

# Early Levels Students' Skills in the Stages of Completion of the Architectural Design Process

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**Abstract** During the design course in architectural education, the student passes through several stages during which he/she stops at several sequential steps in an order that guarantees the achievement of the desired objective i.e. the final product. In order for the student to achieve that product at a high level and ensure an outstanding performance, he/she must complete each of these steps to become a pillar for the next step and contribute to the project requirements. The student must be able to submit such project in the right form to get the highest evaluations where the negatives are surpassed by a large number of positives. In order to control the achievement of all the performance steps requirements, the student must have the required skills to establish knowledge and creative basis, each depending on the nature of those stages and their role in reaching the final product. The research aims to identify the skills needed by the student for the completion of the design process, as an opportunity to support them within the framework of the project program throughout the semester, and then link those skills to the intended learning outcomes ILOs. The research relies on the skills descriptive analysis methodology through teaching experiences in the early architectural design studios. It monitors the requirements of each step in the design stages where it draws out the skills required for the student. The research concludes with a matrix that defines the stages and steps of the design process, the skills of each step, and their relation to the learning outcomes supposed to be formed by students and which are classified according to the thinking skills in Bloom Taxonomy.

**Keywords** Architectural Design Stages, Steps of Stages, Design Process, Thinking Skills, Student Skills

## 1. Introduction

Many researchers and practitioners of education and the students in the fields of education and thinking presented several concepts of design in general and architectural design in particular Fig (1), Ferry J.J. Forman (1967) stated that design is "a proposal of a problem with its needs divided into parts to find the solution", while Korberg (1972) described the design process as "processes of analysis and synthesis resulting from inputs and ending with outputs." Others, such as Jay Doblin (1987), have deepened the design process to see it as "a set of processes extending imaginary ideas from direct to indirect design." [1]

Skills require attention to many details and the nature of advanced skills that are conducted unconsciously. Just as physical skills require training and application, but thinking skills as explained by the great British philosopher Ryle (1949) that thought is largely a matter of practices and skills. And also has clarified the psychologist Bartlett (1958) the

dealing with thinking as complex and requires a high level of skills. [2]

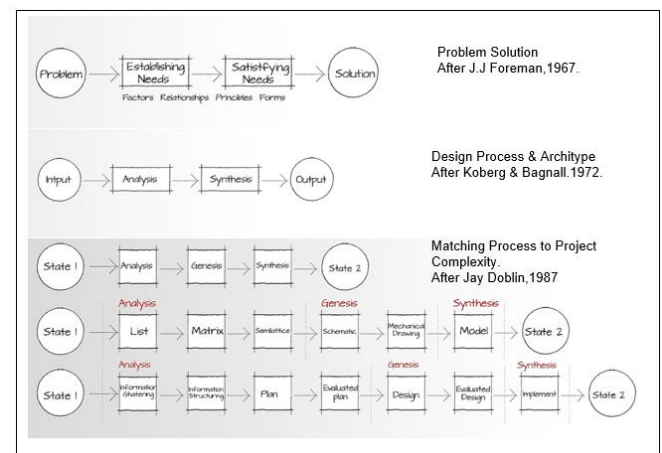


Figure 1. Models from Design Process

## 2. The Concept of Design as Sequential Processes

In regard to the design process with many studio experiments, it is found that it simply needs 8 decisions which can be defined from a clear concept of architectural

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design as *"The grouping of spaces with specifications dictated by disciplined relationships that meet the needs of users, in a 3D form associated with many factors and has an identity and model systems to guarantee the required performance"*.

This concept may be more detailed, but it is indeed a complete presentation of the steps to produce an architectural design. The eight decisions are:

1. Grouping of Spaces
2. Specification of Spaces
3. Disciplined Relationship between Spaces
4. Achieving for User Needs
5. Making 3D Form
6. Identity acquisition
7. Structure System
8. MEP Systems

In order for the students to achieve product with a good working design, in terms of functionality and aesthetics, they must pass the eight decisions listed above, which are distributed in three basic stages in the design production process as follows:

Stage I – Preparation, Stage II – Creation & Stage III – Presentation.

RIBA work plan 2013 organizes the preparation process for the project followed by design, construction, maintenance and operation and finally the post-occupancy Evaluation phase so using building projects into 8 stages [3]. The research summarizes the stages of studio design, in the previous three stages.

These stages converge with The Labat and Solowski (1999) model where created after researchers' insights into design processes. It includes engineering, architecture and industrial design. Where It was sorted into three stages: problem definition and research, creative exploration and Implementation. [4]

### 3. Design Process Stages

The **preparation process** involves studying spatial analysis, site analysis, and ends with the space relationship diagram, which covers the first four decisions mentioned above. While **Creation Stage** is concerned with design concept, its identity and composition in the 2D and 3D, it gives the viewer and the juror a clear idea of the project's image, which covers the fifth and sixth decisions. In **presentation Stage**, the designer provides the established design criteria, how the student designer assesses him/herself, and an integrated report explaining the project systems and analyzing the idea as an appendix to the project. This step ends with producing the poster that includes the components of the project explanation. Here, it may be evaluated - there may be an opportunity for feedback- to correct the jury's notes on the work, or to proceed with the submission of operational drawings. The report includes an explanation of all the work methodology to complete the design process in

seventh and eighth decisions.

## 4. Design Stage Steps

The three stages of **preparation, creation and presentation** cover the entire design processes to a final product that achieves the main objectives, the most important of which is the function of the building and the needs of its users. Each of the three stages requires a set of points to be explained by the studio professor, and the student continues to implement them in multiple images such as: sketches, drawings, perspectives, reports, researches and models. Each step is based on the previous ones, and is considered to be a pillar of the following steps. Thus, the design process is a series of interrelated steps of data collection, phenomenological analysis, program synthesis, and evaluation of results.

The research presents the basic design stages and the necessary steps in the design process. Through the investigation of each step, its role and importance, the study monitors a set of skills for each step, which the student should acquire and develop, whether through continuous interaction with the studio professors or through supporting courses such as history, theories of architecture, environmental studies...etc., or through personal skills such as photography, free hand drawing, or control of the advanced digital drawing and presentation programs, in addition to the psychomotor skills as body language, and decision-making skills based on general knowledge.

### 4.1. Steps of Preparation Stage

#### Step 1: 4-1-1 Feasibility Study

**Table 1.** Skills for step1, Feasibility Study

No.	Step	Skills
One	Feasibility Study	1-Experience in similar projects according to the general and precise specialization.
		2- General knowledge in the field of the project and the related projects.
		3- The possibility of cooperation within a teamwork of different specializations.
		4- Ability to interpret the requirements into an expressive direct language.
		5- Linking economic, urban, environmental and social standards with the project function.

This study is concerned with the importance of establishing the project and its social, economic, environmental and other results. The architect can have a role in preparing it or receiving the feasibility study report prepared by the owner with the help of experts in various fields. In the following table, the skills needed by the student are listed if a feasibility study report is requested for the project (in the early levels, the student may get a general idea of the feasibility study without being asked to prepare it) (Table 1).

**Step 2: 4-1-2 Program Preparation**

The design program for the required project is considered as an "agreement document" between two parties. In architectural education programs, this document represents the terms of a contract and a binding agreement between the studio professors and their students. It is possible that the student - especially in the final stages of study - prepare the project program, to become a complete program for the zones and spaces of the project, and a determinant for the spaces, numbers, building codes...etc. Therefore, the student who prepares the architectural program for the project must have a set of skills, as shown in the following table: (in the early levels of the program, the student may get it from the project professor) (Table 2).

**Table 2.** Skills for step2, Program Preparation

No.	Step	Skills (not required from early levels students - only readings and general knowledge).
Two	Program Preparation	1- Understanding the economic, social and environmental feasibility study of the project.
		2- Sufficient experience in the field of the project or working in similar bodies.
		3- Ability to understand and analyze similar projects regionally and internationally.
		4- Sufficient perception in a major specialization: urban planning - environment - sociology.

**Step 3: 4-1-3 Site Analysis**

The analysis of the site aims to ensure the compatibility between the building and its site, where the positive and negative phenomena of the land geometry as well as man-made and natural surroundings are explained in order to make the right and supporting design decisions for the project. Therefore, the student must have a set of skills that enable him/her to analyze the site as listed in the following table (Table 3):

**Table 3.** Skills for step3, Site Analysis

No.	Step	Skills
Three	Site Analysis	1- The ability to observe and record the elements of the site.
		2- The possibility of documentation by photographing.
		3- Proficiency in identifying present phenomena in relation to the points of strengths and weaknesses, and anticipating threats and opportunities (SWOT)
		4- The ability to write reports, statistics and make sketches.

**Step 4: 4-1-4 Spatial Analysis**

In this step, the student studies the project spaces and zones, and identifies the total Area, and then develops a vision for the distribution of those spaces in the available floors. Then, the student deduces the module, studies each space in terms of furnishing and possible dimensions, and

identifies the level of lighting required for its function as well as the need of entrances, emergency exits and ventilation. Therefore, spatial analysis requires special skills, as shown in the following table, to study the space program and to draw out elements to help the student in the design (Table 4):

**Table 4.** Skills for step 4, Spatial Analysis

No.	Step	Skills
Four	Spatial Analysis	1- Accurate reading of the program.
		2- Efficiency in converting spaces to appropriate geometric shapes.
		3- Full understanding of the theories rules.
		4- Numerical and computational ability to deduce the module.

**Step 5: 4-1-5 Spaces relationship**

It is considered the last step in the preparation steps, where the spatial relationships of the different roles are conceived, either in a matrix or in a bubble diagram, which contains circles representing the spaces, and determines the main and secondary entrances, the locations of emergency exits, and the level of relationships in terms of strengths, weaknesses or isolation, in addition to the core places. The bubble diagram of the different project floors gives an approximate perception of the project design. The space relationship requires the following skills (Table5):

**Table 5.** Skills for step5, Spaces Relationship

No.	Step	Skills
Five	Spaces relationship	1- Reading and understanding the architectural theories of the project.
		2- Studying and analyzing similar projects.
		3- Registration of the client's special requirements.
		4- Interaction with the inferences deduced from site analysis.
		5- Identifying the appropriate diagram for the function and objectives of the project

**4.2. Steps of Creation Stage**

In the teaching of architectural design, creative thinking is a Step followed by a series of procedures to solve the design problem. [5]. We find that creativity is the highest degrees of cognitive classification by model developed by Anderson-Krathwohl (2001) who graduates from knowledge, understanding, application, analysis and evaluation and ends with creativity. [6]

**Step 6: 4-2-1 Design Concept**

The design concept is the main entrance to the creative product in the design process, and is defined as "The starting point that follows different forces, influences the design decisions, helps to stabilize the building, and gives it creative clarity." The idea of the design enables the student to put a justified geometric formation in 2D (plans) or 3D (mass and -perhaps- its details). In order to develop a design, the student must have the skills listed in the following table

(Table 6):

**Table 6.** Skills for step 6, Design concept

No.	Step	Skills
Six	Design Concept	1- Understanding the objectives, vision, mission and values of the project.
		2- Having a high level of general knowledge resulting from reading, dialogue, travel and others.
		3- The ability to be open-minded and to think out of the box.
		4- Full personal conviction of the design importance within the design process.
		5- The possibility of converting philosophical ideas into iconic forms that can be converted into geometric formations.

**Step 7: 4-2-2 Primary Design**

It is an important step to develop a rough Image of the project based on the data collected in the design preparation stage. Thus, the initial sketch of the design idea becomes an important point in the design. Therefore, the student must have the skills listed in the following table in order to pass that step to the following one (Table 7):

**Table 7.** Skills for step7, Primary Design

No.	Step	Skills
Seven	Primary Design	1- The ability to fully understand the project requirements.
		2- The possibility of establishing an image based on the design concept.
		3- The fine control skills to make the architectural sketch.
		4- The ability to imagine space relations horizontally and vertically.

**Step 8: 4-2-3 Plans development**

When the student identifies the features of the plans in the different floors, he can develop his initial sketch drawings to become clearer in the formation of spaces, their directions and openings, core locations, internal corridors, main and sub entrances and emergency exits. So that the student needs to have an additional set of skills as in the following table (Table 8):

**Table 8.** Skills for step8, Plans Development

No.	Step	Skills
Eight	Plans development	1- The ability of interaction between the module and the geometrical form and the program elements.
		2- Identify the possibilities of geometric shapes for the required spaces.
		3-Understanding the role of design principles in their application to the interactive space.
		4- The ability to figure out detailed solutions for the circulation and entrances, and link them to the major spaces.

**Step 9: 4-2-4 3D Forming**

Through multiple observations and the abundance of design experiments with a little of artistic talent, in addition to the guidance of the studio professors, the student can accomplish the composition and details of the architectural project of masses, materials and colors of his/her architectural project in 3D. If the student has a **deductive way of thinking**, he/she can deduce ideas from generalities to details. However, if the student has an **inductive way of thinking**, he/ she can reach to solutions from details to the generalities (they are a majority), but in any case the student must have those skills in the following table to form the building mass (Table 9):

**Table 9.** Skills for step 9, 3D Forming

No.	Step	Skills
Nine	3D Forming	1- Having some of the artistic talent that can be refined by education, experimentation and knowledge.
		2- Having full knowledge of the building codes within the project zone.
		3- Visualization the relationship with the existing or potential form in 2D plans.
		4- Studying, understanding and applying aesthetic principles in architectural design.
		5- Providing an idea stemming from the design concept.
		6- Being constantly updated with the new technologies and building materials.

**Step 10: 4-2-5 Final Image**

When reviewing the design program, it must include the requirements for the work submission: such as plans, sections, elevations, external and internal perspectives, environmental studies and others that were taken into consideration in the design. Therefore, the student has all the requirements elements of the project design presentation, which complete the final image of the project. For the final image to be produced properly, the student has to have another set of skills as shown in the following table (Table 10):

**Table 10.** Skills for step10, Final Image

No.	Step	Skills
Ten	Final Image	1- Having the artistic talent of using and choosing colors to enhance the idea and relationships.
		2- Having sufficient experience in digital programs such as: CAD - 3d Max - Sketch up - PSD... etc.
		3- The ability to read and analyze a large number of projects in their final image.
		4- The ability of drawing with different pens: Graphite - Chinese ink - Marker - Water colors, Crayons, Gouache and Acrylic, in the case of geometric or free hand drawing.
		5- The ability of 3D drawing: perspective or isometric, paper or digital, with the ability to choose geometric shots to support the idea of the project and have a visual impact on the jury.

**4.3. Steps of Presentation Stage**

**Step 11: 4-3-1 Design Analysis**

The student prepares "design analysis slides" to ensure the engineering composition quality in terms of the smoothness and correctness of circulation, the availability of the module, the clarity of the structural system, the compatibility of the proportions of the solid and void, and the extent of commitment to the distribution of the design program components. In order to make these points, the student must have the following skills (Table 11):

**Table 11.** Skills for step 11, Design Analysis

No.	Step	Skills
Eleven	Design Analysis	1- The ability to determine the geometric composition of the project and the possibility of simplifying it in 2D and 3D.
		2- The possibility of detecting the negatives and positives in the relations, and the general composition in accordance with the rules and specified design criteria.
		3- The ability to read and analyze a large number of plans, sections and elevations of similar projects.
		4- Identifying and understanding the elements of the project composition: geometric composition - module - circulation - proportions of the solid and void - mass ...etc.
		5- Understanding the stages of dealing with the design from the stage of preparation and then the production of the idea and its development until the process of preparing the media of presentation.

**Step 12: 4-3-2 Self-evaluation**

**Table 12.** Skills for step 12, Self-Evaluation

No.	Step	Skills (not required from early stages students)
Twelve	Self-evaluation	1- An accurate reading of the requirements of the design program including the client's requests, the visitors' needs, the vision, mission and values as well as the survey program and the surrounding site facilities.
		2- Recognizing the established design criteria in the program, the similar projects, data books in addition to the requirements of the environment, urban, economy and users.
		3- Deducing the criteria so that they are qualitatively or quantitatively measurable.
		4- A deep understanding of the method to deal with the evaluation matrix, and the data mounting process to obtain the objective results.
		5- Measuring the characteristics of the criteria using the <i>Rating Scale</i> , or any other compatible means that contribute to converting them from a qualitative value to a quantitative estimate.
		6- Making a logical arrangement of the relative importance of the criteria according to the nature of the project and the value of its role in achieving the performance of the project.

Before the student presents his project to the jury, it is preferred to make first evaluate his/her production of design, which is called "**Self-Evaluation**". Therefore, the student should establish relatively important evaluation criteria to ensure the achievement of quality performance requirements by achieving the program objectives and the requirements of its users, the needs of the owner or client, the extent of aesthetic impact, and comply with the environmental, traffic and others building requirements, and the application of international criteria for building codes. Therefore, the student should have the following skills in this step: (Formed by the final stages students, and serve students in the early stages of periodic jury by the course professors to be a simplified training on the ability to self-evaluation in the future) (Table 12).

**Step 13: 4-3-3 Poster**

The impressions left by the project poster have a clear impact on the jury and the course professors. It is possible that the background colors, font sizes, distribution of project elements (plans, perspectives, etc.), and determination of the focus point have a positive or negative impact depending on the student's choices in designing the poster. In order for the poster to achieve its objectives, the student must have the following skills (Table 13):

**Table 13.** Skills for step 13, Poster

No.	Step	Skills
Thirteen	Poster	1- Analyzing and studying a large number of posters for various professional and student projects.
		2- Reading the design reference (TOR) to determine the basic display requirements, (drawing scale - colors – sheets Dimensions, etc.).
		3- Arranging requirements locations clearly adding an artistic touch in the completion of an attractive design.
		4- The ability to make presentations using a variety of advanced digital programs.

**Step 14: 4-3-4 Report**

**Table 14.** Skills for step 14, Report

No.	Step	Skills (not required in early stages)
Fourteen	Report	1- Reading and understanding the requirements of the design reference for the components of the report.
		2- The ability to coordinate, organize and present all pages of the report in an attractive and interesting image.
		3- Processing all the technical data, studies, texts and statistics.
		4- Designing a cover commensurate with the function of the project, the design provided and the program requirements (if any).
		5- The possibility of writing and good drafting of all elements of the report in Arabic and / or English. (As per requirements)

The student cannot put all his studies on the poster boards. Therefore, the report serves as attachments explaining the work, systems and details. It becomes a complement to the project data contained in the poster, with the possibility of adding a copy of the project plans and its various perspectives on a drawing scale that fits the size of the report. The preparation of reports requires special skills for students as in the following table: (In the early stages, the student gets experience and skills of preparing reports through the initial research before the completion of the design or in the research methodology curriculum) (Table 14).

### Step 15: 4-3-5 Jury

One of the most important skills for the architecture student is the ability to face the jury, convince them of the idea, clarify the required points, and emphasize the level of the effort exerted in studying and preparing for the work. Therefore, the student must have the following skills for the final jury: Harrows (1972) creates task of **psychomotor domain**, which includes reflex movements, basic fundamental movements, physical activities, skilled movements, and non-discursive communication (Table 15). [6]

**Table 15.** Skills for step 15, Jury

No.	Step	Skills
Fifteen	Jury	1- Full knowledge of all the details along with the theories of the project.
		2- Self-confidence with great humility.
		3- Self-esteem while respecting the views of the members; i.e., do not compliment and at the same time do not ignore their thought.
		4- Attending many juries (if possible) and do not skip the periodic previews of your project.
		5- Doing continuous training on psychomotor skills to improve body language and methods of presentation and speech.

## 5. Conclusions

By reviewing the early levels of architectural design studios (from Studio 1 to Studio 4); the research identified the desired learning outcomes for that educational stage in the design courses. The research then proposed the relationship matrix between these outputs and the stages of the design process. These outputs were categorized ascendingly in terms of level of thinking from lowest to highest (according to classification [7] in "**Bloom Taxonomy**"). This proposed matrix helped to track the achievement of each of these skills, while recording the intensity of their need (ascendingly from 1 to 3) to achieve that skill, taking into account the level of the early stages students.

By reading the Relationship Matrix between the learning outcomes in the design studio and the different design process steps (Table 16), it can be easy to conclude that students need to pre-support skills in the same design studios

or related course descriptions programs (e.g. Design Methods and Processes, Architectural models, Advanced Computer Programs and others) The matrix, as a "framework" that can be built on the project's functional program during the semester, is characterized by being flexible and adaptable, where other learning skills can be deleted or added under thinking skills. Moreover, it gives an opportunity to generalize or focus on any step of the design operations, according to the function of the project, the level of the studio and its objectives of the course description.

The matrix is a research attempt based on the researcher's experience in the years of teaching architectural design at the early levels of architectural education. Through such experience, it becomes possible to identify the student's skills required to achieve the architectural design. It is also possible to develop this attempt in the future to serve as a framework to enable the professors to set priorities for the implementation of the program during the semester to raise the skills of students through an accurate methodology.

Through the previous documentation of the skills required for the student in the three basic stages of the design process to a design product with features and performance criteria, the study provides some recommendations to the professors and decision makers for the students of the early levels of studying architectural design:

1. Early verification of the necessary training availability to enhance and develop the skills required for each step of the design process steps.
2. Building the order of courses in architectural education levels according to the skills required for each level.
3. Supporting the interrelationship between the levels of thinking in "*Bloom pyramid*" while creating means to continuously measure the acquired skill of the student to achieve the architectural design.
4. Including the idea of cooperation and teamwork in order to encourage the transfer of diverse knowledge between members of the team, especially in the preparation and presentation steps.
5. Enhancing the student's abilities of freehand drawings and sketches in the explanation and registration of the project requirements as well as the analysis processes documentation before, during and after the design idea, in parallel and with the same importance of learning digital programs.
6. Directing design students to register and pass elective courses that indirectly support the design completion skills such as: *photography, art painting, sculpture, music and criticism*.
7. Encouraging students to attend workshops outside the design framework, such as *making study models, the principles of writing reports and studying statistics*.
8. Travelling on local and international scientific trips under the supervision of design courses professors through a program to raise awareness, develop knowledge and acquire skills about *the environment, heritage, urban, modern thought and future prospects for architectural design*.

**Table 16.** Relationship Matrix to Prioritize Architectural Design Learning Outcomes at Early Levels according to Bloom's Pyramid of Thinking Levels

Bloom Taxonomy	Design Stages Process	Preparation					Creation					Presentation				
	SKILLS	Feasibility Study	Program Preparation	Site Analysis	Spatial Analysis	Spaces relationship	Design Concept	Primary Design	Plans Development	3D Forming	Final Image	Design Analysis	Self-Evaluation	Poster	Report	Jury
	ILOs [9]															
<b>Remember</b>	<b>Define the Program Requirements</b>	1	1													
<b>Comprehensive</b>	<b>Ability to Studying the Influenced Factors</b>			3												
	<b>Perceiving spatial analysis procedures</b>	1	2		3	2										
<b>Apply</b>	<b>Application for Architectural theories</b>					3										
	<b>Apply the Knowledge of Traditional systems</b>								3		3					
<b>Analysis</b>	<b>Gathering &amp; Analyzing Information</b>			3	2	3					2					
	<b>Linking Between project &amp; its Surrounding</b>						2								3	
<b>synthesis</b>	<b>Ability to work in Teamwork</b>						2				2	2	1	1	1	
	<b>Explain Through Models &amp; sketches</b>					2	3	3	3	3	2	2				
	<b>Think Creatively</b>						2	3	3	3	3	3				
	<b>Control in present Imagination</b>													3	2	
<b>Evaluate</b>	<b>The Possibility of Judging &amp; evaluating</b>									1		2				2

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