of Fine Arts and Design in Izmir University of Economics. It was found that first year students mostly characterize design as an artistic activity and this characterization changes towards a more problem-solving oriented conception of design among the fourth year students. The conception of design is constructed on the basis of the recognition of end products as art objects among first year students while fourth year students tend to define design in reference to the design process.

Keywords: *design education, design learning, design studio*

Introduction

This study explores how students of architecture characterize design. It focuses on the transformation of students' conception of design as they move from first year to fourth year in their undergraduate education. The study employs surveys and in-depth interviews with selected groups of students from all four levels among the students of architecture in the Department of Architecture in the Faculty of Fine Arts and Design in Izmir University of Economics.

Regardless of differences in methods of design teaching, students of architecture almost never formally learn what the design process is. Kowaltowski et al. (2010) indicate that design instructors apply methods mostly informally. Learning about design and design process occur often through what is called "learning-by-doing". Students are expected to acquire an understanding of design and design process through designing rather than formal methods of teaching. In this method of learning, the tutor is a facilitator rather than a transmitter of knowledge.

This application of informal transfer of knowledge in education takes its roots from Ecole de Beaux Arts in the nineteenth century. Schön (1987) defines and focuses on two main devices in this type of teaching. These are "coaching", which designates guidance by the studio instructor, and "learning by doing", which emphasizes student-oriented learning by getting directly involved in what is being learned. According to Schön, these two devices complement each other as what instructors convey about designing and its essential features is graspable by a student only as he/she begins to design (Schön, 1987).

This study takes the setting of the design studio as an educational device in its totality together with the studio instructors, other students, and the physical environment of the studio. We adhere to the general principles of learning-by-doing as it is implemented in design studios; yet, we inquire about what students actually learn about design and design process throughout their education. Often, studio evaluations are based on the end or on the intermediary product assuming that learning could be measured through the quality of the product. In this study, we are suggesting that investigating and evaluating what students learn about design by asking them could provide important insights about design learning.

Design Education

The history of design education shows a progressive move from the workplace into the college and university studio (Lawson, 1997). Modern project-based education in the architectural education owes its structure, content, and method in large measure to the Ecole des Beaux Arts (Cunningham, 2005). Cunningham (2005) states that the Arts and Crafts Movement, which had its roots in mid-nineteenth century romanticism in England, has a formative influence on architectural education. The formation of Bauhaus in Weimar in 1919 can be seen as the educational culmination of this movement.

Design education has common features that transcend countries and design domains. Design schools characteristically use both the physical and conceptual studio as their central educational device. Conceptually, the studio is a process of learning by doing, in which students are set a series of design problems to solve. Thus, they learn how to design largely by doing it, rather than by studying it or analysing it (Lawson, 1997). Physically the studio is a place where students gather and work under the supervision of their tutors.

The role of the design studio can be considered under three headings: (a) learn and practice some new skills like visualization and representation; (b) learn and practice a new language such as the graphic and verbal language of architecture as Schön (1981) explains; and (c) learn to 'think architecturally', which is, as Ledewitz (1985) explains, the "way of thinking" referring "to a particular domain of problems and solutions that characterize and which are fundamental to professional performance (p.2)." However, apart from the three headings mentioned above, the design studio is a complex and challenging experience. Sachs (1999) states that students are not only expected to grasp many new concepts and ideas but they are also asked to perform at least two tasks simultaneously: to design and to learn to design.

Webster (2005) states that it has long been recognized that there are two aspects of any curriculum of architectural studio. First, there is the explicit or declared curriculum that maps out the cognitive student learning, i.e., knowledge, skills, and abilities to be acquired (Webster, 2005). Second, there is the tacit or 'hidden curriculum' (Dutton, 1987) that is concerned with inculcating non-cognitive dispositions such as values, tastes, and beliefs. In addition to being a setting for learning knowledge, skills, and abilities and a place to study, the design studio is a setting in which the student learn what Dana Cuff (1991) has called the culture of the architectural profession, 'architecture', 'design' and the 'role of the architect'.

The central pedagogy for architectural education is project-based learning. In this type of learning, students are expected to make proposals for the development of a piece of architecture in response to a given brief. The core of this pedagogy is design as an activity. This synthetic process employs any information, knowledge, theory or technique from any disciplines which the designer may select as being relevant to the task in hand.

Architectural design is a knowledge-intensive activity (Rodgers, Caldwell, Clarkson, & Huxor, 2001). A designer utilizes knowledge to set design goals, define design issues, and develop design solutions (Chiu, 2008). However, students usually have not yet acquired an adequate body of design knowledge when they start designing. This is because design problems are ill-defined (Goel & Pirolli, 1992), i.e., the problems are unspecific or unknown; it is difficult to predict what issues will emerge and what knowledge is required for the design process.

There is no clearly defined body of knowledge or any system of organising principle for architecture. Instead, architecture borrows theories and techniques from other disciplines as required. This actually demonstrates that the acquisition of knowledge is not an educational end in itself (Cunningham, 2005). Cunningham (2005) draws attention to the design studio's main teaching method – recalling Schön's introduction of Meno paradox – which revolves around stretching student's intellect in terms of recognising the need for particular pieces, seeking the means to search out, and satisfy that need and then employing the results creatively.

Compared to education in other disciplines, design does not seek a single correct answer. During the design process, it is rather expected that the student will make propositions which are often speculative and exploratory in nature (Roberts, 2006). In comparison to the features of professional technical education, the students' responses to design situations tend to be unique and individualistic, and owe more to interpretation and intuition than to a logical or formulaic process or the application of a rational body of knowledge (Schön, 1985).

Learning to Design – Learning by Doing

One of the weaknesses of the traditional studio is that students, in paying so much attention to the end product of their labours, fail to reflect sufficiently on their process (Lawson, 1997). The professionalisation of design and thus institutionalisation of design education has led design educators focus on the product rather than the process itself. Alexander (1964) in his seminal work highlights the importance of process in design and argues that the unselfconscious craft-based approach to design must inevitably give way to the self-conscious, professionalised process when a society is subjected to a sudden and rapid change which is culturally irreversible.

Lawson (1997) states that the change in the designer's role and the separation between the architectural product and the designer paved the way for the central role of drawing. Alexander (1964) explains the central role of drawing as an activity for thinking.

Teaching design and introducing to the students drawing as an activity for "thinking architecturally" has been the major struggle in architectural education. Schön (1987) recalls the Meno paradox to explain the nature of design problems and process of learning to design. Herbert Simon (1969) who thinks of designing as converting a situation from its actual state to a preferred one, proposes to solve the paradox of Meno by distinguishing between "state" and "process". He states that the change of state that occurs can be described when a problem is solved even though the process that would produce it cannot be described (Simon, 1969). Alexander (1964) defines design as searching for harmony between two tangibles which are form and context.

Using Meno paradox, Schön (1987) states that design activity is to look for something without knowing what it is. According to Schön (1987), design cannot be defined exhaustively and to teach a student what design is becomes impossible through conventional methods of teaching which follow the premises of conduit metaphor (Reddy, 1979). Instead, Schön (1987) proposes that it is possible to coach students:

He has to see on his own behalf and in his own way the relations between means and methods employed and results achieved. Nobody else can see for him, and he can't see just by being told, although the right kind of telling may guide his seeing and thus help him see what he needs to see. (Dewey, 1974, p. 151)

Correspondingly, Schön (1987) states that each student must construct for himself/herself the meaning of the other's messages and must design messages whose meanings the other can decipher. Schön (1987) states three essential features of the dialogue between coach and student. The dialogue takes place in the context of student's attempts to design which creates a familiar ground for student. It also makes use of actions as well as words and it depends on a reciprocal reflection-in-action. So, through designing students acquire the sorts of experience to which the coach's language refers. Schön (1987) states that the architectural studio is based on an implicit response to the paradox and predicament of learning to design. The student must begin to design before he/she knows what he/she is doing, so that the studio master's demonstrations and descriptions can take on meanings useful to his/her further designing. The weakness of this method of teaching is that it relies on heavily on the effective communication skills of the studio master. The messages that the instructor designs plays a crucial role. Schön (1987) states that these messages often refer both to the process of designing and to the process of learning to design.

Alexander (1964) describes the most important aspect of the process of learning by doing as enabling the designer scanning mentally all the ways in which other things have gone wrong in the past. Using this description, Alexander (1964) reveals that learning by doing is actually the activity to build history of previous design experience.

Although Schön's effect on the design education cannot be ignored, in the recent years Schön's design for educating reflective practitioner is being criticized. According to Webster (2008), the architectural education after Schön defines new dimensions to enrich the contemporary understanding of architectural education, but, she also demonstrates a number of significant epistemological, ontological, and methodological weaknesses in Schön's work. Webster criticizes Schön's definition for the role of the tutor in the design studio. According to Schön, the role of the tutor is to correct mistakes and correct students' designs. Webster emphasizes that architecture is a dynamic and contested field and she criticizes Schön as being oblivious to the notion of that there might be more than one solution to any design problem. On the other hand, Alexander (1964), referring to the professional and cognitive capabilities of a design tutor, has already stated that it is impossible to correct every mistake and make them as a list of mistakes by the tutor.

Design As...

Design as a form of thinking has been described by many theoreticians with various definitions. Design has been characterized as ill-defined (Eastman, 1969; H. A. Simon, 1973) or ill-structured (Reitman, 1964). Simon (1973) defines design as a problem-solving activity where the actual 'state' is structured through 'analysis' and solved with a proposition of a preferred one by 'synthesis'. Counter to Simon, Schön saw design as construction of steps of changes in the given situation by 'reflection in action' followed by 'reflection on action'. Designers construct and impose a coherence of their own that guides subsequent moves. Each move becomes an experiment for reframing the initial problem definition so the initial situation is transformed into another situation through constructions that are structured by 'selecting particular things and relations for attention'(Schön, 1988, p. 182).

In 1972, Hillier, Musgrove, and O'Sullivan were the first to apply Popper's ideas to design methods in their paper 'Knowledge and design' (Hillier, Musgrove, & O'Sullivan, 1972). Hillier, Musgrove and O'Sullivan (1972) argued that design is 'essentially a matter of prestructuring problems either by the knowledge of solution types or by the knowledge of the latencies of the instrumental set [technological means] in relation to solution type' (Hillier et al., 1972, p. 7). They emphasized the role of what they called 'pre-structuring' in defining problems. They also stressed the corresponding need for a critical analysis of such pre-structuring, which they called as 'reflexive design' (Hillier et al., 1972, p. 7). Hillier et al. (1972) argued that conjecturing approximate solutions much earlier in the process compared to the analysis/synthesis model of design allows to structure an 'understanding of the problem, and to test out its resistances' (Hillier et al., 1972, p. 9). Bamford (2002) states that Hillier et al. (1972) rejected the notion of synthesis as a process by which pieces of a puzzle gradually come together and as a consequence they indicated that by such process a solution can only be visible only towards the end.

The commonly recognized "aha!" response is universally considered as a reference to the moment when a creative flash arrives. This phenomenon is also referred to as sudden mental insight. In the study carried out by Akin and Akin (1996), it is stated that the emergence of sudden mental insight is directly related with the ability of restructuring problem which depends on possessing the required domain knowledge to construct a new definition of problem that have the potential to lead to a new solution.

The views from design studies above indicate various characterizations of the nature of design as a process. These characterizations of design will be used as a guide to investigate how architectural students characterize design.

Methodology

The research presented in this paper was held in two steps. The researchers conducted a questionnaire composed of 14 questions to gather data about the characterization of design among the students of architecture. Following the questionnaires, open-ended in-depth interviews were carried out with groups of 5 students from each year separately to obtain in-depth information regarding their characterizations of design activity.

The participants

The participants ($n = 196$: 61 male, and 135 female; 39 first year, 56 second year, 47 third year, and 54 fourth year) were from four design studios at the Department of Architecture in the Faculty of Fine Arts and Design, Izmir University of Economics (IUE). The undergraduate program at IUE is a four year bachelor program and participants were chosen from all four years. First year students of architecture take design studio with the other four departments which are Fashion Design, Industrial Design, Interior Architecture and Environmental Planning and Visual Communication Design departments.

Data Collection

The questionnaire inquired about the students' conceptions of design. The questions were grouped under three topics: design characterizations, design process, and design education.

The first group of questions under the topic design characterizations was prepared to collect information about the participants' conceptions of design. The second group of questions was focused on the participants' individual experiences of their design process. The third group of questions aimed at collecting information about the subjects' ideas on design education, the tutor's role in the design studio, the exchange of knowledge between the student and the tutor, and the students' dependency on their tutors.

To realize how students characterize design, we attempted to classify design in four different definitions which are "design as problem-solving", "design as insight problem", "design as conjecture-trial," and "design as construction". This classification of design definitions enabled us determine whether there is a general tendency towards a specific definition for every year and observe if there are changes towards another specific definition of design from the first year to the fourth year in design education.

The in-depth interviews investigated the same three topics in an open-ended format. The same questions as in the questionnaire were used to outline the interviews in order to get more in-depth information of the selected topics.

Results

A statistical hypothesis test is applied on the answers of the survey questions to determine the statistically significant results. The results from five questions among fourteen were significant: when asked how the students would define design (Q1, $\chi^2 = 30.733$, $p < 0.002$), how they reach a design idea (Q4, $\chi^2 = 43.532$, $p < 0.000$), which one of the activities in their design process plays the most important role (Q7, $\chi^2 = 33.695$, $p < 0.000$), and in what ways the information exchange occurs between the students and the

studio instructors (Q13, $\chi^2= 62.002$, $p< 0.000$). The results of Question 5 is also evaluated since it was based on a multiple choice items.

Students' Conception of Design

Table 1 shows the distribution of the percentage of students from each year according to how they define design (Q1): (a) design as problem-solving, (b) design as insight problem, (c) design as conjecture-trial, and (d) design as construction. The results indicate that there has been a change from design as insight problem towards a more problem-solving conception of design from first year students to the fourth year students.

Table 1: Percentage of students from each year per design definitions. (Q1)

	(a) design as problem solving	(b) design as insight problem	(c) design as conjecture-trial	(d) design as construction
1st year	18,4	34,2	13,2	34,2
2nd year	18,2	29,1	20,0	32,7
3rd year	34,8	17,4	15,2	32,6
4th year	54,7	5,7	13,2	26,4

The majority of first year and second year students selected 'design as insight problem' or 'design as construction' for Q1. The majority of third year students chose 'design as problem-solving' and 'design as construction.' While almost 55% of fourth year students chose (a) 'design as problem-solving'.

Table 3 depicts the percentage of students with regard to the way they start the design process (Q4). The results show that the selection of (c) "A design idea is constructed by evaluating design input" is the most selected choice among the fourth year students. This also supports the result from Question 1, the move from design as insight problem towards a problem-solving conception of design from first year students to the fourth year students.

Table 3 : Distribution of percentage of students according to the years of education related to how they start to design. (Q4)

	(a) A design idea emerges suddenly	(b) A design idea is generated by investigating one or more projects	(c) A design idea is constructed by evaluating design input	(d) A design idea is generated by transforming ideas used previously in other projects
1st year	25,6	15,4	38,5	20,5
2nd year	46,4	23,2	17,9	12,5
3rd year	40,4	4,3	53,2	2,1
4th year	16,7	11,1	68,5	3,7

Table 5 shows the distribution of percentages regarding the selected keywords by students of architecture to describe design (Q5). The choice (d) "creativity" is the most selected choice for every year of education. The percentage of choice (g) "research" increases as the students' experience in design education increases. The preference of (c) "artistic" shows a decrease as the students' experience in design education increases.

Table 5: The distribution of percentages according to the years of education regarding the selected keywords by students of architecture to describe design. (Q5)

	(a)*	(b)	(c)	(d)	(e)	(f)	(g)	(h)
1st year	2,5	43,5	74	89,7	41	69,2	35,8	43,5
2nd year	0	26,8	60,7	92,9	35,7	69,6	37,5	51,8
3rd year	2	32,7	53,1	87,8	53,1	71,4	44,9	34,7
4th year	0	35,7	51,8	83,9	83,9	62,5	66,1	26,8

* (a) ambiguous, (b) sophisticated, (c) artistic, (d) creativity, (e) solution, (f) idea generation, (g) research, (h) inspiration.

Students' Conception of Design Process

Table 5 depicts which activity in students' design process is more significant (Q7). The activities were (a) analysis, (b) synthesis, (c) inspiration, and (d) incubation. The results indicate that 'incubation' phase becomes less important in the students' design process as they go from first to fourth year. According to the interviews conducted with the fourth year students, it can be said that 'incubation' has no significant place in their design process but rather they replace it with analysis and sketching.

Table 7: Percentage of students from each year regarding to the activities more significant in students' design process. (Q7)

	(a) analysis	(b) synthesis	(c) inspiration	(d) incubation
1st year	28,2	17,9	2,6	51,3
2nd year	28,6	12,5	12,5	46,4
3rd year	53,2	8,5	4,3	34,0
4th year	72,2	9,3	5,6	13,0

Design Education – Devices that students acquire knowledge

Table 9 shows the students' selection of four teaching methods that are used for knowledge transfer between the tutor(s) and student(s) as part of design studio education (Q13). The teaching methods were: (a) one-to-one desk critiques, (b) tutor-to-multiple students desk critiques, (c) critiques in juries, and (d) tutors' corrections.

Table 9: Percentage of students from each year regarding to the teaching devices in the studio. (Q13)

	(a) *	(b)	(c)	(d)
1st year	28,2	43,6	5,1	23,1
2nd year	64,2	15,1	1,9	18,9
3rd year	88,9	2,2	0,0	8,9
4th year	71,2	5,8	17,3	5,8

* (a) one-to-one desk critiques, (b) tutor-to-multiple students desk critiques, (c) critiques in juries, (d) tutors' correction.

Discussion

Students' Conception of Design

The feedback gained from the interviews shows that the definition of design is a collection of all of the choices provided in the questionnaire. However, when they are asked to comment more, students tend to emphasize their experience in the studio as an effort to find a solution to what they're asked to achieve in a given design task. Although, approximately the same percentage of students from each year defined design as a trial-and-error process, the students attended the interviews stated that trial- and-error is always part of the design process. The change in the percentages of students' selecting the choice (a) "design as problem solving" can be evaluated as a move towards the conception of design as a problem-solving activity.

One of the weaknesses of the traditional studio is that students, in paying so much attention to the end product, fail to reflect sufficiently on their process (Lawson, 2001). This issue finds its proof for the second year students in defining their own design process. In the (b) "design as insight problem" choice (see Table 1), the word 'artistic activity' is used in the statement which refers to 'design as an insight problem'. In the interviews with the students of upper years, when the students were asked what is the place of 'art' in design regarding to their previous experience in first year design studio. The students stated that they were unable to relate their submitted projects to any particular field, e.g., architecture, industrial design, etc. However, they are able to classify their work as an object of art. The material used in the assignments like certain paintings and their 'History of Art and Design' course most probably encourage students to think in this direction.

The interview conducted with the first year students indicated that they tend to think over their learning process more than the upper year students since first year students are at the threshold between two different educational systems as they move from high school to college. The first year students stated that they were unable to understand the 'learning by doing' method for a couple of weeks because of the lack of any previous reference to such learning. Then, as they follow the procedure of the studio, they emphasized that they learn to be able to perform this type of learning as they gain experience.

As the experience in design education increases, the students get more involved in an architectural design process and they are able to comprehend more of the nature of design problems. This enables the students to reflect more on their processes by pushing them into managing their own design process, in their own words 'finding strategies'.

Students' Conception of Design Process

As students move from first year to the fourth year through their undergraduate education, while a first year student is in the search for an inspiration, a fourth year student is in search for a problem definition. Consequently, a fourth year student need more information and often conducts analysis to reach a design idea.

According to the interviews with second year students, they stated incubation remains a critical stage in their design process to complete a design task. On the other hand, in the interview with the third year students, incubation ceases to have a place in the design process. However, they stated that there is an unexplainable potential of incubation since it is associated with creativity and inspiration.

Design Education – Devices that students acquire knowledge

The results in Table 9 show that as the experience in design education increases, the guidance of the tutor becomes more a function of learning through one-to-one desk critiques. However, the interview with the fourth year students supports the results of the percentage of choice of the selection of (c) 'critiques in juries' and indicate that the project reviews in the juries were seen as an opportunity to get diverse reviews and perspectives from various jury members. The decrease in the percentage of one-to-one desk critiques in the fourth year education is also dependent to the teaching of the fourth year design studio which is based on weekly juries and not desk critiques.

According to the results for the selection of (d) 'tutors' corrections in the question 13, although the guidance of the tutor plays an important role in learning how to design, the corrections of the tutors on the studio work becomes less and less needed by the students. Students indicate that their dependency on their tutors decreases as one moves from first year to fourth year.

Chiu states that although senior students should have more expertise than junior students, the seniors appeared to have much more demand for design knowledge than the juniors (Chiu, 2010). The increase in the use of (a) 'one-to-one desk critiques' from juniors to sophomores indicates the change in the notion of a tutor in the design studio from a teacher correcting a student's work, to a guide and a source of knowledge for students. Concurrently, in the interviews it is stated that 'one-to-one desk critiques' remain much more efficient since other factors such as jury members and classmates, distract the attention of a student and he/she becomes unable to focus in the dialogue taking place about his/her project.

Conclusion

The focus of the study was to determine if there are changes in how the students of architecture characterize design. Design definitions taken from design studies that reflect different aspects of design were presented to the students. The results of the survey study indicate that there is a common conception of design as art among the first year students. This conception of design leaves its place mostly to design as problem-solving as one moves through his/her education towards his/her graduation.

With regard to the interviews conducted, this change in how students characterize design is caused by the change in the students' conception of design from being based on the attributes of the end product towards an awareness of the nature of the design process. Such insight is considered important not only for the participants in the design studio but also as a contribution to understanding the design studio and evaluating the knowledge to be gained by the student and the informal methods of teaching involved in the design studio.

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