ABSTRACT THINKING

An Introduction to Creative Thinking in Basic Design

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Abstract. This paper critically examines the nature of the dramatic increase in the number of students accepted in schools of architecture in Jordan, and the contradictory decrease in their artistic, creative, thought process, projects problem solving and other skills. The paper also reviews architectural curriculum and courses to identify weaknesses in handling the changes and ultimately within these constraints and in order to handle the students variable potentials, abilities and contradictions, certain exercises in the basic design course are devised in ways that; reduces its dependency on learnable manual skills and conceptual thinking; uses teaching techniques that correlates and incorporates Arts, Architecture and Sciences as complementary topics; approaches and reaches creativity as a procedure not a gift; transfers and travels easily between complexities and simplicities, between natural and artificial intelligence, between abstract and relative thinking; employ geometries and design tools as the main structure of any composition; makes self evaluations of choices, decisions and variables easier. Taking Abstraction as a framework in solving the problem of the exercises gave answers and solution to many problems that was not easy solving under the conventional ways of design.

1. Introduction

Innovative thinking for scientists and researchers is considered a gained skill, while for many artists and architects creativity is a gift we are born with, which is hard to obtain. Some say it can be taught with application of simple techniques. In the field of education all is possible depending on the process of bringing out the gift in those who have it and giving it to those who don't. Bringing out or giving creativity to students of art and

architecture proves to be a subtle and sensitive process for some while being tricky and hard for others. At the same time recognizing the creative students is no different than dealing with new students who have not gained the skills or knowledge in elementary or high school.

1.1. ARCHITECTURE BETWEEN ART AND SCIENCE

Internationally architecture falls in a place between science and art which may mean that architects are neither scientists nor artists but a mixture of both. Although most architects are not specialists in either field they are possibly supermateurs a label the Norwegian philosopher Arne Kvalai uses for those who belong to both fields Hjort (2003).

Creativity is an innovative way of thinking and is the basis for any successful architect as it provides the essentials for producing new ideas and values in sciences. Not until recently and by the emergence of information technology has the gap between arts and sciences (both include architecture) been widely narrowed? In the fifties and sixties most artists were nervous when it came to scientific analysis as they felt that it destroyed parts of the human aspect and creativity Barrow (2003) that may then cause reductionism. As E G Wilson explains “the love of complexities without reductionism makes art, the love of complexities with reductionism which makes science.” Wilson (1998)

1.2. CREATIVITY

Creativity is defined as giving birth to ideas, concepts and values that have never been thought of before. Finding new methods that would enhance and develop the human intelligence and creativity did not simplify the problem but raised its complexities. Although creativity is a simple phenomenon, it is in fact quite complex in itself. It has been studied from the perspective of artificial intelligence, design research, behavioral and social psychology and cognitive science and many others. "Creativity, it has been said, consists largely of re-arranging what we know in order to find out what we do not know." **George Kneller** said in an attempt to further explain creativity, Wikipedia (2007). The outlook towards architecture has changed however, and is now the common ground between science and art.

1.3. LEARNING FACTS

There is a common platform where creativity is not controlled by the few who got its virtues or those who have discovered its tricks. Students can understand these points by understanding that architecture is not an art nor a science but an artistic science or scientific art Hjort (2003). It is an art in a

scientific context or a science in an artistic context. Creativity is an essential tool in design it can be a concept, a method, technique or a trait, but it is not manipulated by certain fields or people Harris (1998). Way of thinking is a learnable process, which includes a variety of patterns that range form high complexities to simplicity in thought and abstractness Harris (2002). Order and randomness in patterns provide the cutting edge for any complex or simple system whether human or machine Gell-mann (2003). Analogue and digits where numbers are turned into graphics is becoming the bridge connecting science to art or vise versa. Geometry is the human interpretation of the complexities of nature Mendelbrot (1982) where as abstractness is the process that takes simple concrete details and phenomenon and makes them ambiguous Armoni, and Gal-ezer, (2006). The abstract refers to things that do not exist at any particular place or time.

1.4. DETERIORATING TASK

Teaching art and architecture in Jordan is a peculiar task. Most students who in role in architecture do not have a solid understanding of the topics related to ways of thinking, creativity, abstraction, project orientation and problem solving because they are not aware of what they are getting into. Students come in with preconceived ideas about architecture as an art oriented study, which will keep them away from science.

This misconception comes from lack of informative career orientations that could have been provided while the students were in high school. Because of the Jordan's educational system in high school and elementary school, teachers of architecture in the university setting are obliged to either use the classically system of teaching through memorization (rote learning) or to work hard to provide the students with the basic skills of learning with a focus on the mind and its creativity which were not instilled in the students before they started the architectural program.

1.5. STUDENT-CREATIVITY

Solving the complexities of student-creativity problems is not only by replacing the classical teaching methods or by only admitting skilled students but also by simplifying the context and ways of which the whole concept is tackled and that can be achieved by, Students need not to learn or develop basic skills of drafting, and technical drafting; they should be aware of the stages, process and progress of their way of thinking, creativity and level of production. They should have a link with the degree of simplicity or complexity, which they are using in their design. Students need to develop the use of terms and how they can integrate them into their designs and how digits and numbers can formulate the concepts. All of this should be based

on processes with strong foundations that will guide them through the stages of the one exercise and the different exercises.

2. Exercises Structure

Now for the student-creativity problem we should have specially prepared exercises with set parameters such as; conceptual abstract orientation which focuses on the use of drafting and modeling shapes within an abstract context with the use of dots, lines, color, plane, surface, mass, faces, square, rectangular etc. This type of exercise requires no measurements or distances and has to be geometrically generated. These geometrics develop certain compositions with visual structure that presents order, focus, proportion, rhythm and contrast. Even though the project does not touch on presenting an architectural object or environmental element, it follows logic that is used in real design. The outcome is of visual compositions and structural arrangements and relations that are aesthetically pleasing. The abilities and skills of the students provide for the development of the sequence as they go through different stages of development. Defined targets are given to the students through clear assignments that must be achieved in order for the student's progress to be analyzed. The exercises should provide variable values and alternatives that allow for different approaches to the solution, which will assist students in recognizing and progress through different dimensions of space and time.

It is critical that the design exercises suit the number of students, their variable abilities, as well as complying with the curriculum and credits they get, while staying within the design parameters mentioned above. From the beginning students are introduced to the design concept and creativity aspect of the project.

2.1. LOOK AROUND

Following the above context the first exercise, is directed to give the students the chance to rely on their own thinking, to experience creativity through indirect practice by restructuring previously designed objects, to comprehend abstraction by reducing and eliminating most details of a fully structured object. Introducing a simple project called "**Look Around**" may fulfill all the above points.

The exercise revolves around a simple idea in which each person comments about simple objects. Sometimes these items are appreciated and loved and sometimes a person will have a specific preservation in regards to the objects color, pattern, layout, details, texture, parts etc. The students are asked to give their opinions and comments in regards to the object they

chose and they write down what they feel are good and bad pointers and how they think it can be improved. In the second session few of the students recognize clearly what may be improved in the object because they have adapted to it and no longer notice its drawbacks. In this type of exercise the students do not follow or even recognize a thinking pattern or a way of dealing with the problem. All of them followed the direct problem solving method. Armoni, and Gal-ezer, (2006). They compared the design of their object with other objects by recognizing the difference or similarities.

Many of the students feel frustrated as they question their ability and skills. Many of these students may belong in this field but because of no previous exposure to such way of thinking 3.5% of them transfer to other specialties out of frustration and exhaustion.

During the third session students were introduced to creative thinking, abstraction and ways of thinking. They were asked to use reductive methods of thinking as a tool in recognizing the basic structure of the object. Reduction in science "means looking at the given problem through some prim, identifying in it structures which are not clear by first sight, and coincide or resemble those of another problem." Armoni, and Gal-ezer, (2006). Students were advised to search for definitions and techniques of creativity, abstraction and ways of thinking. They were also advised to remain objective and not to approach subjective thinking at this stage. By the end of the exercise, which is no longer than four weeks, a reasonable number of students started to comprehend the idea behind abstraction which helps decrease design complexities. Even though, the students did not easily understand the concept behind the exercise, by the end 20% of the students find solutions to about 70% of the problems in their objects. On the other hand 30% of the students are able to identify 50% of the problem while the other 50% just produce a hybrid version of the original object.

None the less the exercise achieved one of its objectives which are to introduce students to abstraction in thinking and to make them differentiate their own ways of thinking from the learnable patterns, methods of creative thinking. The poor results in the first exercise gave indicators of certain shortcomings in the concept of the exercise, which were taken into consideration in designing the second exercise.

2.2. CONSIDERATIONS AND LEARNED LESSON

Some of the indicators are that students chose objects with curved and complex surfaces which prove difficult to simplify back to its basic structure; students were asked to use sketch modeling as it was supposed to make the exercise easier, but the students always try to perfect their ideas by drawing instead of sketching; the students were also unfamiliar with the reversed method of transforming complex problems into simpler ones that

take developed forms and create primitive geometric structures. The shortcomings of the first assignment are taken into consideration in the second exercise as it focuses on:

- Giving the students defined targets, and clear assignments with precise objectives
- Starting by introducing geometry, abstraction and creativity as tools of design
- This design problem shouldn't attempt to suggest that one is designing a specific environment or architectural space,
- The design principles will be fundamental to the language of design and logic which an architect utilizes in any project of any scale
- The exercise comprises of a series of phases starting with simple lines, that move on to shapes, surfaces, plans, spaces and masses.
- The exercise is given full attention and its importance is stressed by giving it ample time, effort and the highest evaluation.
- The exercise is comprehensive in nature, as it includes many of the architectural design key words, elements and principles which are based on mathematical models and generate geometries of abstract concepts

2.3. SQAURES COMPOSITION

There are six main stages to this project that cover certain design tools such as lines, shapes, surfaces, levels, spaces, and masses. Each stage builds onto the one that comes before it and works on completing one segment of the six. Each stage creates an abstract composition from one of the six tools. The six stages are represented in a 16 cm2. See figure (1)

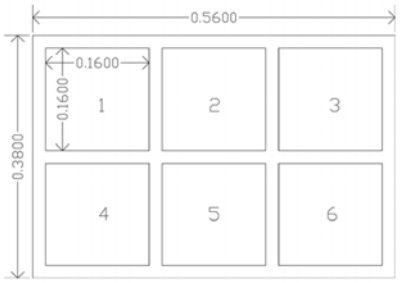


Figure 1. The six stages are represented in a 16cm2

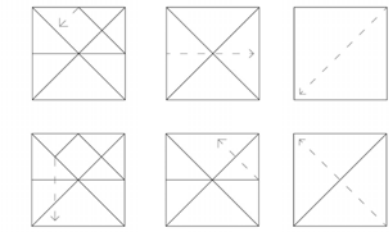


Figure 2. Square rules and order

2.3.1. Squares in Progress

Rules and Orders: The first square follows specific rules, which form the base for all the next squares. As the project progresses through to the next square the lines of the first square form the base construction lines and shapes of the next square. Like the simple 01 binary digits used in creating complex computing interfaces, the exercise will use the simple order of

geometry used in Arabesque Patterns and Geometries the 1: square root 2, which is the one side of the square and its diagonal. Another geometric rule also goes back to the Arabesque Pattern rules where all lines and shapes are generated without using distances or measurements. Line choices are horizontal, vertical or 45 degree while shapes are squares, or 45x45x90 degree triangles or shapes that combine both. Other orders rules how lines and shapes are composed following a mathematical ratio either from the examples explained to the students or devised by them. More rules indicates how lines are generated, intersect, start and end. Choices that give variety to each student's design can be achieved by following their devised ratio or by following thematic thinking that works with continuous lines and composition, or random shifts between separate lines. See figure (2)

Square Requirements: The composition should define a focal point in one of the four quadrants of the main square. With the help of the focal point and the articulation of all construction lines and shapes the composition should be looking pleasing and appealing. Students discuss the exercise as it follows its sequential progression through its timeline. Partial results are drawn form each stage, while the final results of the whole exercise will be discussed as part of the whole concept with its obstruction and creativity.

Square One, the Challenge: The first square presents the biggest challenge in the whole exercise. Although it is an easy task to draft the lines composition, it is hard to create something that look pleasing and appealing only by manipulating a composition of lines shaped into a square made up and divided into triangles. The main challenge is to overcome the limits and constraints that control the lines, squares, triangles, focal point and ratio. This square ultimately forms the base of all other squares, and rules all of the ones to come and thus must be creative. See figure (3)

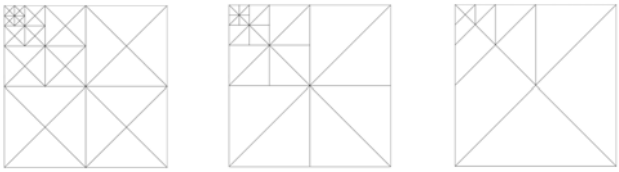
Figure 3. This square ultimately form the base of all other squares

2.3.2. Square One

Facing the Challenge: In the first session nearly all students find it hard to comprehend the procedure, because they are not given examples or demonstrations, and when that happened most of them rely heavily on the graphic illustrations given to them in the handouts, in order to understand the text and its concepts. This causes the students at their first attempts to replicate the illustration that they are given or something near to it.

The Ratio: The ratio concept was the most explicit idea, which many students either ignored, or followed randomly or adopted a ratio without recognizing its nature or equation. Others interpret the ratio as something that deals with lines repetition or arrangements away from real generated subdivisions, intersections, proportions and parts. Few students comprehend ratio in a thematic visual concept where intersections reach the edge or sides of the square or reach the square diagonals or one diagonal. Beside the ratios mentioned in the exercise description here are some of the ratios and proportions reached by the students.

Ratio Generating Squared Division: Ratio producing square division is either coming from multiplied by four (1, 4, 16, 64) or multiplied by two (1, 2, 4, 8, 16, 32, 64), where the first generate beside the vertical horizontal squares, a 45° rotated squares, the second only gives shapes based on vertical horizontal 90°.The same of the above ratio is projected on the angular based composition. That was the most popular ratios with about 30% of the students maneuvered within its general arrangement. See figures (4,5,6)



Figures 4,5,6. Ratios produce lines, squares and triangles divisions.

The zigzag Ratio: Reductive thinking which some students adopted generates reductive ratio of the add one ratio (1, 2, 3, 4, 5, 6, 7, 8, 9) and that ratio followed the one line-one intersection composition were angles generated juxtapose and alternate between the 90° and the 45° direction. This ratio is one of few which broke the symmetry trap. See figure (7)

The arrow ratio: The arrow composition followed the, add two ratio (2, 4, 6, 8, 10, 12), which symmetrically equalized the above zigzag ratio. This composition like many other compositions, which follows the even ratio and numbers, fell in the symmetry constraint. See figure (8)

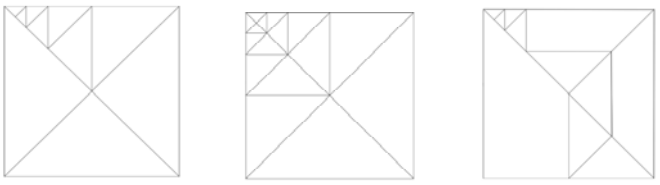


Figure 7. *Figure 8.* *Figure 9.*

The Random Ratio: Most students followed the random ration where division, intersection and proportions followed the trial and error route. Some of them followed visual judgment and evaluation of where and when a line should change direction, which intersection to stop or to continue, to go horizontally, vertically or diagonally. See figure (9)

The Thematic-Rhythm Ratio: This group falls between those who follow an order and those who don't. They follow the rhythm of lines and shapes as they succeed in creating depth with foreground and background lines. They also succeed in finding spatial arrangements where lines and shapes are organized in a linear, radial, clustered and central method. This clear arrangement weakens the effect of the left quadrant focal point, which the other ratios worked perfectly in directing the eye to that point. See figure (10)

The focal point: As mentioned focal points in the first and the other squares comprises an important parameter in the composition order and may effect how pleasing the composition is. Achieving focal point is not as difficult as the ratio. All students are able to comprehend the idea, its objectives and how to achieve it. The result varies from default symmetry, which diagonally and gradually catches the eye from one end and moves it to the other end, to the default ratio and order, which gradually reduces the distances, the divisions, and the proportions gradually towards the targeted quadrant. See figure (11)

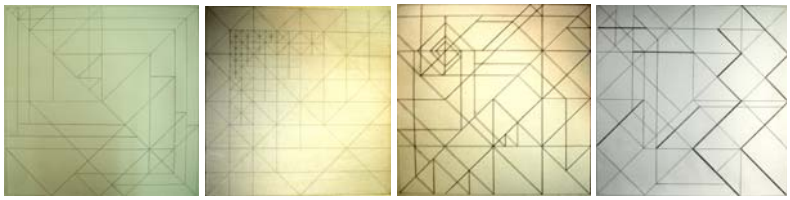


Figure 10. First from left: clear arrangement weakens the effect of the left quadrant focal point. *Figure 11.* (The rest) Focal point creates pleasant compositions.

Most students followed the image-manipulated composition, which concentrates, on ending lines that intersect at the upper left quadrant. Although this group did not reach the ratio focal order as that of the random and thematic image still they composed a better base that shifted the focal point between the first and the other quadrants. Some students who followed the ratio-focal order found themselves short of lines and shapes needed to complete the other stages and to place the focal points in other quadrants. Many of them, even when they reached the sixth stage they had to return to the first square and to revise and change its design. In the exercise students are not allowed to add lines except to square two, but they may omit as many lines as they want in square three through six. The primary purpose of the

first composition is to generate the ordering system for all squares with a secondary goal of have a good composition.

2.3.3. Square Two

Square two goes for the second level of abstraction, which we may call, abstracting the abstract. The target here is to turn and weaken the composition of square one by transforming it into construction lines thus turning it into a background, and to darken certain lines that would create a foreground hence a new focal point. This has to be done without deleting or adding any lines, but rather by emphasizing the tone or thickness of a certain group of original lines and shapes that are found in the square. See figure (12)

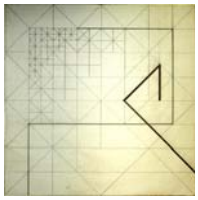


Figure 12. left: Foreground-Background, abstracting the abstract.
Figure 13. right: combination of BAS RELIEF and low masses.

The Foreground-Background Abstraction: Finding foreground and background composition from the line-shape composition was not that difficult, if the focal point is to remain in the upper left quarter. In this square students were asked to move the focal point to the upper right quadrant. Many students started to recognize some of the shortcomings in square one, as now they started to comprehend the notes that were given to them in regards to the completion of the lines and shapes of square one. They were warned that they should be prepared to incorporate their design into new designs in later squares. About 50% of students ask for permission to revise or redesign square one, which changes the ratio in some cases while others changed the thematic arrangements. Students were asked to be aware of these points and thus not to break the rules of square one and the whole exercise. The task is not difficult but finding a pleasing linear composition is not easy. Students tried to find focality by emphasizing the tones of a group of lines that intersect the upper right quadrant. The result was not pleasing at all. Few of the attempts, at this stage, could have recognized what would have made for a pleasing composition of line weight, which in abstraction is the ability to see new development in context, which is if you lost the background, you lose the foreground.

2.3.4. Square Three

Square three presents the most difficult and the most pleasing (if successful) composition in all of the six squares.

Square three is a prudent but shy step towards taking square one into the 3rd dimension. The square called BAS RELIEF, which is adding depth or projecting areas to create edge line composition. The BAS idea goes around grouping shapes into planes and layers into contour lines. In order to eliminate any other effect other than the relief effect, the students were asked:

- To shift the focality to the lower right quadrant.
- To use horizontal planes or layers of maximum 2cm depth or height.
- No tones, shapes, or lines, all are of white horizontal layers.
- Edges of depth or projection are taken from the construction line of square one.
- Create good composition
- Contrast is not a factor in perceiving this square.

The results showed that nearly 80% of the students replaced the tone contrast with a relief and contour contrast. They placed the lowest and highest depth and projections at the targeted focal quadrant. See figure (13) About 20% of the students readjusted the lines composition in square one in order to find lines or shapes in the targeted quadrant, to help them create focality in it.

Alternatives in the lines oriented composition of square one was more successful and easier to develop into square three than that of the shapes oriented ones. 20% of the students did not reach the BAS RELIEF contour idea and instead they founded a base plan with projected masses of low height objects.

2.3.5. Square four

Balance effect, not focality was the main requirement or objective of square four. White, black, and one primary color or two primaries with black are the permitted or available tones to give balance to square one.

At first glance most of the students thought that balance meant equal, so about 50% distributed equal areas of the same shapes and nearly of the same size between the two prime colors or between white and black tones. In both cases they placed the third tone in between the other two tones so it would enhance the equal distribution of both. Here students missed the role of value, intensity, and hue as tools of tones in manipulating the visual effect of the composition. Tones and colors in abstraction context are not measured in areas or shapes but rather in values and intensities.

For the first time the ratio people found themselves in better position than that of the thematic and random composition people. In this square shapes emphasis compositions used in square one were easily incorporated and

developed into the balance composition than that of the linear composition used in square one.

Here the difference between the linear and the shape emphasis is coming from the length of the line traveling and intersecting with other lines before changing its direction.

Lines change direction at the first or second intersection creates shape emphasis, while lines travel full distances and create many intersection before changing direction create linear emphasis.

Square four prove not challenging and the least pleasing and creative one. Balance was not that influential as that of focality. Also it did not integrate or integrated in the ratio concept as that of the focality. See figure (14)

Figure 14. Balance effect, no focality.

Figure 15. Spatial focality on the balanced tonal base

2.3.6. Square five

Square five presents an advanced step in taking abstraction into the third dimension. It accumulates and nearly finalizes the use of most of the design tools on all stages. Students now were asked to create spatial focality on the balanced tonal base of square four. In this stage emphasis goes back to the linear strength of square one. At this stage nearly all students started to master the idea of lines and shapes influence, in the design language, logics, and variables.

Few of the students found it difficult to manipulate vertical planes (2cm-6cm) into 3-D focality. Still, how 3-D focality can be pleasing remains a visual-human virtue, which only gained by practice. Some of the students, about 15% of them, repeated the faulty focality of square two by placing multi-intersecting planes at the targeted quadrant. The same students who did that at square two did it at square five. This arrangement detached the vertical planes from their background. That did not create spaces that integrate the vertical Planes with their background but rather, found independent compositions of vertical planes. Despite that, many students reached the concept of the 3-D views such as; isometric, axonometric, and perspective. So the visual influence and judgment at this stage gets more thrust than that of the mathematical ratio and proportion referred to in early stages. See figure (15)

2.3.7. Square six

Finding masses and forms in square six came to finalize the concept of creativity in abstract form. It also stresses the superiority of proportion over ratio. Here at square six the emphasis goes back to the powerful presence of shapes as that of square four and possibly certain cases in square one. Focality now returns back to the upper left quadrant as that of square one. Students recognized that masse composition was not a helpful tool in creating focality. Most of the students referred back to the contrast trick. They founded a tall 6cm high, small shape at the focal quadrant and raised low and medium height (2 cm-4 cm) big shapes on the other part of the square. Ratio here has no presence in this composition, the relative proportions of the masses heights, shapes, and areas manipulated the composition and gave many students the solutions of the problem at this stage. See figure (16)

Figure 16. Mass composition was not a helpful tool in creating focality

Four squares, six squares, nine squares or twelve squares: The six squares exercise was later developed by either reducing the number of stages to four, or by increasing it to nine and to twelve. Other development in the concept of the exercise was more explicit, and was implemented by developing Arabesque patterns out of the square and triangle composition. Of course this would not happen without getting the circle as a major player in creating the Arabesque pattern. The presence of the circle increased the complexities, which contradict with the abstraction objective. Anyhow the six square versions prove to be the most effective in reaching the basic design objectives.

3. Specific Results of the Exercise

The exercise description was of a long nature, which scared big part of the students and reduced their expectations of a successful design. Explaining the exercise content, the geometrical ratio, abstraction, proportion, concepts and most of the ideas took a very long time and many illustrations and examples which frustrated many students and many of them asked are we going to achieve and reach that? Few of the students, those of limited

background and skills, could have had understand the concepts and ideas behind the abstraction, ratio, proportion issues. You will understand all in due time, that was the reply to their early questions.

Square one was presented to everybody including tutors as the main ultimate solution. Too much stress was laid on keeping in mind and from the first beginning to the end that square one shall be an ideal comprehensive composition that can incorporate an integrate all the targeted design tools of square one and the coming five squares.

Giving examples and illustrations to the students at early stages gave more side effects than curing. Many students thought that examples gives optimum or best solution or something very near to it. Mathematics and ratios approach or way of thinking was not fully favored by most of the students; many of them prefer the thematic, random, or proportional compositions.

Pursuing the focal point idea and moving it from one quadrant to the next in the progression of stages enhanced the students' way of thinking and provided them with a visual tool that assisted them to mathematically and visually understand and approach creativity from an abstraction perspective.

Handling line and developing it into design tools of shapes, surfaces, layers, spaces, and masses was much easier than composing it in concept, order, geometry, rhythm, contrast, and balance.

Making decisions that include choices of when to start, to stop, to continue, to intersect, to combine, to join, or to alternate…etc. was not fully the students decisions, nor of the exercise rules. Many of them reached that by the concept of trial and error. That method was intended to find certain balance as to direct the students into the course of the exercise, but at the same time to give them certain margins to maneuver, to try, and to experiment everything in the exercise content. This technique worked much better in the six squares exercise than that of first Look Around exercise. The six squares exercise proves that abstraction, way of thinking and its techniques work effectively in geometries than abstractions in the redundancy technique used in the Look Around project.

4. General Discussion and Conclusions

Approaching creativity through abstraction has achieved the following.

- It reduced and in cases fully closed the gab between the needed skills and background of those students who want to study architecture and the fact that many of them are coming with no skills or creative background. In simple words, students with any artistic background and skills can study architecture including those who don't have any skills

- It reduces the gap between art and architecture and between science and architecture and between creativity and intelligence.
- It brought together, and accumulated students' creativity, way of thinking and skills and many other variables in one project and experience.
- It provided an artistic, scientific and educational common platform, which assisted those who wants to approach architecture through arts or by the way of sciences.
- Containing clear and tight rules and constraints did not limited students from coming with many alternatives and distinguish solutions.
- Dividing the exercises into stages and keeping students from not knowing the end results, or what exactly the design will look like at the end, frustrated some of the students and reduced their interests in the work.

5. Specific Results

Presenting the tools of design into abstract geometries produced the following results.

- Balanced curve with 16% of the students with grade A, 21% B+, 26% B, 18% C+, 14% C, 5% D+ and no fails or D grade.
- Most of the students who dropped architecture and moved to other specialty happened at the beginning of the Basic I course. No drops happened at the end of it or at the second semester.
- At each stage of the exercise progress, students started to recognize their own progress and the change in their way of thinking, creativity, attitudes towards abstraction, and above all understanding the best approach to design methods and techniques.
- Students mastered the pleasing issue by understanding that it is a personal view gained by the virtue of relative judgment. On the other side they understand that the design tools are abstract methods and techniques that can be learned and applied directly or indirectly.
- It makes the students understand the difference between the two exercises and between the different stages in the one exercise.
- It well acquainted the students with the design tools as a language of logics and variables.
- The first exercise achieved 65% of its objectives while the second achieved about 85% of its objectives.
- Both exercises prove that abstraction can give answers, alternatives and solutions to complex problems if approached at the proper technique.

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