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Thinking Designing and Architecture

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Abstract
Studies conducted without any thinking systematics may result in a waste of time and effort as well as a waste of manpower and resources. In ideas developed without possessing adequate knowledge and right-thinking systematics, if the needs are not responded appropriately, attitudes and behaviors inconsistent with the scientific understanding may be exhibited due to several factors such as ego or even the wrong decisions made as a result of pressure from environmental effects and expectations may be insisted upon, making it difficult to find a solution. Therefore, it is becoming increasingly important to carry out the thinking and design processes in accordance with certain strategies.

In the present study, a proposal is made to address and improve design and architectural design –a special form of design– processes and education by training and ensuring the effective use and improvement of ability to think which is one of the most important characteristics of humans. Prepared by using the phenomenographic research method, this study is comprised of three main sections. The first section addresses the brain's structure and physiology, the second section explains how thinking process occurs and the third section describes the architectural design process and methods and practices are proposed for better management of the design process.

Keywords: Architectural Design, Design Equation, Iceberg effect, Divine view, Real Problem

Introduction

Designing structures that incorporate various components such as materials, techniques, art and humans at the same time is not only a mental process requiring the simultaneous consideration of several parameters but is also a scientific field of study with a spiritual aspect. As with many other disciplines, architecture is also a field of study that requires a great deal of mental effort. Architectural structures built without careful thinking may be deserted and become derelict sooner than expected as they lose their function to meet expectations. Such problems result in significant waste of time, effort and financial loss, thus it is increasingly important for the architects working in structural design process to carry out the design activities in accordance with certain protocols. Teaching effective design methods and techniques as part of the architectural education curriculum, outlining specifications for structural design and placing further emphasis on its teaching will be able to contribute to increasing the level of life comfort worldwide and decreasing the environmental effects.

Due to people's dynamic nature, the imitation-based thinking method used in designing buildings which are their living spaces may fail to fulfill expectations. Therefore, designers should be able to foresee problems by using intuitive approaches, think creatively to solve these problems, perceive the connection between events and facts and correlate events and facts that seem irrelevant. All of these approaches can be considered as mental activities that provide the designers with significant advantages.

These skills must be improved for a more effective thinking. It is thought that use of different methods and techniques in enhancing the said skills will contribute to the design process in a positive way. In this regard, it is considered that conducting the architectural design process which is a sort of thinking activity by using the thinking techniques based on the most recent scientific data will contribute to obtaining more accurate results within a shorter time.

The human brain is in a constant state of thinking to interpret the passively received information every day. In addition to this interpretation function, in some cases, our brain focuses on problematic points and begins seeking solutions to these problems in order to fulfill the needs that enter and affect our lives directly. This quality described as the ability to think is the most characteristic attribute of humans. Fields of study such as education, religion, science, history, art and literature have gained meaning as a result of mind and ability to think. Thus, by enhancing the thinking power, comprehension ability which is the most important characteristic of humans that constitutes the basis of all fields of study will be improved. It is expected that an enhanced conscious ability to think will increase the cognitive awareness levels of individuals, activate their personal talents and potentials and turn them into a productive process.

From past to present, people have constantly sought ways to improve their level of life comfort. This search has gained further importance today. In this regard, it is observed that design is coming to more prominence in all aspects of people's daily lives.

In an effort to increase their level of life comfort, people try to solve problems by establishing unusual alternative relationships and connections between the images they have interpreted in their minds to overcome the difficulties. This special thinking activity aimed to solve a certain problem is called design. Thus, design can be defined as a special form of thinking which is already present in humans.

Thinking, a necessary activity for society and people to maintain their lives and enhance their welfare level, and its special form design are highly significant brain and mind activities. Performing these highly significant activities continuously and consciously will contribute to increasing the welfare and happiness level of humans.

Today, as well as in other periods of time, only productive designers who can have access to accurate knowledge and information, establish correct correlations between such knowledge and information, make right choices from this network of correlations and think outside the box will be able to pioneer and contribute to increased level of life quality and comfort.

According to studies, there are two reasons of human thinking processes. In the first case, humans seek solutions by focusing on specific points which they subjectively call deadlocks that directly affect life and which they experience in activities to meet their daily life needs, while in the second case, humans seek spiritual guidance beyond material needs. The aim of this study is to address the brain in which the thinking processes occur by considering these two different features individually and to help humans perform the thinking processes more effectively while they are trying to satisfy their material and immaterial needs. Accordingly, the concept of ability to think which is the most valuable human trait, is defined and methods and suggestions are presented for the effective training, use and improvement of this ability.

The most distinctive feature of human brain is memory and ability to think. Although both field of studies work on brain and ability to think, neurology focuses on tangible data while psychology studies abstract data. In the present study which aims to contribute to the effective thinking and design process, both tangible and abstract aspects of thinking

process have been studied. Thus, the first section of this study addresses the physiological structure and functioning of brain in which the thinking process physically occurs. After the functioning mechanisms of brain are determined, the factors that support an effective and correct thinking and design process in the brain and the factors that hinder this process are detected. Following a physiological study of the brain, mental activities that can be described as abstract and concepts associated with these activities are explored and proposals are made to enable an effective thinking and design process.

Cognitive Thinking in Scientific Literature

The earliest recorded studies on brain are from an ancient Egyptian epitaph dating back to the 17th century BC. The first modern studies were, interestingly, conducted by Le Boe Slyvius and Descartes in the 17th century AC. With the invention of microscopy in the 18th century, neurons were viewed for the first time. When the electron microscopy was invented in the mid-19th century, more elaborate investigations were performed on neurons and more realistic information was sought. In the 19th century, Frans Joseph Gall suggested the idea that different sections of brain corresponded to different intelligence characteristics while Wilder Penfield et al. were able to stimulate the cerebral cortex of fully-conscious individuals and obtain all responses. With these studies, all thoughts and ideas on brain changed. Wernicke and Broca conducted notable studies to detect the language center in the brain. Pavlov's student Anokhin revealed that intelligence was affected by neuron tentacles, not by the physical magnitude of brain and the number of cells, that the tentacles were linked to the other cell tentacles and cell-to-cell electrochemical communication occurred via these parts (Onan, 2010).

Another point to consider in studies on thinking and brain is the concept of intelligence. In one of the earliest studies on intelligence, Alfred Binet developed the first intelligence test in 1910 by monitoring the intelligence development of two girls and devised the concept of IQ (Onan, 2010).

In conclusion, our knowledge on brain today dates back to the information recorded starting from the 17th century as well as data found and recorded systematically in the last 70 years, especially following the invention of electron microscopy.

Method

With this study which was designed as a multidisciplinary theoretical study, it was aimed to develop a model and help all professionals who carry out training and design activities to improve their training strategies and proficiencies. The study was designed as a theoretical case study in which qualitative research method was preferred and the phenomenographic research method (Çekmez, Yıldız, & Bütüner, 2012) was used. Data were collected by exploring publications that could be classified as scientific resources. The scope of study was limited to the thinking process, design and brain where these processes take place. No study was mentioned in the present study that required the approval of the ethics committee.

Findings

Data gained through sensory organs and transmitted to the brain via the nervous system are actually just electrical signals. From a materialistic point of view, thinking is defined as a brain activity. However, the fact that intelligence is an intangible attribute and lacks a volume or mass that can be measured with a device proves this definition inadequate. Since brain and intelligence are two separate concepts, fields of study that address them as two different subjects have been developed. The fields that study the human brain physically as an organ in which thinking processes occur are called neurology and neurophysiology, while the field that studies it as a concept is called psychology. In this study, due to its different characteristics, the process of thinking was investigated from

different scientific resources in the light of data physically obtained from brain as well as abstract data.

Investigation of Brain in terms of Tangible Data
Brain Structure
Throughout their lives, humans constantly sense what happens around them through their sensory organs and transfer such information from the senses to the brain via the nervous system. However, the brain not only temporarily stores the information transferred through sensory organs as raw information but also associates the newly received information with previously stored images, interprets and re-stores them permanently. All of these processes occur in brain which is an organ containing approximately hundred billion cells called neurons.

When human body is studied, it is detected that the body is controlled by the brain which is located in the skull. In brain studies conducted according to basic information obtained in the light of neurophysiology, it is observed that vital functions of human body such as control and management as well as all cognitive activities in daily life are performed by brain without any conscious intervention.

The human brain is divided into two hemispheres known to have different functions. The brain hemispheres are connected to each other by a bundle of nerve fibers called corpus callosum in Latin and communicate and work harmoniously in this manner (Eden, 2020) (Nakiboğlu, 2003). Studies demonstrate that the left side of brain is more responsible for functions such as classifying information and building logical relations with other information while the right side of brain is more responsible for functions such as imaginary thinking, creating new images by seeking to build new relationship systematics between images (Nakiboğlu, 2003). On this subject, Allan Baddaley says that humans have at least two types of working memories, the first one being verbal and the second one being visual-spatial (Simth & Kosslyn, 2017).

All activities performed by the brain are the activities of cells called neurons which are actually the brain's building blocks. The brain essentially has three functions performed by neurons. Firstly, the neurons receive information from the environment through sensory organs and transfer such information to the brain, secondly, they interpret the obtained information and thirdly, the organs are stimulated and activated. In this regard, neurons fall into three types of categories: sense neurons, information processing neurons and motor neurons. Sense and motor neurons can be considered as communication tools, therefore, the subject of interest of this study is the information processing organ brain which contains approximately a hundred billion neurons in an average person. The brain also embodies ten glial cells for each neuron that are responsible for the communication, maintenance and support of neurons (Simth & Kosslyn, 2017).

Neurons, the building blocks of the brain, are composed of three parts: cell body, dendrites and axons. A normal neuron is connected to and interacts with other neurons from neuronal junctions called synapses with its thousands of dendrites and axon branches. Input is received from other neurons by dendrites while it is transmitted to other neurons by axons (Goldstein, 2013) (Simth & Kosslyn, 2017). Reception and transmission of input via different channels indicates that neurons process, interpret and then transmit the input. This indicates that the passage of input through neurons is not a regular, mandatory transmission but that neurons participate in interpreting the input and determining the reaction.

The Functioning of Brain
Brain's learning is the process of generation, settlement and connection of new neurons with other neurons (Wolf, LeCraw, & Barton, 1989), (Turhan & Özbay, 2019). The learning

mechanism in brain called neuroplasticity can be defined as the change of synaptic activity and brain maps in connection with neural activity (Sagi et al., 2012). It is suggested that change occurs in the brain with learning in two ways, the first one in internal structure of neurons, especially in synaptic areas, and the second one with increased number of synapses (Turhan & Özbay, 2019).

The information perceived through senses are processed by the brain with neurons and connections between these neurons. Networks built through connections of brain cells with other neurons, rather than their individual existence, contribute to the functioning of brain (Wolf, LeCraw, & Barton, 1989), (Turhan & Özbay, 2019). Interneuronal connections grow stronger as they are used and get weaker when they are not used. Human brain has a trillion synaptic connections in early stages of life while this number is reduced to fifteen thousand in an adult depending on his or her thinking activity level (Keleş & Çepni, 2006), (Turhan & Özbay, 2019).

Brain neurons are normally cells functioning through glycolysis. Since active brain cells have increased need of energy, blood flow to these regions is higher. With increased blood flow, neurons in active regions of the brain will have more glucose and oxygen required for glycolysis to meet their energy needs. More blood flow and nutrition to the actively used regions of brain shows that the neurons in other regions obtain less nutrition than the active regions. This demonstrates that inactive neurons have no access to sufficient nutrients and oxygen and die over time (URL-1, 2020).

It was observed that increased number of dendrites in regions responsible for memory and learning could result in a stronger memory (Czeh et al., 2001), (Wolf, LeCraw, & Barton, 1989), (Turhan & Özbay, 2019). Active neurons tend to produce more dendrites and a single cell may occasionally form approximately thirty thousand dendrites. Increased number of dendrites is an indicator of a wider network of connections and thus the cell can be more active. As enabling neurons be more active will contribute to their nutrition, it will eventually help the cells to have a longer lifetime. More NFG protein is produced in active brain cells, which is a protein described as the maintenance substance of neurons and marks these neurons as active, different or compatible and connects them to each other (URL-1, 2020).

Studies demonstrate that the brain capacity increases through the connections between cells, rather than its available number of cells. Studies on this subject indicate that the number of connections between cells in much-used areas of the brain is higher (Nakiboğlu, 2003).

Different information input and output pathways in neuron cells indicate that the information received is processed in the cell, interpreted and then transmitted in accordance with the individual’s experiences and personality. This suggests that each cell contributes to the decision-making mechanism as previously constructed. However, since each cell is constructed according to different topics in individual’s previous conscious thinking activities, it is thought that the received information is passed through varying numbers of alternative cells and thus through dendrites and axons according to the individual’s thinking infrastructure and that possibilities are determined differently for each individual. Thus, among these possibilities, individuals consciously select and activate the option that is the most compatible with their genetic predisposition and their previously established characters. In cases when input from stimuli is insufficient, previous experiences and cognitive processes are used to help interpret the stimuli (Simth & Kosslyn, 2017).

Factors Affecting the Functioning of Brain

In enhanced cognitive level, connections between neurons may change at any time due to internal and external stimulants. Gender, activity, age are among the factors affecting learning. Education, social interaction, physical and intellectual activities and all sorts of cognitive improvements affect learning and cognitive working capacity of brain positively. On the contrary, poor sleep quality, malnutrition, addictive drug use, anxiety and depression affect learning and judgment negatively as they cause adverse morphological changes in the brain, reduced brain cells and decreased dendritic connections (Vance, Mcguinness, & Fazeli, 2010).

Neurons use glucose and oxygen to meet the energy need. However, organs responsible for procuring and delivering these substances to the brain may send different substances with similar properties to the brain. Some of these substances may affect the activation levels of neurons and lead to complications in information processing. Some of these substances used instead of glucose and oxygen in the brain enhance the cognitive level while some of them reduce the cognitive level, and in some cases, they cause cognitive disorders. In order to increase the cognitive levels of individuals, first of all, brain health must be ensured. Therefore, individuals must be extremely careful during substance intake into the body via diet, respiration or IV and only good and beneficial substances must be taken in a controlled manner (URL-1, 2020).

Use of substances such as drugs and alcohol causes the release of dopamine hormone associated with pleasurable sensations in the region known as the reward center of brain and leads to an increase in dopamine hormones in the brain. Thus, these addictive and harmful substances may cause addiction in individuals and may be taken into the body consciously. The dopamine released due to the intake of addictive substances affects the neurons over time and results in wrong decisions by individuals. Constantly high dopamine rates also affect the brain areas responsible for learning and lead to an impairment in abilities to learn, store and remember new information. Excessive release of dopamine prevents individuals from taking pleasure in eating or similar activities which are known as natural rewards with positive contributions to human health and results in impaired health (N.P, 2020). All activities that come with a reward may cause addiction and affect the brain's cognitive level as they increase the release of dopamine. Among these addictions, betting and gambling are the earliest known types of addictions. However, highly widespread activities at present such as computer games, internet, online shopping, overeating are among the addictions that affect healthy thinking (N.P, 2020).

In this respect, some nutrients that can help cognitive level include water, lycopene, omega3, iodine, folic acid, vitamin B6, vitamin B12, vitamin C, vitamin K, zinc and vitamin E intake and activities such as sufficient sleep, exercise and sports. Furthermore, taking a change from monotonous life styles and taking up activities that have not been done before, that is, breaking routines is considered as one of the most significant factors that induces the restructuring of neurons (Stiles & Jernigan, 2010). (Turhan & Özbay, 2019).

Substances and activities that prevent the healthy progression of interneuronal communication and cause a decreased and impaired cognitive level include alcohol consumption, intake of drug substances to the body, some medical drugs, smoking, malnutrition, insufficient sleep and stress. (URL-1, 2020).

Investigation of Brain in terms of Abstract Data

While thinking is considered as a brain activity in physiology, it is recognized as a mental activity in abstract sense. The brain's three main functions which can be categorized as interpreting, deciding and determining the method and process of implementation are defined as the thinking activity.

Humans are passive beings as they maintain their lives within the limits set by the nature's rules that they must obey in the environment in which they are born and grow up. However, differently from other living creatures, humans have an impact on their ecology to a certain extent thanks to their ability to think. Especially throughout the time period from industrial revolution until today, humans have had as much impact on their ecology as to cause damage to their own environment. The underlying reason is the human's ability to think.

Thanks to their ability to think as an ontological feature, humans store a great amount of information they passively receive every day from their environment through sensory organs, compare this information with previously-stored information and perform the interpretation process in their brains. This newly interpreted information are no more abstract images, but meaningful images stored in the memory. During the interpretation process, humans think to associate and correlate the information stored in the memory independently from each other.

After information is received by the sensory organs from the environment and delivered to the brain, various mental activities occur to describe the process of information processing and response generation, the most important of which are listed below:
Impulse: The desire to satisfy one's needs to survive.
Motive: The tendency to satisfy one's needs and desires.
Perceive: To detect the environmental events and objects through sensory organs as they are, in a realistic manner and without interpretation.
Understand: To describe the perceived events and objects as positive or negative.
Learning: Permanent changes in one's behavioral system as a result of perceiving, experiencing and interpreting the events and objects in the environment.
Intelligence: The speed at which individuals perceive, interpret and behaviorally respond to environmental effects.
Memory: The faculty of storing and recalling images of learned information required for thinking.
Thinking: During this activity, the brain seeks to interpret, associate between and find solutions to perceived information and objects and events previously stored in the memory as images as a result of individual experiences.
Judgment: Comparing multiple objects and activities with experienced information stored as images in the memory and selecting the most appropriate one in line with the environmental effects.
Curiosity: The desire to associate, understand and learn the missing information in the environmental factors that the individual fails to interpret or associate when the brain evaluates the factors during the thinking process.
Designing: Mixing the previously imagined objects and activities in mind in a different pattern and order from what is known.
Emotion: The state when perceived images affecting the behaviors and expectations of an individual positively or negatively become meaningful in mind.
Consciousness: Being aware of the impact of environmental events on oneself and others and perceiving, thinking, identifying them as good or bad and taking a realistic action.
Value: Activities, attitudes and behaviors that individuals consider right to live a more harmonious life in interactions with the environment.
Behavior: All kinds of attitudes shaped by the genetics, environmental factors and experiences of individuals acquired throughout their lives.
Personality: Attitudes developed by an individual without being influenced by other individuals in the society.

Mental activities impulse and motive arise more without one's conscious effort while curiosity, emotions, consciousness, value judgments, behaviors and personality emerge as a result of thinking activities. During thinking activity which is a sort of information processing, knowledge is a prerequisite of thinking. Therefore, memory is one of the most

important factors for a healthy thinking process as it is the capacity to learn and store the information. When mental activities are studied in this regard, it is observed that a thinking activity with learning capacity and right method of judgment can be a determinant that affects other mental activities.

Brain activities related to thinking can be essentially categorized into three main functions: analysis, synthesis (Mutlu Avinç & Vural, 2020) and action. Analysis is the stage where the information perceived through sensory organs is interpreted, synthesis is the stage where a selection is made between the known information and the information interpreted differently than the known information, and action is the step where the decided thoughts are put into action. However, achieving different results during thinking largely occurs in the synthesis stage. The determinant factor in synthesis is the individual characteristics such as emotions, knowledge level and experiences. Therefore, synthesis activities with an awareness of individual characteristics can be called conscious thinking or conscious design.

Conscious Design

Various methods may be selected to reach a goal in thinking or designing processes carried out in order to solve a problem. There are essentially two kinds of thinking methods. In the first method, things are perceived, interpreted and imitated as they are in similar situations when necessary. In the second thinking method, on the other hand, the known images previously interpreted and stored in the memory are combined differently from the known way, alternatives are generated and the best option is selected after these alternatives are eliminated from a critical point of view. The creative ideas put forward in education, science, technical fields, medicine, art and daily life come from the mental process of designing which refers to the conceptual combination of objects and activities with no relations or similarities to each other (Gürkan & Dolapçıoğlu, 2020).

The term design which can be defined physiologically as a special form of thinking, one of the brain activities, is defined in Turkish Language Institute (TDK) dictionaries as "shape envisaged in mind; the first draft of a work, structure or technical product; pattern; drawing plan; framework laying out the methods and procedures to be followed throughout a research; layout; later copy of a previously perceived object or event in mind." However, these definitions are insufficient since design is defined as mere copies of perceived objects and events and mental creation is disregarded. In order to envisage a shape in mind, there must be previously perceived, interpreted and stored images and information. These activities refer to different mental activities, not design. Therefore, it is thought that design can be more accurately defined as mixing the previously learned and imagined objects and activities in mind in a different pattern and order from what is known.

Considering design as a one-step mental activity will be a poor unrealistic definition because while using the designs produced in a design process carried out without sufficient consideration of initial needs, humans who are dynamic beings may experience serious problems. Thus, in order to provide the best solutions to any matter considered to be a problem, the required information must be collected at a maximum level and the thinking activity to find a solution must be done in a systematic manner. Since addressing the design process well will increase the success rate, it is considered as an important step in many disciplines. As is the case with thinking activity, the design process also can be categorized into three stages which are again analysis, synthesis and action.

Analysis in Conscious Design Process

Putting the tasks in order of priority, job sharing and assigning the people to be in charge are the basic approaches while carrying out a task in all of parts the world having no connection with each other. Sharing the knowledge and know-how and performing a task according to a predetermined plan were regulated as rules in time over the course of

history, then this chain of rules became widespread, were shaped into a culture and handed down from generation to generation via various organizations (Hassa Organization–Ottoman Organization of Architects, Ahi Community etc.). Today, in all scientific disciplines, sharing and transferring knowledge is considered as a very important process. To this end, scientific publications are commonly used across the world. For example, the pre-design process which aims to provide the architects with comprehensive information infrastructure they will need during design (Cebe, Özen, & Akın, 2019) has been called "preparation of building program" and started to be considered as a separate study discipline (Pena & Parshall, 2001).

During analysis, the required information and documents must be determined fully and accurately according to the findings about the problem, these findings must be analyzed correctly and the problem to which a solution is sought must be identified clearly in the light of this information. Problems are usually like icebergs which are submerged in water by about ninety percent and cannot be fully observed from above water. Therefore, problem identification can be incomplete when they are only evaluated according to the initial findings. In order not to have an incomplete solution or solution lessness at the end of the solution process of incompletely or incorrectly identified problem, the analysis process must be relieved from the "iceberg effect" and the "real problem" must be found. For humans, it is impossible to identify all problem details with a divine point of view. However, detecting all information that can be accessed with today's technology - significant or insignificant, logical or illogical, little or a lot – and building an accurate cause-and-effect relationship between facts will contribute to the success of analysis significantly.

Many methods have been developed to perceive problems and events. The most widespread one is the 5W1H technique which is commonly used by journalists in investigations to understand a particular incident or situation. In this technique, answers are sought to five predetermined basic questions to understand an incident. These questions are What? Where? When? Why? Who? and How? This method is a good investigation strategy to arrive at a fast conclusion in early stages of identifying an existing problem due to its analytical nature. However, since the design process does not only seek answers to these questions, the analysis must be much more thorough and detailed. If these questions are answered basically in all case studies, significant deviations from the intended target may occur during synthesis due to the possible iceberg effect. Since the thinking process has a dynamic nature, the analysis stage must also have a dynamic nature. Asking the right questions will lead to finding the right answers. Similarly, asking the wrong questions will lead to seeking wrong answers that has no contribution to the solution and eventually cause a waste of time and effort. Therefore, during analysis, selecting the method that is likely to give the best results, tailoring the method in accordance with the problem and making an evaluation accordingly will contribute to the process immensely. For example, the 5W1H technique which is commonly used in journalism can be tailored as 3WHOs, 2Ws and 1H (Who? To whom? For whom? What? Why? How?) in a criminal investigation.

Synthesis in Conscious Design Process

In design process, the highest possible number of combinations of images created by existing information in mind are considered and the personally ideal combination is found. Identifying the problem accurately and asking the right questions will make it easier for the designer to focus on the right point and finding the right solution. Today, a number of methods are proposed for thinking or its special form design. The major ones include brainstorming, cause-and-effect diagram, 5W1H, six-thinking-hats flow diagram, Pareto effect (Lezki, 2016), drawing, modeling, writing scenarios.

In this study, it is aimed to integrate the design step into the entire process and develop an integral analytical thinking systematics as it is one of the most significant determinants

in cause-and-effect relationships that can be found in both theoretical and applied scientific disciplines. To this end, it is thought that the systematic research method proposed here will contribute to creating alternative thinking products such as presenting thinking methods to the designers during synthesis, increasing the level of existing knowledge while seeking solutions to problems, flexing the distribution of information, adapting such information to other information, changing some information with new information and changing the order criteria.

Design Equation

A systematic plan consisting of stages affecting each other throughout a certain process as well as information needed in each stage (unknowns) and the desired results are similar to mathematical equations with multiple unknowns. Thus, this systematic plan is laid out as a mathematical equation in which the aim is to find a solution by determining the unknowns and organizing them depending on whether or not they affect each other. With design equation, originally a sort of analytical thinking method, it is aimed to organize the thinking (design) process of finding solutions to problems, prioritize and obtain the necessary information, analyze the information and propose solutions according to these analyses and eventually obtain more accurate results in a shorter time with a refined process.

In design equation, parameters are not identified only as objects and activities. They are sometimes identified as an object and its known characteristics, sometimes as activities and their potential outcomes and sometimes as events that include both objects and activities. For instance, during an architectural design process, individuals with disabilities or light and environmental pollution are added to a design equation under the parameter of sensitivity. In design equation method, different thinking and solution-seeking methods can be used for each equation subgroup. Reflective thinking may be preferred in one part of the equation while the brainstorming technique is used in the other part.

The design equation is based on the approach suggesting that objects and activities are present and imaged in human mind and besides their plain forms, they are also meaningful especially with the environment in which they are learned and with other associated objects. In this sense, meaning is described as imaging an array of objects and activities after they are associated with each other in a particular order. The biological structure of brain also supports this approach. Thus, neurons, dendrites and synapses can defined as organs representing object images, activities and connections determining the path of transmission, respectively.

Well-constructed design equations in thinking activities will contribute to obtaining more accurate results within a shorter time. One of the most significant advantages of a well-constructed design equation is the existence of a predetermined and desirable outcome. In this method that might contribute significantly to the architectural design process, one side of the equation has objects and activities waiting to be combined with induction technique and analytical thinking while the other side has an exercise and thinking ground compatible with the deduction technique used for determining the result of objects and activities and the characteristics of a whole. The design equation does not only collect and analyze the information required to reach a goal but also analyzes the desired result. Thus, the equation aims to use the known to find the unknown on one hand and detect the missing parts by analyzing the goal (that is, the known) on the other hand. This method may in fact be described as a combination of induction and deduction thinking methods.

The terms on both sides of design equations are actually equation terms determined in accordance with a particular vision the desired result of which are known. Improvements may be done occasionally during the design process including material improvements, production method improvements, aesthetic improvements and financial improvements.

In such cases, it is meaningless to alter the entire equation, detecting and focusing on only the relevant parameters of the equation and improving these parameters which are considered to cause problems in the equation will be a sufficient and fast way to obtain the targeted outcome. There are already many equations in human mind due to experiences. Designers or in general humans with a certain cognitive level put these new alternative images next to each image in the equation as they learn a more accurate option, thereby increasing the number of alternative outcomes and selecting the best option that responds to their personal experiences and expectations during thinking activity. There is a higher possibility of attaining more accurate outcomes from more alternatives. In human mind, separately imagined sets of objects and sets of activities may be divided into different groups among themselves. Therefore, increased number of sets and elements means increased number of combinations. Personal knowledge level of the designer is a significant factor in obtaining more accurate and unique outcomes.

A higher number of proposed alternative solutions needed to accomplish a more accurate outcome is directly proportional with a higher number of information parameters in a design equation. Therefore, the level of knowledge must be increased as much as possible while constructing a design equation on the condition that the unnecessary information is eliminated.

It is not a right approach to narrow the thinking activity down to just induction or deduction. Thus, considering methods such as Imitation, Simplification, Intuitive thinking, Alternative development, Analogy-making, Critical Viewing, Empathetic thinking, Motivated thinking, Sensory thinking (brainstorming speaking and hearing senses), Emotional thinking in solution phases of the equation may enrich the solution alternatives.

According to thinking systematics that differ from person to person, the main approach of this design system which is considered to help especially individuals with a weak immediate memory span is that analysis and synthesis steps are associated with an inductive logic from an analytical point of view while the expected outcome is added to the system simultaneously with a deductive logic.

The outcome desired from each design is different. Different knowledge and thinking methods may be needed depending on the characteristics of the design. Therefore, many known thinking methods were included as the equation subcomponents in the design model equation given in Table 1 with which it was aimed to contribute to the use of visual intelligence in order to make the model more comprehensive and easy to remember.

Table 1. Design Equation and Subcomponents

ANALYSIS		+	SYNTHESIS			=	DESIGN	
INDUCTION	WHITE HAT		IMITATION				DEDUCTION	
SIMPLIFICATION	YELLOW HAT		MOTIVATED THINKING	CUSTOMER DEMANDS			CRITICAL VIEWING	BLACK HAT
ASKING THE RIGHT QUESTION	5W1H; 3WHOs, 2Ws,		EMPATHETIC THINKING	USERS DEMANDS			ASKING THE RIGHT QUESTION	5W1H; 3WHOs, 2Ws,
			ANALOGY MAKING					
			ALTERNATIVE DEVELOPMENT	GREEN HAT				
			SENSORY THINKING	SPEAKING	BRAIN STORMING			
				HEARING				
				SEEING	PROTOTYPE			
					MODELS			
					VIRTUAL 3D STUDIES			
					DIAGRAM			
					GRAPHICS			
					DRAWING ETC.			
					WRITING			
				TOUCHING	SAMPLE			
				SMELLING	SAMPLE			
				TASTING	SAMPLE			
			EMOTION THINKING	RED HAT				
			ASKING THE RIGHT QUESTION	5W1H; 3WHOs, 2Ws,				
			INTUITIVE THINKING					

Implementation in Design Process

As Al-Jazaria said, an unimplemented design is at an ambiguous position between right and wrong. Thus, in many disciplines, one point that is as important as design is the implementation of design. While waste of time, effort and materials may occur in implementation faults concerning inanimate objects, irremediable losses may occur in implementation faults concerning the living beings. The timing, order and form of implementing the decisions must also be considered as a design and thinking process. Therefore, it is thought that performing the design equation process similarly in implementation of designs concerning objects or activities will contribute to the process significantly.

Discussion

In order to obtain accurate results during decision-making process, it is important that a clear unprejudiced mind should find the highest possible number of alternatives and select the most suitable one. This is important not only in applied sciences but also in theoretical sciences.

For a more productive cognitive process, physical and mental health as well as a physiologically and psychologically ready mind are required. In this regard, first of all, neurophysiologic principles identified in section 5 for biologically effective functioning of brain and increasing its capacity should be considered as the first step of thinking and design process. Preliminary preparations such as strengthening the memory, increasing the intellectual level, doing exercises to enable fast and agile functioning of brain, determining the goals, clarifying the purpose, providing motivation, overcoming the anxiety will ensure a more conscious thinking process and more accurate designs.

Conclusion

Today's problems may be multifaceted and practices advised as solutions may cause other unforeseen problems. It is observed that environmental pollution is increasing due to increased production and raw material demands especially after industrialization, natural resources are consumed recklessly, the natural balance is disturbed and the lives of all living creatures are endangered (Özen, 2009). To this end, the problem-solving process should be addressed well and the problem and its outcomes should be considered from multiple perspectives.

All around the world, use of construction materials and carbon emission are among the leading topics regarding environment-human interaction. Therefore, construction processes should be addressed carefully. Conscious designs produced by architects who are the most important actors in a construction process will raise the life comfort standards and minimize the environmental effects. It is thus highly significant that conscious design methods and techniques are taught in architecture education.

In this study, the design equation developed in order to contribute to enhancing the conscious design skills in architecture education is presented as a proposed model to the consideration of academicians teaching architecture.

The main approach of this design equation which aims to ensure a more effective and conscious design process is the association of induction and deduction methods with an analytical system and the presentation of method as a table (Table 1) to activate the visual memory.

The aim of this study which can be customized to be used in all disciplines has been summarized with the following sentence.

Think hard (so that you can) **work less** (and) **do more**.

Recommendations

A broad knowledge infrastructure facilitates access to information and finding a solution. Thus, experience (knowledge, know-how) is an important parameter that can be defined as recording and sharing knowledge from doing something. During problem-solving processes in all disciplines, the process will be easier if a high-level cognitive design program is followed, the problem is addressed from various perspectives and it is performed systematically.

The design equation model presented in this study can be adapted into other disciplines and thus the problem-solving processes can be performed more effectively in such disciplines.

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