DEVELOPMENT OF CURRICULUM AND PEDAGOGY FOR THE EFFECTIVE TEACHING OF ARCHITECTURAL GRAPHICS AND DRAWING

Thesis Submitted for the Award of the Degree of

DOCTOR OF PHILOSOPHY

in

Architecture

By

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2025

DECLARATION

I, hereby declare that the presented work in the thesis entitled "Development of Curriculum and Pedagogy for the effective teaching of architectural graphics and drawing" in fulfilment of degree of **Doctor of Philosophy (Ph. D.)** is outcome of research work carried out by me under the supervision of Dr. Raminder Kaur (18258), working as Professor, in the School of Architecture and Design, of Lovely Professional University, Punjab, India. In keeping with the general practice of reporting scientific observations, due acknowledgements have been made whenever work described here has been based on findings of other investigators. This work has not been submitted in part or full to any other University or Institute for the award of any degree.

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CERTIFICATE

This is to certify that the work reported in the Ph. D. thesis entitled "Development of Curriculum and Pedagogy for the effective teaching of architectural graphics and drawing" submitted in fulfillment of the requirement for the award of degree of **Doctor of Philosophy (Ph.D.)** in the School of Architecture and Design, is a research work carried out by Chaudhari Dhananjay Baliram, 41900291, is bonafide record of his original work carried out under my supervision and that no part of thesis has been submitted for any other degree, diploma or equivalent course.

(Signature of Supervisor)
Name of supervisor: Dr. Raminder Kaur (18258)
Designation: Professor
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University: Lovely Professional University, Punjab, India

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ABSTRACT

A crucial component of the curriculum for architecture includes technical subjects. These technical subjects in turn become the integral part of architectural design studio. Diverse technologies that are relevant to architecture design are covered under these technical subjects. It is therefore very important to integrate the design and technologies correctly.

The most natural technique to chronicle architectural work is to sketch. A single line depicting the building has a lot of significance as it expresses specific things more effectively and in depth than spoken or written explanations. It communicates architectural information across languages, overcoming language barriers.

The expression of architecture is technical drawing of the building and graphical representations of building components. If a design is not accurately represented by the student and comprehended by the instructor, it cannot be adequately perceived, understood and evaluated.

The way that architecture students generally perceive architectural graphics and drawing subject, indicates that the approaches used to teach and learn the curriculum in architecture schools and colleges need to be reassessed. As a result, the teachers, professionals or other individuals may perceive incorrect interpretations of design. Thus, the purpose of this study was to examine 'architectural graphics and drawing' curriculum and what are the challenges in teaching and learning of this subject in different colleges affiliated to Savitribai Phule Pune University in Pune.

A survey research procedure utilizing random sampling technique was employed to identify 46 faculties teaching architectural graphics and drawing subject in various institutes and 149 students were identified too. A standardized questionnaire and interview schedule served as data gathering tools. Descriptive and inferential statistics were used to analyze the data. Content Analysis was used to examine the interview data. The outcome demonstrates that the architectural design process is cut off from the current typical sequence of the architectural graphics and drawing curriculum.

Additionally, the results of comparative analysis of various syllabi suggest that 'architectural graphics and drawing' curriculum needs revision as far as evaluation and examination system is concerned. One of the most important aspects of the architecture

curriculum is sketching which is neglected by students and faculty. Students need to develop their sketching skills and they need proper guidance from the faculty about sketching.

Moreover, the research identifies the crucial units of architectural graphics and drawing curriculum such as scale drawing, three dimensional orthographic projections of solids and sketching.

Thus, the purpose of this study is to identify the crucial aspects of architectural graphics and drawing curriculum and based on students' understanding about these crucial aspects of curriculum, identify and recommend the efficient teaching models. This will help to develop the curriculum of architectural graphics and drawing and to enhance output of the student when it comes to conveying Correct Design Concepts.

Key words- Curriculum, Technical subjects, Expression of Architecture, Communicate, Incorrect interpretations, Development, Crucial aspects, Correct Design Concepts.

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Abbreviations

AGD	Architectural Graphics and Drawing
AC	Abstract Conceptualization
CE	Concrete Experience
CBCS	Choice-Based Credit System
CIE	Continuous Internal Evaluation
ELT	Experiential Learning Theory
KMO	Kaiser-Meyer-Olkin (test)
RO	Reflective Observation
SEE	Semester End Examination
SPPU	Savitribai Phule Pune University

Glossary

Horizontal Plane - HP	A base Plane on which the object is resting or elevated. Conventionally, this is the Ground Plane
Vertical Plane – VP	A plane perpendicular to HP, which forms the background for the object or a plane.
Plane	A two-dimensional shape that is closed is known as a plane.
Center	A center is the point marked on the midpoint of the diameter of the circle or a point of intersection of the lines joining opposite vertices.
Base	Base is the plane from which the solid object is derived. E.g. Square base Prism, Hexagonal base Pyramid etc.
Side	Side is the line that encompasses the Base. E.g. A Square base prism of side 20 MM
Vertex	A point of intersection of sides of the base.
Axis	An imaginary line passing through the center of the bases or Apex
Apex	An apex is a vertex where two or more lines or edges of the solid meet, and it is located directly on the axis of the base of the shape.
Edge	A line joining the vertices of two bases or vertices of the base and the apex.
Face	A plane formed by the lines joining the sides of the base/s and the respective adjacent edges or apex.
Drawing	A drawing is a technical representation of an idea or creative thought.
Design	A design is a creative thought or an idea that may or may not be a solution for an issue

CHAPTER-1: INTRODUCTION

II शिल्पिलक्षणम् II

भवन्ति शिल्पिनो लोके चतुर्धा स्वस्वकर्मभिः ॥
स्थपतिः सूत्रग्राही च वर्धकिस्तक्षकस्तथा ।
प्रसिद्धदेशसङ्कीर्णजातिजो ऽभीष्टलक्षणः ॥
स्थपतिः स्थापनार्हः स्यात् सर्वशास्त्र विशारदः ।
न हीनाङ्गोऽतिरिक्ताङ्गो धार्मिकस्तु दयापरः ॥
अमात्सर्योऽनसूयश्चा तन्द्रितस्त्वभिजातवान् ।
गणितज्ञः पुराणज्ञः सत्यवादी जितेन्द्रियः ॥

(सयमतम् ५ अध्याय।)

This Sanskrit verse describes the four essential skills required for the successful erection of an edifice. In ascending order, ***Taksaka****, the stone or wood cutter,* ***Vardhaki****, the meson or the carpenter,* ***Sutragrahin****, the master mason or supervisor, generally the disciple or the son of the architect, and finally, the* ***Sthapati****, the architect. High intellectual, moral, and ethical standards are set for the architect. He must be a man of quality, physically sound, just, compassionate, learned in mathematics, incorruptible, familiar with ancient authors, and well versed in all forms of knowledge (Sarva Shastra visharada). We can also interpret this to mean the four stages a person has to go through, and the skills required to graduate to the highest level as an architect.*

1.1 History of Drawing

Architectural design was determined by drawing from the beginning. The Gudea statue in the Louvre, which depicts an architectural design and is one of the oldest representations of architectural plans, shows that drawings were used in many contexts in Mesopotamia as early as 4000 years ago. Although the architectural drawing etched

into the plate that lies on Gudea's knees represents the orthogonal projection of a temple or sacral building surrounding a shrine, it was not just technically complete; it also had a symbolic significance.

Drawing is the means of portraying the design, according to Vitruvius, whose De Architectura Libri Decem is the only complete work of classical antiquity's architectural principles still in existence. In order to do this, the architect needs to have a solid understanding of geometry. By establishing the term ‘ordinatio’, or ‘fitness’, he also establishes the ground plan, elevation, and perspective, all of which result from creative and logical thinking and result in an appropriate layout of the building and its elements.

The 19th century witnessed the establishment of the first formal collections for architectural designs and drawings at architectural offices and educational institutions. The desire to secure not only the drawing but also the architectural concept itself led to the necessity of meticulously documenting the drawings. The drawings remain the same in their original form even while the built buildings change, get damaged, or are rebuilt all over again. In order to preserve the original construction and design of the building, the plan acts as a medium that carries both the design drawings and the construction drawings.

Besides contributing to their functional or cultural-historical significance, architectural drawings often have a high inherent creative significance. Despite this, this significance in the history of graphic arts—including painting—is by no means secondary. To add to this, the pedagogic interest of the universities does not limit to drawings but rather to any and all documents pertaining to the design and construction process as well as completed buildings.

1.2 Background of the Study

Throughout history, the architect has been in a position that has constantly evolved, often centered upon leadership because the profession demands that an architect be multitalented in all building-related domains.

The relatively recent notion that technology belongs in one location and architecture

(design) in another has had a catastrophic effect on architecture (Banham, 1984). According to Peters (1992), the design-technology divide has had such a devastating effect that the real meaning of architecture is on the verge of being obsolete. According to Peters (1992), we have divided off all technical knowledge related to actually building what we design and it still continues as of today. As a result, we educate students who are competent communicators and thinkers as well as and form designers, but who lack communicating their ideas through technical drawings which is necessary for the building preparation.

It goes without saying that architectural education is not flawless. varied educators have varied meanings for teaching architectural design; each follows their own set of philosophies and beliefs and teaches in a unique way. According (Salama & Wilkinson, 2007), there is a great deal of variation in the subjects taught, the focus areas, and the instructional pedagogies used in various schools and even within the same.

The manner in which students approach learning has a significant connection to the manner in which they have studied and comprehended the main ideas of the subject matter in earlier years. This relationship holds significance in determining how they approach studying in the years to come and how effectively they learn (Iyer, 2015).

The significance of the initial drawings, sketches, schematic drafts, and series of images that attempt to study its context, as well as those that shape the graphic documentation enabling the building of architecture in every aspect, cannot be overemphasized in the development of any project. These early drawings, sketches, and schematic drafts already contain the first conceptual idea, clear and definitive, anticipating the documentation of the project and sensing some material, building, and physical circumstances. (Alba Dorado, 2017).

Thus, drawing is a contemplative tool that helps us visualize our ideas, define a framework to grasp, design, and define them, and communicate the core of our concepts by defining, fixing, and transforming them into something that can be constructed.

The most natural way to document architectural work is through drawing. A single line representing the building has extensive meaning, and it can communicate more effectively and in detail than verbal or written explanation. It is a piece of art that allows

a work to be moved in time and space. It conveys architectural information across linguistic boundaries.

The line that will carry out the "drawing" must be drawn clearly, with no room for question as to its length, width, thickness or type. Regardless of the line being created manually, with the use of sophisticated tools or with the aid of a computer, it makes no difference.

For a very long time to come, the most straightforward method to envision an existing or proposed structure will continue to be a drawing of the building drawn on the drawing sheet in accordance with universally accepted technical norms. The degree of detail distinguishes a technical drawing from a more informal drawing or sketch. A technical drawing provides detailed information of the entire object- from the layout to line to type to thickness to the building geometry, dimensions, and graphical annotations and symbols.

Therefore, this thesis explores how technical architectural drawing, which is part of the Architectural Drawing and Graphics curriculum, is taught and learned in a course. This aims to find challenges of the curriculum and approaches to improve students' understanding of the subject. Thus, it is possible to interpret this research as an effort to propose solutions for the problem of understanding Architectural Drawing and Graphics subject and its curriculum. The results of this study are expected to serve as a foundation for resolving the more significant issue of technical architectural drawing education in architecture, known as the "Design-Drawing schism." The results of this study should also have some impact on the manner in which Architectural Drawing and Graphics curriculum is being taught and learned with an improvement in the curriculum itself.

1.3 Statement of the Problem

Presenting future reality is the aim of the architecture drawing. It is a two-dimensional representation of architectural elements i.e. drawing (walls, columns, roof etc.) and composition of identifiable symbols or annotations i.e. graphics (door/window openings, type of door/windows, material indications of brick, stone, concrete, glass

etc.). Savitribai Phule Pune University, Pune (SPPU) has adopted similar terminologies for the subject of architectural graphics and drawing – I & II subject which is taught in the First year of Bachelor of Architecture course.

According to (Dytoc, 2007), educators face communication and classroom culture challenges when trying to stimulate the minds of architecture students. Being a creative field, architecture demands greater cognitive openness from its students in an attempt to mimic creativity. This type of mind-opening and illumination is vital while representing their ideas and concepts.

The importance of representing the creative ideas in the form of architectural drawing cannot be overemphasized, yet there appears to be a need to reconsider how architectural drawing is taught technically, given the nuances and perspectives of both architects and students.

During the past few years, architectural education has consistently stressed the necessity of re-examining pedagogy of architectural drawing and graphics as curriculum. This necessity became increasingly apparent due to many reasons; one of them could be the conventional curriculum, the need of practicing architects as teachers, students' approach, extensive use of software and many others.

The reviews of literature reveals that several attempts or approaches are being made to frame the pedagogy mainly for architectural design but very rarely for technical subjects and for architectural graphics and drawing subject.

Thus, this study seeks to identify the crucial aspects of the curriculum and recommend parameters for an instructional model that might be used to teach the subject of architectural graphics and drawing in an effective manner. It looked at different creative and non-traditional ways to organize instructions and tried to figure out what factors might be defined and standardized. This study looked at the curriculum structure and conventional methods of teaching this subject that are already in use in order to appropriately address the larger issue.

The following research questions were established to guide the research's path:

a. Which are the crucial aspects of the content of the curriculum of architectural graphics and drawing I & II at various universities and especially Savitribai Phule Pune University?

b. How is the architectural graphics and drawing subject taught, and what is the students' level of understanding?

c. How significantly do teaching methodology and the curriculum affect the learning outcome of the students?

1.4 Aim of the Study

- The aim of this study is to explore the teaching and learning of the subject of architectural graphics and drawing and to analyze the Savitribai Phule Pune University curriculum for the architectural graphics and drawing subject with respect to its content and evaluation.
- To make students understand the correctness of the subject of architectural graphics and drawing.

1.5 Objective of the Study

- To identify the aspects of the subject, architectural graphics, and drawing.
- To identify and recommend the efficient models of teaching for architectural graphics and drawing.

1.6 Justification – Need for the Topic

First, other professions are challenging the architect's traditional status as the leader of the other related professions, as observed by (A. O. Olotuah, 2016) According to (Iyer et al., 2015), this declining leadership position is an indication of the design-technology divide that is pushing architecture towards waning. It seems that all professional content related to building- what we design, is highly specialized, meaning that architecture students are better educated to design than to build. One of the reasons is the lack in communicating the design with necessary technical construction drawing correctly.

Therefore, the study's justification stems from its effort to identify the critical aspects and the discrepancies in students' technical drawing so that the subject, architectural graphics and drawing, could bridge the gap between design and construction.

Because of the increasing discontent with the efficiency of its instruction in architectural institutions, rethinking on teaching architectural graphics and drawing through situational analysis becomes important. It starts with the analysis of content of the curriculum of Savitribai Phule Pune University and the pedagogy to be imparted on the first-year students by the teaching faculties.

Technical subjects in architecture are a very important part of the architecture curriculum. Construction technologies deal with various technologies applicable to build the building. The physical output of design is in the form of any building or structure which must withstand to accommodate the user safely.

Architectural drawing and graphics as a subject is the language of architecture. A good design cannot be expressed and evaluated properly if it's not correctly represented by the student and then understood by the teacher.

Following points support the Justification of the topic-

Firstly, as per Indian schooling systems and curriculum, there is no curriculum related to architecture till 12^{th} grade. The students taking admission in the first year of architecture are directly exposed to the totally new curriculum of design and technical subjects. Therefore, the purpose of this thesis was to investigate the fundamental causes of this discrepancy and to identify methods that could lead to a paradigm change in the teaching approaches of architecture.

Secondly as stated earlier, architectural drawing and graphics is a universal language of communication for architects and the contractors, which is very specific and technical. Any wrong communication in design and construction detail leads to misinterpretation of the design by the other consultants and the contractors. This study therefore attempted to address issues that directly impact on construction of the buildings.

In order to create an instructional model that would be sensitive to the prejudices present in the architectural industry, this study aimed to determine relevant

characteristics, such as the teaching methodology of the teachers, the professional needs of practicing architects, and the level of understanding of students.

Lastly, this study is significant since the global education system continues to be evolving. One significant change is the transition from a traditional teacher-centric educational system to student-centered learning (SCL). The degree of acceptability of student-centered learning is a very successful teaching strategy that was highlighted by (Gonzalez et al., 2010). Considering that teaching architectural graphics and drawing is a fundamental component of architectural education and is necessary to bridge the knowledge gap between professional practice and academic theory, it should not be neglected. This research intends to solve the problem of imparting valuable knowledge to students and integrate drawing and graphical instruction in the framework of student-cantered learning.

1.7 Scope of the Study

Two important components of the undergraduate architecture program—specifically, the subjects of architectural graphics and drawing—are the focus of the current study. The first component is a thorough examination and analysis of the current curriculum for this subject as it is taught at Savitribai Phule Pune University (SPPU), Pune. This entails assessing the syllabus's organization, subject matter, and teaching methodology in light of the guidelines set forth by the Council of Architecture (CoA), India's statutory regulatory authority for architectural practice and education. In order to determine the curriculum's strengths, weaknesses, and possible areas for improvement within the current framework, the study looks at how closely it complies with industry requirements and national academic standards.

The study's second component, which focuses on pedagogical methods, is to determine, evaluate, and suggest an efficient teaching strategy for the instruction of architectural graphics and drawing. The subject's foundational significance in establishing critical skills like technical drawing and architectural communication means that the quality of its teaching strategies directly affects students' academic and professional growth. The study examines a number of teaching techniques in this section, including conventional

studio-based learning.

The ultimate goal is to improve educational outcomes by putting forth a strong, flexible teaching model that may be used in architectural programs.

1.8 Limitations of the Study

SPPU affiliation: The study is limited to the curriculum and academic institutions associated with Savitribai Phule Pune University (SPPU). Because there are 23 architectural colleges in Maharashtra that are part of SPPU—the greatest number of institutions using a single curriculum and assessment system—this is noteworthy. This emphasis guarantees uniformity in the information gathered from these universities.

Target Group: The study's target group is restricted to first-year students. In accordance with the SPPU curriculum, the first two semesters of the Bachelor of Architecture (B. Arch.) program are dedicated to teaching architectural graphics and drawing. By focusing on this particular cohort, the study hopes to collect information pertinent to the fundamental phase of architectural education.

Emphasis on Hand-Drawn Exercises: The study especially looks at architectural graphics and drawing exercises that are hand-drawn. Digital drawing and software applications are not included in the current study because they are introduced in the second year of the B. Arch. curriculum. This restriction makes it possible to examine traditional sketching methods in detail.

Academic Stakeholders: This study is limited to inputs from the Academic stakeholders, i.e., Students and Teachers only. Professional stakeholders such as Contractors, Architects, etc. are not part of this Study. Being an exploratory study, one can carry forward this study with the inputs from Professional stakeholders.

1.9 Structure of Thesis

When we discuss a thesis, we are referring to a comprehensive document that summarizes research on a particular subject. The functions of the various components of a thesis are explained in this article. Let's take it one step at a time.

1.9.1 Chapter 1: Introduction

The introduction is the title of the first chapter. This serves as the author's introduction to the book, explaining the plot. In this instance, the research's primary argument or point is summarized in the introduction. Additionally, it outlines the study's aims and objectives. The researcher's aims are the precise actions they will take to accomplish their goals, whereas their goals are what they want to accomplish. An objective might be to examine various architectural graphics and design curricula and offer suggestions for improving comprehension of the subject, for instance, if the objective of the study is to determine how to create pedagogy for efficient teaching of the subject.

In addition, the problem that the thesis seeks to solve is mentioned in the introduction. Justification entails elucidating the significance of this matter. This study examines the language of architecture communication, with the argument that it is important to study since it impacts the profession and employability.

1.9.2 Chapter Two: Review of Literature.

Literature Review is devoted to the study of pertinent literature. Here, "literature" refers to the research and publications already done on the subject. This chapter examines the views of various researchers on the matter. It's like compiling every book and article on a topic to see what has already been written about it. This makes it easier for the researcher to comprehend what has been accomplished and what knowledge gaps still exist.

1.9.3 Chapter Three: Methodology

The research techniques employed are described in the third chapter. Information is gathered by the researcher using research procedures. They could perform experiments, interviews, or surveys, for instance. The reason this chapter is significant is that it outlines the researcher's strategy for collecting information to address their issues.

1.9.4 Chapter Four: Result Analysis and Discussions

The findings are presented by the researcher in Chapter 4. Findings are the results of the study, or what was found following data collection.

Analyzing these results entails closely examining them to determine their significance.

For instance, if the study revealed that students' comprehension of the subject is inadequate, the analysis would look into the reasons behind it.

The consequences of the findings are examined in the discussion section. The potential repercussions or impacts of the study findings are known as implications.

The study demonstrates that a particular policy or method aids students in better understanding the subject, it may be inferred that teachers should use these pedagogies and that authorities should apply the policies pertaining to the curriculum and assessment procedure in order to enhance students' comprehension.

1.9.5 Chapter Five: Conclusion and Recommendations

Chapter five, the last chapter, offers recommendations and a conclusion. The key findings and conclusions of the study are summed up in the conclusion.

The suggestions derived from the results are called recommendations. If the study reveals, for instance, that a certain teaching approach or curriculum modification is beneficial, it may be suggested that colleges adopt that approach and make the necessary curriculum modifications.

To summarize, a thesis is structured to lead the reader through the entire research process, from comprehending the issue to talking about the findings and making recommendations for further research. To create a comprehensive picture of the study done, each chapter is essential.

1.10 Definition of Terms

Pedagogy: the method and practice of teaching, especially as an academic subject or theoretical concept.

Effective teaching is essential for helping students comprehend and retain the material they are taught. For instance, to make a lecture more interesting and memorable, a teacher may employ storytelling.

To encourage pupils to learn from one another, a teacher may assign group projects. This approach fosters teamwork among students. Using practical exercises, like as science labs, is another example that enables pupils to learn by doing rather than merely hearing

Learning outcome: is a mixture of knowledge, skills, abilities, attitudes and understanding that an individual will attain as a result of his or her successful engagement in a particular set of educational experiences.

Teachers may more effectively structure their classes and determine if students are learning through the application of learning outcomes. For both teachers and students, they offer clearly established goals.

Educational Research: Educational research is a careful, systematic investigation into any aspect of education.

Assessing what works and what doesn't in teaching is made easier by educational research. It offers evidence that can enhance instructional strategies and improve student learning.

Learning: Learning is a relatively permanent change in behavioural potentiality that occurs as a result of reinforced practice (Alavi & Toozandehjani, 2017) Learning is "the acquisition of habits, knowledge, and attitudes. It involves new ways of doing things, and it operates in an individual's attempts to overcome obstacles or to adjust to new situations. It represents progressive changes in behaviour…. It enables him to satisfy interests to attain goals" (Crow and Crow, 1973)

Thus, the process of gaining new information, abilities, values, or attitudes via education, experience, or study is known as learning. It involves practice or interactions with the environment that lead to somewhat lasting changes in behavior or knowledge.

Teaching: It's a structured process where the instructor engages with the students to provide what he or she believes the students should learn based on their individual learning needs.

Teaching assists others in learning through mentoring, instruction, or guidance. Sharing values, information, and abilities with students is accomplished using a variety of techniques, such as practice, conversation, explanation, and demonstration.

Research in Architecture Pedagogy: It examines how architecture is taught, learnt, and comprehended. It focuses on enhancing studio culture, curriculum design, teaching strategies, and the influence of technological advances and critical thinking on the professional growth of future architects

1.11 Important Domains of Research in Architecture Pedagogy:

Studio-Based Learning:

Foundation of architecture education.

Studies examine how studio settings affect critique, creativity, and teamwork.

Curriculum Development:

Examines the integration between sustainability, technology, history, and design philosophy.

Frequently examines how to achieve a balance between technical training and intellectual understanding.

Digital Tools and Technologies:

Significance of software like BIM (Revit), CAD, VR/AR, and parametric design software (Grasshopper, Rhino).

Studies examine how design thinking and learning are influenced by digital literacy.

Interdisciplinary Approaches:

Promoting integration with environmental science, sociology, urban planning, and the arts.

Encourages design education to address problems holistically.

Critical Pedagogy:

Emphasizes decolonizing architecture education, social justice, and inclusivity.

Queries with narratives that are being taught and illustrated.

1.12 Anticipated Outcome of Knowledge of AGD.

The study of architectural drawing and graphics is anticipated to produce a number of noteworthy results that advance students' understanding and proficiency in this area. The expected results and expectations are as follows:

• Improved Techniques Understanding: It is anticipated that students would acquire a thorough understanding of diverse architectural graphics and drawing techniques, such as scale, annotations, and various graphic projection techniques including orthographic, axonometric, and isometric. For design concepts to be communicated successfully, this fundamental understanding is essential.

• **Enhanced Communication Skills:** The capacity to accurately convey design drawings is one of the main results. In order to meet the demand for better communication in architectural education, new approaches to architectural drawing and graphics will be defined. This will enable students to communicate their design goals more effectively and clearly.

• **Bridging the Design-Drawing Schism:** The gap between design concepts and how they are presented in drawings is known as the "Design-Drawing schism" in architectural education, and it is the focus of this study. It is anticipated that by emphasizing this problem, the curriculum will promote a more integrated method of teaching architectural graphics, resulting in a more coherent comprehension of representation and design.

• **Curriculum Improvement:** It is expected that the research will influence the teaching of architectural drawing and graphics, which will enhance the curriculum. In order to better meet the requirements of students and the demands of the industry, this entails improving the course objectives, content, and outcomes.

• **Critical Thinking Development:** As students work with architectural drawings and graphics, it is anticipated that they will acquire critical thinking abilities. Their capacity to critically think about design and its implications in practical contexts is improved by this process of evaluating and interpreting drawings.

• **Integrating Qualitative and Quantitative Data:** Students will get a comprehensive understanding of architectural graphics and drawing through the integration of both qualitative and quantitative data in the curriculum. They will be better able to comprehend the technical and artistic aspects of their work as well as its larger context with this method.

These expected results demonstrate the value of a well-designed architectural graphics and drawing curriculum that aims to give students the abilities and information they need to be successful in their future employment.

1.13 Chapter Summary

An outline of the study's objective and scope was described in this chapter. The research challenge was defined in relation to the efficient teaching of the subject of architectural graphics and drawing, and to identify the curriculum content. The aim of this study was therefore to explore the teaching and learning of the subject of architectural graphics and drawing and to analyze the architectural curriculum with respect to its content, evaluation and outcome. The study attempts to justify that teaching architectural graphics and drawing is a fundamental component of architectural education and is of vital importance to bridge the knowledge gap between professional practice and academic theory.

This chapter focuses on the scope and limitations of the research which is within the framework of Savitribai Phule Pune University curriculum for First year Bachelor of Architecture students.

CHAPTER - 2: REVIEW OF LITERATURE

2.0 Introduction

Enhancing learning approaches/methodology/pedagogy is not new to architecture, but as the technical aspect of a creative course, designing ingenious approaches to the teaching of architectural graphics and drawing subject in the Architecture curriculum is not only desirable but absolutely necessary.

The section aims to investigate and convey the current state of knowledge on the topic of this study. It seeks to conduct a literature review on architectural education, educational research (learning sciences and technologies), and teaching of architectural structure. The importance of this chapter stems from its attempt to identify untouched/ unanswered/undiscussed areas in terms of the cause and effect of the gaps in the literature that this study sought to fill.

The review begins with an overview of the Concept of Educational Research. This is followed by a review of the curriculum of various universities about this subject. Further to that, various research papers pertaining to this research were reviewed and analyzed to identify the research gap. The aim of the analysis is to define various aspects of architectural education and their significance in the architecture profession. In addition to that, several methods of instruction in architectural drawing and graphics are offered, followed by a discussion of pertinent theories with the goal of grounding the subject within an established framework of knowledge. This chapter concludes with an overview of literature gaps.

2.1 Flow Chart for Review of Literature

A systematic approach has been implemented for the research review of the literature. Various stages implemented are described in the flow chart shown below. Every stage is further discussed in detail to identify the research gaps.

Various aspects of the literature review, such as Curriculum, Methodology, and Theoretical framework, are being discussed.

The flow chart is shown below:

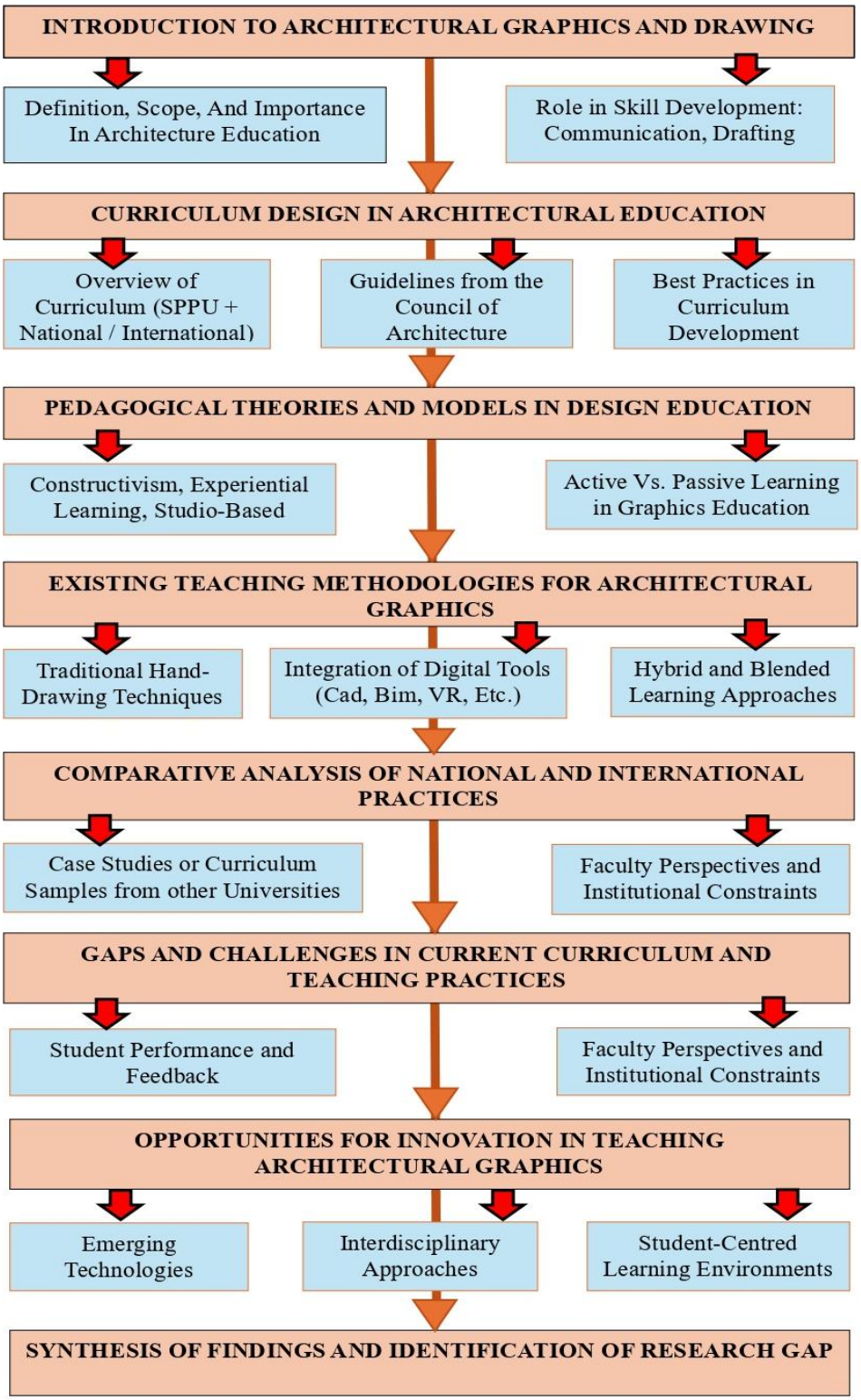


Figure 1 Flow chart Review of Literature.

Source: Author

2.2 Concept and Theory of Educational Research:

2.1.1 What is Educational Research?

Educational research is broadly characterized as research of the behavior of students, teachers, administrators, parents, and other community members who engage with educational institutions. The term behavior refers to a wide range of phenomena including learning, beliefs, skills, abilities, interests, methods, techniques, and feelings. "Learning" has been a focus of research in education across several decades. Since education is fundamentally concerned with teaching and learning, the primary goal of educational research is to uncover strategies to improve student learning.

2.1.2 Definition

Educational research is a comprehensive and methodical research into any area of education. The French word "recherche" implies to travel through or survey.

2.1.3 Purposes of Educational Research

1. To acquaint students with the nature of educational research, including its objectives, types, and significance.

2. To offer students knowledge on how to identify, understand, and evaluate educational research so that they can become informed users of it.

3. To offer guidance on the principles for conducting educational research, including problem selection, resource utilization, and structuring the project etc.

2.1.4 Types of Educational Research

There is no clear consensus on the sorts of educational research that exist. This primer will cover the following types:

Ethnographic - Ethnographic approach aims to articulate social interactions and collective behavior. It makes use of qualitative methods, particularly close observation and thorough documentation of social interactions and occurrences.

Historical - Historical research is an endeavor to understand and characterize historical circumstances. Oral histories and written records are examples of qualitative data that

are typically used in it.

Descriptive - Descriptive educational research writing aims to explain and characterize current circumstances. It is based on both quantitative and qualitative information obtained from written records, in-person interviews, exam results, surveys, and other sources.

Correlational - Correlational analysis examines for correlations or draws predictions. It is based on quantifiable data that can be correlated to demonstrate a relationship among variables, such as test scores, grade point averages, and attitudinal measures.

Action and evaluation - Action and evaluation research aims to improve a given context (such as a school or district) by assessing the worth of a program, process, or product. The objective of action and evaluation research is not to extrapolate findings to a wider population.

Causal Comparative - Causal Comparative research seeks to investigate cause-and-effect relationships in which the causes are already present and cannot be changed. The study uses both qualitative and quantitative data, including written papers, interviews, and test results.

Experimental - Experimental research seeks to investigate cause-and-effect relationships in which causes can be changed to produce various types of consequences. It is heavily reliant on quantitative data, such as test scores and performance metrics. (Mrs. Manashee Gogoi, Dr. Pranab Barua 2019)

Type	**Purpose**
Qualitative	To offer comprehensive narrative explanations of things using terminology that enhances comprehension.
Quantitative	To apply numerical descriptions of phenomena to address certain queries or theories.
Basic	To expand one's knowledge and comprehension of phenomena.
Applied	To resolve practical educational issues.
Evaluation	To make a decision about a program or activity.

Action	To enhance practice in a classroom.
Non-Experimental	To articulate and anticipate outcomes without changing the variables that affect them.
Experimental	To ascertain a causal relationship between two or more occurrences by means of direct manipulation of variables which influence behavior or performance in the classroom

Figure 2 Type and Purpose of Educational Research

Source: Author

2.2 Architectural Education: Design Education and Technology Education

Notwithstanding the admirable efforts made in the field of architectural education, it seems that more emphasis has been placed on design education than technological education. The definition of architecture as a creative endeavor in the built environment is "the art and science of creating and constructing communities, open spaces, or buildings in accordance with aesthetic and functional standards" (Louis et al., 2025). It accomplishes its objectives through two mediums, namely design and technology, which are not mutually incompatible. The greatest architectural creations throughout history, including modern buildings, have been those that have expertly and delicately combined the two threads. In this sense, it is crucial for architectural education to address and adequately prepare students for both design and technological education.

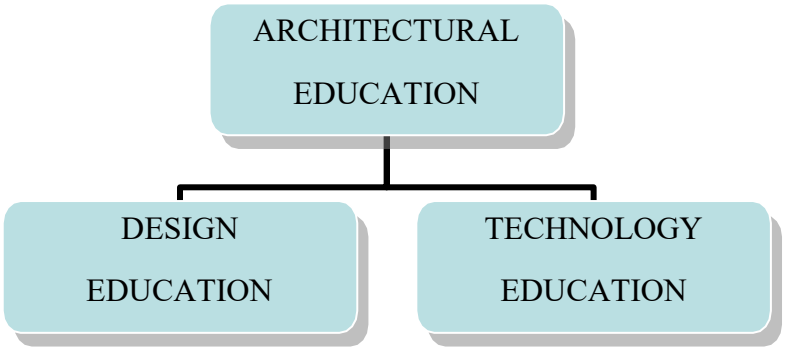


Figure 3: Stratification of Architectural Education

Source: Adapted from Connector, (2000)

While the study of the materials and processes used to create such shapes has traditionally been emphasized in technology classes, the study of architectural forms generally takes place in the design studio (Adolph, 2016). As seen in Figure 2, architectural education may be divided into design education and technological education.

However, it is very necessary that the design ideas and the technological concepts must be represented correctly in the form of graphics and drawings.

2.3 Architectural graphics and drawing as a technical subject

In the subject of architectural graphics and drawing, term graphics represents the symbols, annotations, characters, and lines that are used to represent the building elements graphically, e.g. doors, windows, materials like brick, stone, concrete, glass, etc. and various graphical symbols for various services like HVAC, plumbing and drainage, electrical and so on. These graphics adhere to a specific measuring scale in order to maintain consistent detail throughout the drawing. The term drawings represents fundamental technical drawings that detail the structure of a building. Many building features rely heavily on architectural drawings. It is primarily used to communicate the design to the client, for construction purposes, estimation, and so on. Architects and others use architectural drawings for a variety of purposes, such as transforming a design concept into a convincing proposal, communicating ideas and concepts, persuading clients of a design's merits, enabling a building contractor to construct it, keeping track of completed work, and creating a record of an existing building. Conventions for architectural drawings include specific perspectives (floor plan, section, etc.), sheet sizes, scales, annotations, and cross-referencing. Traditionally, drawings were created using ink on paper or some comparable surface, and any necessary duplicates were meticulously prepared by hand. Drawing on tracing paper became common in the 20th century, which improved the efficiency of making mechanical reproductions. The advent of the computer significantly changed how technical drawings were designed and produced, almost eliminating the need for manual drawing and introducing new forms based on organic curves and intricate

mathematics. Currently, the great majority of drawings are produced using CAD software.

The significance of architectural drawings cannot be overstated. It has several advantages that can benefit all of its stakeholders in some way.

2.3.1 Understanding the space

Correct architectural drawings provide a clear and accurate understanding of the space in which the work will be performed. Looking at the drawings, one can thoroughly analyze the requirements and better utilize the space.

2.3.2 Aids in persuading clients

Showing the drawings to clients can help them get hired. Clients can get a quick overview of the various elements of the building and provide feedback.

2.3.4 Allows to explore new ideas

You will have a better view of the plan while working with the architectural drafting. Details can be added to the plan. You can contribute more ideas to make it better.

2.3.5 Improves the construction process

Architectural drawings provide an excellent starting point for the entire construction process. It simplifies and smoothens out the procedure. This allows workers to work more efficiently on various aspects of construction.

2.3.6 Summary

Architectural Design, as a core subject of the architecture curriculum, necessitates a careful teaching and learning approach. Because of the current global scenario and the demand from the building industry, architecture is no longer limited to "Design" by an Architect. Other supporting subjects, besides Design, reflect the complexities of architecture and are crucial.

As a result, the architecture curriculum is divided into two core subjects: design subjects and technical subjects (Architecture = Art + Technology). It is critical to integrate technical subjects with the Design.

Building technology, materials & construction, architectural graphics and drawing, working drawing, quantity survey, building services, and all the other technical subjects use the same language. Construction materials and technology may differ depending on the need and type of structure, but the representation of everything, whether design, technology, or services, remains consistent throughout the world. This is represented in an architectural drawing using specific norms / guidelines / standard graphics, etc. to communicate the same meaning to an architect, a consultant, a contractor, a mason, and the client.

It is observed that the subject “Architectural Drawing and Graphics” which is the language of communication, is not followed correctly by architecture students. This in turn communicates the wrong message to the teachers and the other stakeholders.

Thus, there is a need to define the new approaches to Architectural Drawing and Graphics which will in turn help to get better output in communicating correct design drawings.

2.4 What is Learning

Prior to starting the teaching process, it is crucial that educators understand the meaning of the term "learning."

Learning is the process of gaining experience, knowledge, skills, and values by combining the various forms of information that we interpret to determine what has to be done and how to accomplish any activity. Learning causes alterations in an individual's current behavior.

Learning begins when the child is still in the mother's womb and requires constant practice or instruction to result in a long-lasting behavioral change. Learning allows people to develop new behaviors in addition to altering their current ones.

2.4.1 Types of Learning

We can classify Learning in different types, such as:

1. Informal Learning
2. Non-formal Learning
3. Individual Learning

4. Group Learning
5. Motor Learning
6. Verbal Learning
7. Discrimination Learning
8. Cognition Learning
9. Sensory Learning

2.4.2 Factors Influencing Learning

There are three factors that influence learning. These factors are:

1. Psychological individual differences of learners
2. Teachers' enthusiasm for classroom learning
3. Environment and other factors

2.4.3 Significance of Learning

- Learning helps us understand the basic necessities of life.
- Learning helps to adapt to a new environment.
- Learning helps respond to dangers and fear.

2.4.4 Factors Affecting Learning

In any learning task, the learner is the most important person. The following are the elements that influence the learning process.

1. Learner's physical and mental health
2. The basic potential of the learner
3. The level of aspiration and achievement motivation
4. Goals of life
5. Readiness and will power

2.4.5 Theory of Pedagogical Approaches: (Learning Methods)

Various teaching methods were reviewed from the books, research papers, and to study the pedagogical approaches. The following are more relevant to the research. These methods are learning methods that are stated below.(Hills, 2017)

Method 1: Learning by Doing.

Students must be able to experiment with new real-world skills in a guided setting. Instructors should be present to monitor pupils and recognize when a student is having difficulty, as well as the cause of the difficulty. They should be ready to answer any questions, mistakes, or omissions that a student may have while exploring.

Method 2: Incidental Learning.

Students can acquire things through implicit instruction without the requirement for explicit instruction. Instead, teachers should let students determine their own objectives and provide them with tools that will let them learn the essential information "in passing." It is the responsibility of course designers to construct contexts in which factual information can be organically gained.

Method 3: Learning by Reflection.

Instructors should support their pupils in learning how to ruminate over their ideas in a useful way. Students should learn to ask and pursue interesting questions through conversation with their teachers in order to improve their understanding as creators.

Method 4: Case-Based Teaching.

Teachers must provide students with scenarios that show how to address expectation failures when they occur while they are working on projects.

Method 5: Learning by exploring.

Learners ought to have access to a variety of experts. The perspectives of the many experts should be compared and contradicted by the students, who should have rapid and easy access to these specialists.

Teaching Method 6: Learning by arguing.

Instructors must be ready to adopt many viewpoints. A teacher should be able to react to a student's perspective by offering an argument either in favor of or against it. The instructor should not be viewed as the last arbiter, but as a tool that students may use to hone their own concepts. (R. E. Slavin, 2006), (J. Bergmann and A. Sams, 2012)

2.4.6 Summary:

Effective teaching requires the application of an appropriate method by the teacher. There are many different teaching styles available to a teacher. The instructor can

design their own lesson plans, use other teachers' lesson plans as collateral, or find lesson plans online or in publications. A teacher must take into account the learning objectives, the environment, and the pupils' existing knowledge while choosing a teaching strategy. There are many different ways for students to learn and show what they know. Teachers commonly employ strategies that take into account different learning styles in order to aid pupils in remembering knowledge and enhancing understanding. To guarantee that all students have equal access to educational opportunities, a number of initiatives and techniques are used.

There are several ways to carry out a lesson plan, such as through asking questions, providing explanations, modeling, working in groups, and giving examples.

2.5 What is Teaching (Soliman, 2017)

An essential component of the educational process is teaching. It is a set of activities designed to promote learning. Its unique purpose is to spread knowledge and foster comprehension and proficiency. The teacher and students engage in an interaction during instruction that helps the pupils focus on the objective.

The process of teaching typically occurs in a classroom setting. It is a structured procedure whereby the instructor engages with the students to provide what he or she believes the students should learn in accordance with their learning requirements.

The following categories apply in the teaching-learning process:

- Traditional Method: Teacher Centered
- Modern Method: Facilitator (student-centered)

In the current environment, the conventional method has been replaced by the modern method.

2.5.1 Difference Between Teaching, Instruction, and Training

Teaching

- Education is a more intricate process.
- It is theoretical
- It changes based on the learning style of the student.

- Instruction is founded on individual learning differences;
- It explains how something is done.
- It covers the cognitive, emotional, and psychomotor learning domains.
- Instruction is a carefully organized activity that takes place in a classroom.

Instruction

- To achieve the goal, a specific teaching approach must be used.
- It varies based on the objectives and requirements of the students.
- It covers a range of educational resources that improve learning.
- Instruction offers guidance for the teaching-learning process.
- It might conclude with the classroom learning procedure.
- Learning that is teacher-centered
- It must be adhered to rigorously in order to complete a task.

Training

- It is focused on practical application.
- It's a subset of teaching
- It's to prepare for a skill test
- It emphasizes a learner's skills and talents
- Training is carried out by drill, instruction, or discipleship
- It reveals a person's latent talents and abilities
- It quickly improves skills and abilities

2.5.2 Nature of Teaching

- Learning is facilitated by the process of teaching.
- Teaching is the specific use of information, abilities, and qualities intended to offer a distinctive service that addresses the educational requirements of both the person and the community.
- Teaching emphasizes the formation of values and coaches students in their social interactions in addition to giving them learning opportunities to accomplish curriculum outcomes.
- Teachers utilize techniques that help students cultivate a good self-concept.

- Teaching is an all-encompassing activity that uses a methodical approach to achieve the objectives of education.
- The teacher is one of the key players in this goal-driven process.

2.5.3 Phases of Teaching

The phases of teaching are the various stages that make up the teaching process.

The instruction can be split into the following three stages:

- Pre-Active Teaching Phase
- Interactive Teaching Phase
- Post-Active Teaching Phase

Pre-Active Teaching Phase

- The planning of instruction is carried over into the pre-active phase.
- The activities a teacher completes before class are included in this phase.
- During this phase, the classroom is planned, techniques and methods are adopted, the chosen subject is sequenced, teaching aids are used, and so forth.

Interactive Teaching Phase

- The second phase involves carrying out the plan, giving students learning opportunities in appropriate settings such the classroom, lab, outdoor space, or library.
- All of the tasks that a teacher completes after class are grouped under the teaching phase that is interactive.
- These exercises typically focus on how the material is presented and delivered in a classroom setting.
- The instructor gives students lots of verbal stimulation, explains things, asks questions, listens to their answers, and offers advice.
- Activities in this phase include class assessment, learning about prior knowledge, interest, attitude, etc., by asking probing questions and conducting a diagnostic section, and presenting the stimuli, feedback, and reinforcement.
- It serves as the platform for real instruction.

Post-Active Teaching Phase

- The post-teaching phase consists of the teacher's activities, such as evaluating the results to identify students' difficulties, particularly in understanding particular areas, reflecting on the teaching on their own, and determining what adjustments should be made to the system for the following instructional period.
- During this phase, which summarizes the teaching task, the teacher addresses the students' questions both orally and in writing to evaluate their conduct and accurately assess their abilities.

2.5.4 Levels of Teaching

Different subject content might be presented by the teacher during the teaching-learning process. The teaching levels could be divided into the following categories:

- Memory Level of Teaching
- Understanding Level of Teaching
- Reflective Level of Teaching

Memory Level of Teaching

The presentation of the facts and information, as well as its cramming, are the main points of attention at this level. The memory level of instruction is exemplified by Herbart.

Understanding Level of Teaching

Prior to teaching at the understanding level, one must first teach at the memory level. When assessing the level of instruction, the instructor emphasizes the importance of helping the students comprehend the facts, generalizations, and principles.

Reflective Level of Teaching

It encompasses both the understanding level and the teaching memory level. Teaching at a reflective level is "problem-centered." This makes the classroom setting appropriately open. Because the teacher raises such a dilemma in front of the students, they get so motivated and engaged that they begin to construct and test hypotheses in order to solve their problems.

2.5.5 Methods of Teaching

In teaching, we often employ two methods or strategies:

- Teacher-Centered Approach
- Student-Centered Approach

The teacher-centered approach

The most significant figure in this approach is the teacher. The main function of students, who are seen as "empty vessels," is to passively absorb knowledge through lectures and direct instruction with the ultimate purpose of testing and evaluation. The main responsibility of educators is to provide knowledge and information to their students. According to this approach, instruction and evaluation are two distinct rights. A test assessment that has been scored is used to gauge student learning.

Student-centered Methodology

In this approach, teachers are viewed as authoritative figures, but both teachers and students actively participate in the learning process. Coaching and facilitating learning and general content comprehension are the main responsibilities of the teacher.

2.5.6 Principles of Successful Teaching

The teacher when comes to the classroom must keep in mind the following principles and must also try to be prepared to follow the principles of -

1. Definite Aim
2. Activity
3. Motivation
4. Interest
5. Linking with Life
6. Individual Differences
7. Selection
8. Planning
9. Division
10. Creativity and Recreation
11. Democratic Dealing

12. Revision
13. Suggestiveness
14. Progressiveness
15. Co-operation

Principle of Definite Aim:

Beginning lessons with a clear objective is best. The teacher may veer off course without a clear goal, and his instruction may also lack consistency and preciseness. If the class is randomly and aimlessly planned, the pupils won't learn much. Even the best education would fall short if it lacked a clear goal. A clear goal is very beneficial to both the teacher and the students. It makes instruction and learning engaging, efficient, accurate, and definite.

Principle of Activity:

If the pupils do not actively engage in the lesson, teaching is unsuccessful.

Learning becomes lively and quicker if the pupil is made active physically as well as mentally. If the learner actively engages in the learning process and practices the material being taught, teaching can be facilitated. Children learn their best through self-activity but that activity must be psychologically sound. By putting students in real-world settings, experiential learning eliminates the rigidity of the courses. The pupils completely participate in the activity and get both qualitative and quantitative knowledge. Only the knowledge he/she acquires via self-activity becomes a part of his/her life. Hence, instruction should be designed to give students the most opportunities possible.

Principle of Motivation:

The motivational principle is seen to be crucial for a good teaching-learning process. If the pupils are genuinely motivated for the class, it is claimed that half the battle is won. The fuel for the mind's engine is motivation. In addition to encouraging learning, motivation also makes it possible. It piques a child's interest, and if he/she is genuinely interested, he/she is attentive, which leads to successful learning. So, teachers should adequately engage pupils by designing engaging learning environments.

Principle of Interest:

Principle of Interest, just like the principle of motivation, is very important from the learner's point of view. It is totally depending on the teacher how to make any topic interesting and if the students arouse interest in a certain topic, they learn it faster and effectively. The teacher should try to keep the interest in the students alive. If at any stage the students lose interest in a certain topic, they will not take their attention off the subject but also tend to develop a dislike for the teacher. Creating interest will facilitate the process of learning.

Principle of Linking with Life:

Real life situations have to be linked while teaching the students to facilitate learning and to make them aware of similar situations. Students learn the fundamentals when they are linked to life situations. The portion to be taught if personified with a live example becomes simplified and easy to understand and will also be easy to recall and recapitulate.

Principle of Recognizing Individual Differences:

Each individual has their own thinking and views. Each individual has their own perception of things and their own views and outlooks. Effective teaching is that which recognizes individual opinion and appreciates and encourages the thoughts as long as it is in the right path. Students can go astray and it is important that they are brought to the right and relevant objective. It is rightly said that, "The purpose of a teacher is not to mold students into his/her own image, but to mold students into their own image."

Principle of Selection:

Successful and effective teaching has to be well planned and the teacher has to be very selective in his/her approach and examples. The teacher should carefully select his/her order of topics to be covered and they should be well organized and associated with carefully selected examples. The examples and points should be precise, simple and in relevance with the subject matter.

Principle of Planning:

Successful teaching is not possible without good and effective planning. The subject teacher needs to plan the entire subject as per the topics to be covered with respect to

the number of classes to be undertaken. Even the topic to be covered in one class needs careful planning, the examples, exercises and assignments should be planned and taken keeping in mind the subject relevance and objectives. The teacher knows best what is ideal and best for the learner and the planning is done accordingly.

Principle of Division:

Every teaching needs careful planning and in the process of planning comes careful division of activities, subject matter and even the lecture needs to be carefully divided as per time available and as per the weightage of easy and difficult topics. Easy topics may need less time and difficult topics may need more time, talent of teaching and tact of the teacher.

Principle of Creativity and Recreation:

Successful teaching brings joy to both the teacher and the students. Work becomes its own reward for the teacher, and the students take full advantage of it. Formal teaching should not be done on a regular basis. It should inspire children to be creative. Successful teaching is a source of creativity and recreation. It instills in the students a desire to be creative and engages them in activities that they enjoy.

Principle of Democratic Dealing:

Teaching definitely involves a considerable amount of freedom to be given to the teacher so as to allow the teacher to deal and adjust the teaching procedures and activities as the teacher feels best suitable for the students. But the same needs to be checked and a healthy teacher- learner environment has to be created for the betterment of all. The teacher should not differentiate and be impartial with students. The teaching should be free from dictatorship.

Principle of Revision:

Effective teaching needs and involves a revision of the taught subject matter. It is a good practice to revise whatever is taught after the class is over to help the learner to recapitulate the important points and also to brush up the taught matter. The psychomotor activities should also be given at the end of every unit taught so that the learner has a revision of the taught and the teacher will also get feedback of whether the student has achieved the objective of teaching. Revision can also be in the form of

questions from both sides to achieve teaching and learning.

Principle of Suggestiveness:

Suggestion rather than dictation is used in good teaching. The military spirit is not conducive to a well-run classroom. The teacher suggests activities, materials, and modes of response. Suggestion aids in gaining student cooperation. Good teachers do not give orders; instead, they make suggestions, which the students follow. As a result, in good teaching, a teacher makes suggestions to students about doing or not doing something.

Principle of Progressiveness:

Education needs to be progressive. A good teacher is interested in the student's development of attitudes and interests, concepts and knowledge, skills and talents, and the creation of thought and behavior patterns. Optimistic teachers look for ways to improve. Good teaching should incorporate approach and technique advancement. Effective teaching constantly seeks to improve in light of fresh experiments in the teaching sector. Teaching is progressive when it advances consistently.

Principle of Co-operation:

A collaborative effort between the teacher and the students is essential for effective teaching. Lack of cooperation could result in poor instruction. Hence, a teacher should organize his or her lessons so that the students have plenty of opportunities to cooperate in planning, managing, participating in discussions, and other classroom activities. (Emam et al., 2019)

2.6 Maxims of Teaching (Kalamkar et al., 2023)

The maxim of teaching can be termed as guidelines for organizing phrases and ideas in a way that makes them simple to understand when being taught in a classroom. They serve as a standard for instruction.

Using teaching maxims helps to carry out instructional procedures and teaching activities.

The teaching maxims are particularly useful in participation of students in the teaching and learning processes. They pique the students' interest and encourage them to learn. (V.K. Rao, 2004) They increase the students' awareness of the educational process.

An excellent teacher ought to be well-versed in as following:

2.6.1 Proceed from the known to the unknown:

The most natural as well as straightforward method of delivering a subject is to move from a concept the students already understand to a concept they do not. The students greatly benefit from what they already know. This implies that the teacher should pique students' attention in a lesson by asking those questions about topics they are already familiar with. The teacher must connect the new topic to the previous one step by step. It is impossible to learn something new in a vacuum.

2.6.2. Proceed from Simple to Complex:

The simple work or subject must be covered first, and then the more complicated one can be covered. The definitions of simple and complex should be viewed from students' perspective rather than an adult's. By providing the children with complex tasks before the easier ones, we would be stifling their interest and initiative.

2.6.3 Proceed from Easy to Difficult:

The students' standards must be kept in mind as we order our lectures for simplicity of understanding. Their interest will be maintained by this. The psychological makeup of the student must be taken into consideration while deciding what is simple and what is challenging. One skill could appear simple on the surface, but it might be challenging psychologically. There are many things that seem simple to us but are challenging for students. Also, the students' best interests must be considered.

2.6.4 Proceed from the Concrete to Abstract:

A concrete material greatly aids a students' imagination. "Things first, words later," as the saying goes. "Things, Things, Things," Rousseau said. Students cannot think in abstractions at first. They learn best from things they can see and touch. It must be taken care not to keep the students in the 'concrete stage' all of the time. This is the first step for students to take to progress to the higher stage of 'abstraction' as they grow older.

2.6.5 Proceed from Particular to General:

Examples relevant to the situation should be provided before principles and guidelines

are given. In reality, the students should develop general principles for themselves after learning specific facts.

2.6.6 Proceed from Indefinite to Definite:

In the early stages, students' ideas were indefinite and very vague. These concepts must be defined, clarified, precise, and systematic. Each word and concept presented must be clear in the students' mind as a picture for effective teaching. Actual objects, diagrams, and pictures must be used appropriately for challenging ideas. Every effort should be made to arouse the students' interest in the lesson.

2.6.7 Proceed from Empirical to Rational:

The foundation of empirical knowledge is observation and experience. An element of abstraction and an argumentation strategy are necessary for rational knowing. The broad consensus is that a youngster initially encounters information in the course of his daily activities before being aware of its rational foundation.

2.6.8 Proceed from Psychological to Logical:

A logical approach considers the way the information is organized. The students' interests, needs, mental makeup, and reactions are psychologically examined. When we intellectually approach an issue, we often do so from our own point of view rather than from the perspective of the student. While employing a psychological approach, we progress from the concrete to the abstract, from the simple to the complex, and from the known to the unknown.

2.6.9 Proceed from Whole to Part:

The whole has greater relevance for the students than its component parts. After doing their research, J.P. Guildford, E.B. Newman, and May Seagoe come to the conclusion that the "whole" approach is often preferable to "part" learning since the content to be learned "makes sense" and its component parts can be perceived as interrelated by the learner. The learner recognizes a connection between the main ideas of the subject matter.

2.6.10 From Near to Far:

Students learn best in his/her immediate environment. He/she should therefore become familiar with his/her surroundings initially. They may learn things that are not related to the local geography gradually before moving on to Tahasil, District, State, the nation, and eventually the entire world.

2.6.11 From Analysis to Synthesis:

Analysis is the process of breaking down a problem into manageable parts, and synthesis is the process of combining these separate parts into one complete whole. Dividing a complex problem into units simplifies and simplifies it.

2.6.12 From Actual to Representative:

When youngsters are presented with actual objectives, they learn quickly and remember them for a long time. They will especially benefit from this. Adults should be given representative items in the form of photos, models, etc.

2.6.13. Proceed Inductively:

This maxim is similar to all of the ones mentioned before. In the inductive approach, we start from specific examples and create general norms with the help of the learners' engaged participation. Assuming a definition, a general rule, or a formula, we apply it to specific examples when using the deductive method. It must be acknowledged that maxims are ultimately designed to be our servants, not our lords. Moreover, they are generally connected. Various maxims are appropriate in various contexts. It is crucial that each maxim be used carefully for this reason. They serve as a tool, not an end.

2.6.14 Summary:

These are the maxims for teaching. Every topic may be very readily discussed and understood by the student using these maxims or approaches, and knowledge can be attained very quickly.

Examples: The teacher can introduce the topic Scale Drawing using the axiom known to unknown. Before moving on to the unknown, the teacher should first introduce or describe the known things or technical aspects of scale drawing that they observe in

their daily life.

2.7 Types of Learning

"Learning is described as a process that results in generally long-lasting changes in an organism's behavior". Depending on the following factors, learning can be divided into a variety of categories: (Abbasian, G., & Bahmanie, A. 2013.)

This may be further classified into the following types:

1. Verbal Learning
2. Learning Motor Skills
3. Concept Learning
4. Problem solving
5. Serial Learning
6. Paired associate learning

When it comes to the approaches or methods used to introduce behavioral changes, Robert Gagne (1970) divided learning into the following categories by taking into account a hierarchical order:

a) Classical conditioning
b) S-R (Stimulus - Response) learning or instrumental and operant conditioning
c) Chain learning
d) Verbal associate learning
e) Multiple discrimination
f) Learning of concepts
g) Learning of Principles

Educational psychologists led by Benjamin Bloom created a classification of degrees of intellectual behavior that is crucial to learning. According to Bloom's Taxonomy, educational goals can be divided into three "domains":

1. Cognitive
2. Affective
3. Psychomotor

Here, the first type of learning shall be described. The following are examples of learning according to the particular area of behavior where modifications are introduced:

2.7.1 Verbal learning – involving Verbal Expression

This kind of education aids in the development of verbal conduct. The outcomes of such learning include the languages we use and the modes of communication we employ. Verbal learning also includes the school-related practices of rote learning and memorization. The person uses signs, pictures, symbols, words, figures, sounds, and voices as crucial tools for participating in the process of verbal learning.

2.7.2 Learning Motor Skills - Dancing, Walking, Swimming, Typing, etc.

This type of learning may cover the adoption of all motor skills.

Examples of this learning include learning to swim, ride a horse, drive a car, fly an aircraft, play a musical instrument, strike a running target, draw a geometric pattern, add and multiply large lists of digits, conduct experiments, and handle numerous instruments. The learning process helps the student develop a variety of abilities, which aid in gaining speed and accuracy in the sphere of operation of these activities and foster a sense of confidence in the learner to execute with ease and enjoyment. The art of mastering these abilities can be learned by employing some suitable learning techniques, methodical acquisition, and fixation of a set of ordered actions or responses.

2.7.3 Concept Learning

An abstract idea concerning objects, people, or events is represented by a concept in the form of a mental image. For instance, our mental image of a tree conjures up the similarities or shared characteristics of all the various trees we are familiar with. Concept learning refers to the development of such notions as a result of prior knowledge, education, or cognitive processes. Learning concepts is extremely helpful for naming, recognizing, and identifying things. Our notions have an impact on all of our conduct, including verbal, symbolic, physical, and cognitive activity. So, a large portion of what we do, say, comprehend, reason, and judge is governed by the concepts we learn. (Iyer, 2015)

2.7.4 Problem Solving

Problem Solving learning is a higher type of learning in the hierarchy of learning and the acquisition of behavior. This learning needs the use of cognitive abilities such as reasoning, thinking, the capacity to observe, discriminate, generalize, and imagine, as well as the ability to infer, draw conclusions, and try out fresh ways and experiments, among other things. An individual may be driven to attain an unknowable objective or to achieve a goal based on earlier experiences, the effects of coaching, training, formal or informal learning and information acquisition, habits, attitudes, interests and learning, sets, and so on. This type of education has fundamentally enabled people to make significant contributions to the growth and improvement of society.

2.7.5 Serial Learning

When learning material is delivered to a student in a sequential or serial order, this is referred to as serial learning. Children come across it frequently in the classroom when they are supposed to memorize lists of information like the alphabets, math's tables, names of the various states in their country, leaders and social workers' names in alphabetical order, etc. Serial learning experiments have demonstrated that items at the end of the list are simpler to remember than those in the middle.

2.7.6 Paired Associate Learning

Learning assignments are introduced in this form so that learners can pick them up because of associations. Because of its connection to Lord Kishan, a village's name like Kishanpur sticks in people's minds. Similar to this, when someone thinks of the term Ganga, they immediately think of the Ganges River. So, the approach of paired or multiple association may be used to learn or retain a large portion of verbal or motor learning.

2.8 Kolb's Experiential Learning Theory (ELT)

Many theories, such as Piaget's cognitive development (1970), Lewin's social psychology (1948), Dewey's pragmatism (1934), Ruger's client-centered treatment, Maslow's humanism, and Perls' Gestalt therapy, have been proposed (Demirkan and

Demirbas,2008), have combined to create the Kolbs Experiential Learning Theory (ELT). ELT defines learning as a cycle that begins with experience, goes on to include reflection, and culminates in action that provides a context for reflection (Kolb, 1984). As depicted in Figure 2, it includes the four levels of the learning cycle: Concrete Experience (CE), Reflective Observation (RO), Abstract Conceptualization (AC), and Active Experimentation (AE). (Kolb, D.A.) 1981, 1984.

These levels of learning cycle that ensures student "touches all the bases" is how Kolb's experiential learning style concept is often represented (Salama, n.d.):

2.8.1 Concrete Experience - encountering a fresh scenario or experience, or reinterpreting an already existing one.

2.8.2 Reflective Observation of New Experience

Particular attention should be paid to any discrepancies with respect to experience and comprehension.

2.8.3 Abstract Conceptualization

Reflection generates a fresh concept or enhances the already existing draft concept (learning from personal experience).

2.8.4 Active Experimentation

The learners put their ideas to the test in the real context to observe what occurs.

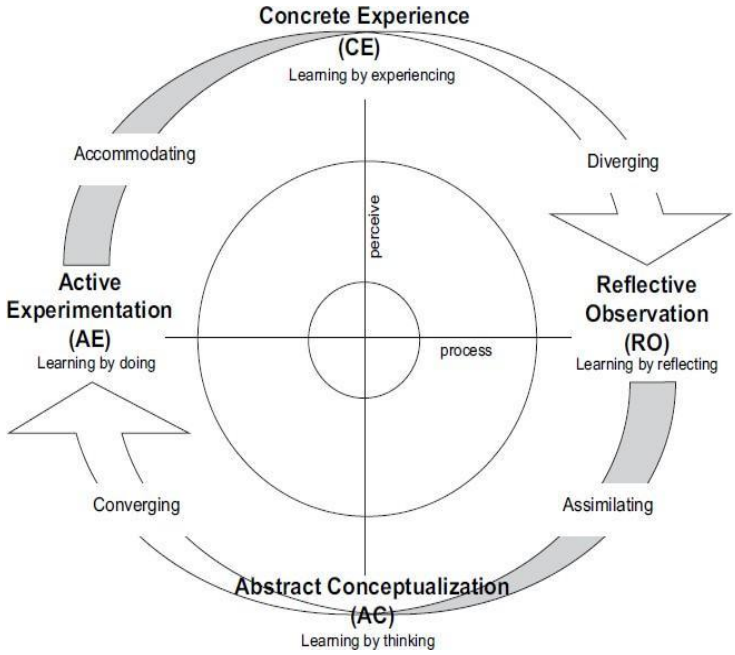


Figure 4 Four Learning Phases of Experiential Learning Theory

Source: (Adapted from Kolb, 1999:4)

Perceiving (represented by the vertical axis in the image) and Processing (on horizontal axis) are the two bipolar learning aspects that ELT. According to Demirkan and Demirbas (2007), learners may be grouped into one of four learning styles using an amalgamation of results on the two dimensions: Accommodating (CE and AE), Diverging (CE and RO), Converging (AC and AE), and Assimilating (AC and RO).

2.8.5 Accommodating learners

Accommodators observe and process via Concrete Experience (CE) and Active Exploration (AE). They prefer themselves in making things (prefer learning through 'hands-on' experiments), also they comprehend their world through their sensations and use actions to convert into knowledge (Hsu, 1999). Additionally, they prefer to solve problems by trial-and-error method rather than through the analytical method. They are impulsive and chaotic in the approach to solve the issue rather than being rational and sequential (systematic). Accommodators prefer to work in / as a group to attain established targets and perform given duties, and they frequently rely on others for information. They are extroverts, thus they like working on group tasks.

2.8.6 Diverging learners

Divergers understand things using Concrete Experience (CE) and process through Reflective Observation (RO). They have a strong imagination and are extremely emotive. They have a strong affinity for teamwork in group tasks because they value people, and they are able to generate new ideas by creating or assimilating numerous observations (Talagrand, 1997). They are less interested in generalizations and theorems. Unlike other learning styles, their approach to problem solving is more creative than methodical (Utaberta et al., 2013). They have broad cultural interests as well as a broad perspective that enables them to sift through data from various sources and contexts (especially from concrete situations). They are quite good at coming up with original concepts.

2.8.7 Assimilating learners (Assimilators)

Visualize their surroundings via Abstract Conceptualization (AC) and perceive it through Reflective Observation (RO). These have a symbolic notion of the world around, processing and transforming knowledge through thinking (Demirkan and Demirbas, 2007). Assimilators are mainly interested in vague ideas rather than concrete implementations. They excel in formulating hypotheses. They focus on the small things. They have a predilection for the conventional learning environment, which is defined by teacher-centric lectures, extensive readings, and a love of exploring analytical methods. They demonstrate a capacity for in-depth research. They resembled the usual researcher in every way.

2.8.8 Converging learners (Convergers)

Perceive via abstract conceptualization (AC) and process through active exploration (AE). The students approach problem-solving with rational, practical, and emotionless viewpoints (Hsu, 1999). The students are proficient at blending theory and application. Their understanding is structured properly, and they apply hypothetical-deductive reasoning to a particular issue (Smith and Kolb, 1996). They have great strategic thinking skills. These students favor trying out novel concepts, computer simulations, and real-world scenarios (Kolb and Kolb, 2005a). They emphasize skills.

	Active Experimentation – AE (Doing)	**Reflective Observation – RO (Watching)**
Concrete Experience – CE (Feeling)	Accommodating (CE/AE)	Diverging (CE/RO)
Abstract Conceptualization – AC (Thinking)	Converging (AC/AE)	Assimilating (AC/RO)

Table 1 Kolbs Learning Style Characteristic Description

Source: Kolb & Kolb (2005b)

LEARNING STYLE	**LEARNING CHARACTERISTICS DESCRIPTION**
Diverger	● Has CE and RO as dominant learning abilities ● Strong in imaginative ability ● Best at generating ideas and viewing (concrete) situations from many different perspectives ● Interested in people ● Emotional ● Broad cultural interests ● Prefer to work in groups ● They are less concerned with theorems and generalizations ● Their approach to problem solving is not systematic

Assimilator	● Has AC and RO as dominant learning abilities ● Strong ability to create theoretical models ● Best at understanding a wide of range of information and putting it into concise, logical form ● Excels in inductive reasoning ● Concerned with abstract concepts rather than people ● Prefer readings, lectures, exploring analytical models, and having time to think things through
Converger	● Has AC and AE as dominant learning abilities ● Strong in practical application of ideas ● Best at finding practical uses for ideas and theories ● Can focus on hypo-deductive reasoning on specific problems ● Unemotional- Logical and pragmatic in problem solving ● Has narrow interests ● Prefer to deal with technical tasks and problems rather than with social issues
Accommodator	● Has CE and AE as dominant learning abilities ● Greatest strength is doing things. ● Strong ability to learn from primarily "hands-on"experience ● More of a risk taker- enjoy new and challenging experiences ● Performs well when required to react to immediate circumstances ● Solves problems intuitively- tendency to act on "gut" feelings rather than on logical analysis ● Prefer to work with others to get tasks done.

Table 2 Learning Styles

Source: Kolb & Kolb (2005b)

Among the various experiential models that use dialectic inquiry, it has been argued that Kolb's learning theory offers one of the few complete and fully generalized models.

2.9 Blooms Taxonomy

Benjamin Bloom, an American educational psychologist, is honored by the name of the Taxonomy. In the 1950s and 60s, Bloom led a team of educators who intended to establish a common vocabulary that would allow educators to talk about and share teaching and evaluation strategies.

The Taxonomy of Educational Objectives was published in 1956 as a consequence of their cooperative effort.

The various learning objectives (or goals) that teachers establish for their students are categorized according to Bloom's Taxonomy. E. J. Furst, M. D. Englehart, David Krathwohl, W. H. Hill, and Benjamin Bloom (editor) published "The Taxonomy of Educational Objectives, The Classification of Educational Goals, Handbook I: Cognitive Domain," which served as the first publication to introduce the taxonomy.

Affective, Psychomotor, and Cognitive are the three "domains" into which Bloom's Taxonomy splits educational goals. Acquiring the necessary knowledge and skills at lower levels is a precondition for learning at higher levels in the taxonomy. To encourage teachers to concentrate on all three domains and develop a more comprehensive style of instruction, Bloom's Taxonomy was developed. (Valsson, 2022)

2.9.1 The Cognitive Domain

Bloom's cognitive skills encompass a range of categories, including knowledge, comprehension, and critical thinking related to specific topics. The lower-order aims in this domain are typically prioritized in traditional schooling. The taxonomy has six levels that go from the lowest order processes to the highest:

Knowledge: Recall terminology, facts, fundamental ideas, and responses to demonstrate memory of previously learnt content.

Knowledge of specifics - terminology, specific facts

Knowledge of ways and means of dealing with specifics - conventions, trends and sequences, classifications and categories, criteria, methodology

Knowledge of the universals and abstractions in a field - principles and generalizations, theories and structures

Comprehension: Arrangement, comparison, translation, interpretation, elucidation of essential ideas, and summarization of facts and concepts.

Translation

Interpretation

Extrapolation

Application: Using fresh insights. Apply newly acquired knowledge, facts, techniques, and principles in novel ways to solve issues in novel contexts.

Analysis: Analyze and dissect data by determining reasons or motivations. Draw conclusions and locate data to back up generalizations.

Analysis of elements

Analysis of relationships

Analysis of organizational principles

5. Synthesis: Compile information together in a different way by combining elements in a new pattern or proposing alternative solutions

Production of a unique communication

Production of a plan, or proposed set of operations

Derivation of a set of abstract relations

6. Evaluation: Make assessments of facts, ideas' viability, or the caliber of work using a set of standards in order to present and defend your beliefs.

2.9.2 Relation with Architecture Education

Examples: - First Year B. Arch. Subject – AGD – Three Dimensional Solids and their generations- Orthographic Projections.

A. Cognitive Domain

i. Knowledge – The teacher defines “the Horizontal (HP) and Vertical Planes (VP)”, explains the purpose of HP and VP, and teaches the orientation of the object with respect to HP and VP and explains how the 3D object is represented in 2D by orthographic projections.

ii. Comprehension – The Student starts visualizing the 3D object with respect to HP and VP.

iii. Application – The student then draws the 2D object on the drawing sheet as per the

orientation of the object by applying Orthographic Projection Method.

iv. Analysis – While working on the drawing sheet, the student analyzes the various planes of the objects which are seen from Front Elevation and Side Elevations. The Hidden planes are represented by dotted lines.

v. Synthesis – Students, after getting knowledge about Orthographic Projections, students orient the object in various positions and try to draw the object with respect to HP and VP. e.g. placing the object at some angle or elevating the object with respect to HP etc. Teacher asks students to try different objects at different positions and draw the object.

vi. Evaluation – Students submit their drawings to the teacher, and the teacher evaluates the drawings based on Rubrics.

B. Affective

Skills in the affective domain describe the way people react emotionally and their ability to feel another living thing's pain or joy. Affective objectives typically target the awareness and growth in attitudes, emotion, and feelings.

There are five levels in the affective domain moving through the lowest order processes to the highest:

i. Receiving: The lowest level; the student passively pays attention. Without this level no learning can occur.

ii. Responding: The student actively participates in the learning process, not only attends to a stimulus; the student also reacts in some way.

iii. Valuing: The student attaches a value to an object, phenomenon, or piece of information.

iv. Organizing: The student can put together different values, information, and ideas and accommodate them within his/her own schema; comparing, relating and elaborating on what has been learned.

v. Characterizing: The student holds a particular value or belief that now exerts influence on his/her behavior so that it becomes a characteristic.

Relation with Architecture Education

Affective Domain

i. Receiving: Students listen to the teacher's lecture and remember the name of newly introduced topic i.e. "Orthographic Projections".

ii. Responding: Students participate in discussion about the new topic "Orthographic Projections". They exchange Questions and Answers about the topic.

iii. Valuing: The teacher asks students to participate in a brainstorming session about this new method and encourages them to draw sketches and add written information for the sketches in their own words to understand the Object orientation.

iv. Organizing: The student collects information about various 3D objects and visualizes its orientations in various ways to visualize the objects and identify the methods to draw them.

v. Characterizing: When working individually, students demonstrate their independence. Here, the teacher assigns groups of students to create 3D models of the objects. In a group activity, every student contributes (displays the cooperation). When tackling problems, students adopt an objective mindset.

C. Psychomotor

Skills in the psychomotor domain describe the ability to physically manipulate a tool or instrument like a hand or a hammer. Psychomotor objectives usually focus on change and/or development in behavior and/or skills.

Bloom and his colleagues never created subcategories for skills in the psychomotor domain, but since then other educators have created their own psychomotor taxonomies.

i. Imitation: Observing and patterning behavior after someone else. Performance may be of low quality. Example: Copying a work of art.

ii. Manipulation: Being able to perform certain actions by following instructions and practicing. Example: Creating work on one's own, after taking lessons, or reading about it.

iii. Precision: Refining, becoming more exact. Few errors are apparent. Example:

Working and reworking something, so it will be "just right."

iv. Articulation: Coordinating a series of actions, achieving harmony and internal consistency. Example: Producing a video that involves music, drama, color, sound, etc.

v. Naturalization: Having high level performance become natural, without needing to think much about it. Examples: Michael Jordan playing basketball, Nancy Lopez hitting a golf ball, etc.

D. The Revised Taxonomy

A more modern knowledge of cognitive processes and their significance in education is reflected in the Revised Taxonomy, which adds improvements to the original Bloom's Taxonomy. (Hussain & Spady, 2017)

Improvements and Extensions

A group led by Lorin Anderson and David Krathwohl updated Bloom's Taxonomy in the 1990s. They presented a two-dimensional framework that combined dimensions of knowledge and cognitive processes.

The changed cognitive processes were:

1. Keep in mind (recall details)
2. Understand (Grasp concepts)
3. Apply (Make use of knowledge in novel contexts)
4. Analyze (deconstruct data)
5. Evaluate (Make a decision based on standards)
6. Create (generate original ideas)

Furthermore, four new categories were added to the knowledge dimension:

1. Factual Knowledge (fundamental concepts)
2. Conceptual Knowledge (Element Relationships)
3. Knowledge of Procedures (How to Do Something)
4. Metacognitive Knowledge (knowledge of one's own education)

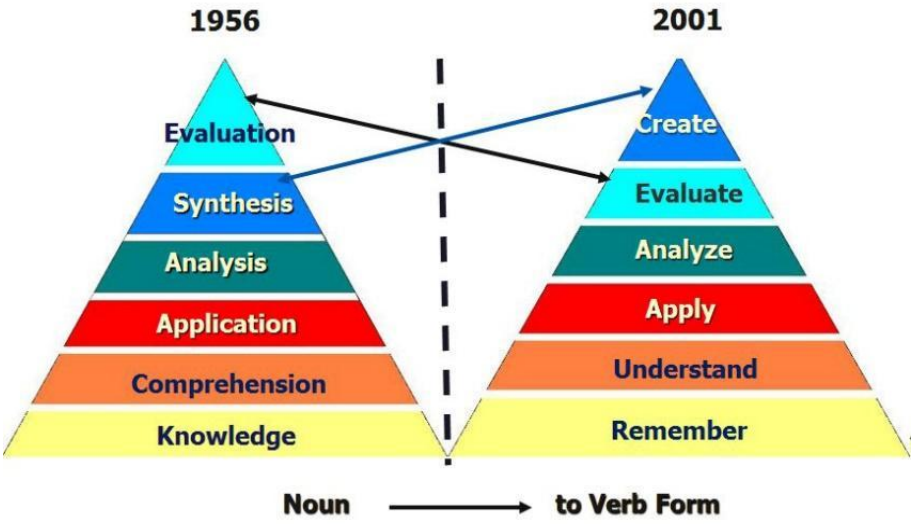


Figure 5 Bloom's Taxonomy Revised

Source: Wilson, Leslie O. 2001

E. Summary

When it comes to the planning, execution, and assessment of various development techniques, Bloom's Taxonomy is an excellent reference model for everyone involved in teaching, training, learning, and coaching. The more in-depth components within each domain offer extra points of reference for learning design and assessment, be it for a single training need, lesson, session, or activity, or for a whole course, syllabus, or program that involves a sizable number of trainees, students, or an entire organization.

The study of architecture facilitates the development of all three forms of learning: cognitive learning, which is the acquisition of knowledge; affective learning, which is the development of attitudes and emotions; and psychomotor learning, which is the acquisition of manual or physical skills. The goal of architectural education is for the final-year student to leave the institution as a transformed individual who is knowledgeable, skilled, and has a unique style. He should also be able to reason independently and be prepared to tackle a variety of design challenges. All of this is accomplished up to a point, but throughout the process, Bloom's Taxonomy is used in every facet of architectural education.

2.10 Summary of Curriculum Review and Research Gap:

The Syllabi, the Course content and Evaluation of the Curriculum of Architectural Drawing and Graphics subject is obtained from the various Indian Universities to compare

- Savitribai Phule Pune University (SPPU),
- Symbiosis School of Architecture, Urban Development and Planning, Symbiosis Open Skill University Pune, (SSPU)
- MIT School of Architecture, MIT Art Design and Technology University Pune, (MIT-ATD)
- College of Architecture, Bharati Vidyapeeth, Pune, (BVP)
- Dept. of Architecture, Anna University Chennai, (DOA-AU)
- BMS College of Architecture, Bengaluru, Visvesvaraya Technological University, Belagavi. (BMS)
- Manipal School of Architecture and Planning, Manipal Academy of Higher Education, Manipal (MAHE)
- The Institute of Architecture and Planning Nirma University, Ahmedabad (IAP-NU)
- Institute of Design Planning and Technology, Sarvajanik University, Surat, (IDPT- SU)
- School of Planning and Architecture, New Delhi. (SPA -ND)

Curriculum for Architecture in various Public, Private and Skill universities are studied and analyzed which are Savitribai Phule Pune University (SPPU), Symbiosis Skill and Professional University, Pune (SSPU), MIT Art Design and Technology University, Pune (MIT ATD) and Bharati Vidyapeeth, Pune (BVP)

The comparative analysis is as follows

Sr. No.	SPPU	SSPU	MIT-ATD	BVP
1	Architecture stream was under Engineering Faculty till 2015.	New Private University	New Private University	Now Private University. Initially affiliated to SPPU
2	Subjects are as per COA Guidelines	Subjects are as per COA Guidelines	Subjects are as per COA Guidelines	Subjects are as per COA Guidelines
3	Core Subjects: Arch. Design, Build. Const & Mat., Arch. Draw & Graphics, History of Arch. Services, WD, etc.	Similar Subjects are offered with few skilled based subjects.	Core Subjects: Arch. Design, Build. Const. & Mat., Arch. Draw & Graphics, Hist. of Arch. BS, WD, etc.	Core Subjects: Arch. Design, Build. Const. & Mat., Arch. Draw & Graphics, Hist. of Arch. BS, WD, etc.
4	Credit & Marking System for Evaluation	Credit & Marking System for Evaluation	Credit & Marking System for Evaluation	Credit & Marking System for Evaluation
5	Syllabus Structure is Exam oriented	Syllabus Structure is Exam oriented	Syllabus Structure is Exam oriented	Syllabus Structure is Exam oriented
6	Subjects are treated independently Though school can modify as per School Philosophy	Very much Framed structure results into less scope for creative thinking	Subjects seems to be treated independently	Subjects seems to be treated independently .

7	No specific Structure for Integration of Subjects.	No specific Structure for Integration of Subjects	No specific Structure for Integration of Subjects	No specific Structure for Integration of Subjects
8	SPPU has introduced Audit Courses like Crafts, Creative Writing and Performing Arts for First Year, Foreign language, Cyber security and Yoga for Second Year and so on.	Under Skill Plan, Skill based activities are introduced which include Model making, Presentation skills etc.	University level credits like Yoga Performing Arts, English Communication, Spirituality and Value Education are offered by School of Holistic Development	Very much Similar to SPPU. Introduction of Audit Course and Electives.
9	Revision of the Syllabus is after Every 5 years	Revision of the Syllabus is after Every 5 yrs.	Revision of the Syllabus is after Every 5 years	Revision of the Syllabus is after Every 5 years
10	Integration of Subject is left to Teachers	Integration of Subject is left to Teachers	Integration of Subject is left to Teachers	Integration of Subject is left to Teachers
11	No Theory Exam Only Sessional Assessment (Int. 50 +Ext 50)	No Theory Exam Only Practical (Int.40+Ext 40) + Skill Assessment 20	No Theory Exam Only Sessional Assessment (Class Int. 50 +Ext 50)	No Theory Exam Only Sessional Assessment (Class Int. 50 +Ext 50)
12	Taught in First Year only.	Taught till III Semester	Two years	Taught in First Yr. only
13		No specific rubrics for assessments		No specific rubrics for assessments

14	No specific rubrics for assessments Sketching is part of the Subject with minimum 15	Sketching is part of the Subject under skill activities.	No specific rubrics for assessments Sketching is part of the Subject.	Sketching is part of the Subject.
15	sketches to be submitted. All institutes follow similar curriculum with minor variations.	All institutes follow similar curriculum with minor variations.	All institutes follow similar curriculum with minor variations.	All institutes follow similar curriculum with minor variations.

Table 3 Comparative analysis of the Curriculum of various universities in Pune.

Source: Author

2.10.1 Summary of observations of Curriculum Review and Research Gap:

We shall dissect the findings from the curriculum review and the research gaps in architecture education in this section. We shall carefully examine each point to determine its significance and meaning.

Observations Regarding the Gap of the Curriculum:

Guidelines-Based Syllabi:

Every course framework, or syllabus, complies with the guidelines established by the Council of Architecture. This indicates that although the fundamental framework is the same, each university's methods for teaching the material and evaluating its students vary slightly.

Curriculum Duration:

Architectural Graphics and Drawing subject's curriculum is only taught to students during their first four semesters of the Academic year, i.e., First and Second year only. Students must absorb a lot of information quickly because this is similar to having a special class that only occurs during the first two years of the Academic year. The structure of the syllabus is oriented towards Examination and marks.

Exam Format:

No Theory Exam: This subject lacks a conventional theory exam, in contrast to many others that have an end-of-term (final) exam. The Continuous Internal Evaluation (CIE) is used to assess students instead. This results in casual approach of students towards Architectural Graphics and Drawing subject.

Evaluation Rubrics:

Undefined Rubrics: The curriculum does not provide a clear explanation of how students are graded. Teachers can use evaluation rubrics as a guide to help them assign grades in an equitable manner. These are not clearly stated, which causes confusion regarding the expectations for students and the evaluation process.

Choice-Based Credit System of Evaluation:

Choice-Based Credit System (CBCS): CBCS is used by all universities. In comparison to other technical topics such as Building Construction and Materials, the Architectural Graphics and Drawing subject has a minimum of credits (average of 3 credits), which discourages students from taking this subject very seriously. There is very limited choice for opting for the credits as well.

Course Objectives and Outcomes:

Inadequately Definable Objectives and Outcomes: Some colleges fail to provide students with clear explanations of the knowledge or skills they will acquire (outcomes) and the things they should learn (objectives). This is crucial because students may better comprehend what they need to focus on when they have clear goals. All subjects are treated independently.

Curriculum Integration:

SPA New Delhi's Curriculum: In the first semester, this subject and architectural design were combined at the School of Planning and Architecture (SPA) in New Delhi. This implies that students study this topic alongside their exposure to design, which may enable them to recognize the connections between the two subjects.

Comparing curricula of International Universities:

Integration with other subjects: Architectural Graphics and Drawing (The title of the subject varies in different universities) is frequently connected to other courses, such as

design and history, according to an analysis of the curriculum from international universities. Since it is regarded as the language of Architecture, students acquire useful abilities that they may apply in every other subject.
In conclusion, the observations show the existing architectural curriculum's research gaps. By comprehending these gaps, the educational system may be enhanced, and students can be assured of a successful and holistic education.

2.11 Summary of Research Papers' Review and Research Gap:

Architectural pedagogy must experiment with different approaches and methodologies in order to enhance architectural education. But at the same time, the development of a new approach to teaching must be both desirable and practical. There are a number of papers available to help teachers and students learn architecture as a whole as a result of this.

M.I. Alba Dorado expresses his views that when we begin to design, work, and think with our hands, via them, we may first shape an outside item and then think about and build the architectural project. As we create, our hands serve as bridges between the realms of substance and cognition, allowing us to work with our concepts, clarify them, and patch them up into something that can be constructed.
He makes an effort to investigate how our hands play a part in design in order to discover more about how an architectural project is created and developed before speaking about topics that are relevant to us about how they are taught.
Drawing plays a significant part in this process, serving not only as a tool for visualizing and defining the materialization and construction of the projectual concept, but also as a thinking-generating element since it allows us to interact with and reflect on the idea that gave rise to it. (Dorado, n.d.)

Elena Kupriyanova argues that a basic distinction among the ideas of "architectural drawing" and "drawing of an architect" may be made. The essential distinction is that each is the result of a different manner of perceiving the space and an

object and each tackles a different issue. A drawing by an architect is a method of analyzing the topic surroundings. Architectural drawing is a way of visual modeling in drawing that shapes an architect's professional attitude, view of the environment, and capacity to generate a technical image.

There are architectural sketching approaches that have been shown to help to the development of the student-professional architect's attitude.

While teaching students to draw from nature, the experience of drawing is initially developed while considering visual perception.

The responsibilities for representing various sorts of places (architectural compositions) and imagining them are introduced in the second level.; (Kupriyanova, 2021)

Drawing is the most organic technique to document an architectural work, according to Jerzy Gomólka. The equivalent of a musical notation system for a musical piece, in my opinion, is an architectural drawing. A work may be moved in both time and space with this code. It communicates across verbal boundaries about the architecture. Everyone is in agreement that a drawing of any project has a great deal of descriptive potential and that a single line may convey information more effectively than entire pages of spoken explanation or even the most intriguing pantomime show. Nonetheless, some students find it challenging to begin expressing their thoughts through sketching.

Moreover, he worries that architectural studios may one day stop using drawings in their current format; investors may be shown his building via spatial projections; and directions for construction robots may be transmitted by digital gadgets. (Jerzy Gomółka, 2015)

Drawing representation, according to Kupriyanova, is a crucial form of communication and also an important aspect in confirming the sophistication level of the design process. It depicts the basic concept intended for audiences – the professional expert, the investor, and the artist. It allows you to compare the sketched concept to the design goal. Concept - sketch - mirror - execution. It transforms everyone’s vision of

the art of creating space, exhibiting the multifaceted perception of architecture and the multidisciplinary nature of professional practice. It is rich in aesthetic values and technical substance.

Each sort of artistic endeavor in the realm of visual expression has a direct bearing on the maturation of abstract thought, the opening of the imagination, and the improvement of sensitivity. It serves as an important tool for architects as well as their brand.(Kupriyanova, 2021)

Drawing, according to Beata Makowska, has a vital part in the development of pupils' spatial imagination, which is essential in the creative process, in which the computer is merely a tool. Traditional as well as innovative digital technologies play critical roles in the development of future architects. Yet, the proliferation of modern technology poses new obstacles in the education of a designer. According to recent polls, the lack of instruction in freehand drawing, particularly sketching, has had a negative impact on the development of students' creativity. A poll was done a few years ago by Design Intelligence and Almanac of Architecture and Design among 800 prominent American architecture companies, who were asked to rate new workers, graduates of architectural schools. The findings showed that 14% of young architects lacked the ability to sketch creatively and skillfully.

A method to experience space is through drawing. It is where cognitive and creative activities are concentrated. Its job is to note existing forms that have been selected from reality and to uncover imaginary ones that have been disguised. The actual world we inhabit and the mental and imaginative realms are connected via sketching. Drawing allows for "free" creativity. The creative process "involves two processes, integrating and reorganizing, together constituting key parts." (Makowska, 2016)

Arta Jakupi et al. hope to demonstrate the potential of architectural representation by including community interaction and growth into the design process. 'Design and Execution is synonymous to a silent game, and that game is performed via

sketching,' says the author. Architectural drawings and visual language are discussed in this article as a means for communication, teaching (understanding architecture), and involving individuals in public design.

Drawing was shown to be crucial for comprehending, educating, and facilitating relationships, including:

- Visualizing concepts and projections as an intellectual activity.
- Acquiring knowledge of notions and connections.
- Informing the public on how architecture is portrayed and valued.
- Helpful for creating interactions since it allows you to collect people and plan with them.

The implementation of the architectural drawing as a communication tool, which could be appealing and very well understood by the community, is further stated to be able to encourage public participation, discussion, and inception of an idea, ensuring their participation in the planning and design process as engaged and knowledgeable citizens. (Jakupi & Jashari-Kajtazi, 2018)

According to the respondents, this study confirms that the focus on the client is a crucial factor in evaluating an architect's performance. This finding suggests that the architects who took part in the study are aware of the fact that a strong performance in terms of the client can help them to survive in the profession. A Maisa concludes about Analysis of architect's performance indicators in project delivery process. Design buildability, on the other hand, was selected as the performance indication with the lowest RII value, indicating that architects believe it to be the least significant of the available performance indicators. Architects should be aware that Design and Construction are inextricably linked, and as a result, they should focus more on design buildability in their work. These results help architects identify which performance metric needs to receive more focus, as well as other project participants including clients, contractors, and management of consulting organizations.

This study offers valuable inputs to architects, establishes a foundation for evaluating the importance of performance indicators and their associated metrics for

gauging architect performance, and offers recommendations for further study in the building sector, especially in the area of architecture management and practice. In the future, other significant indicators may be included to create a more comprehensive performance evaluation. (Marisa, 2018)

N. Utaberta et al. may discover that the evaluation and grading systems in the fields of Art and Architecture, particularly in their studio-oriented curriculum, are more challenging than any other fields and majors. It is acceptable since their teaching and learning methods differ from and are more complex than those used in theoretical courses. Nonetheless, there is a widespread belief that their grading and assessment system lacks standards and norms, making it a holistic and subjective system. This assertion is also coherent. While reviewing and grading student projects, jurors and instructors do not follow any specific criteria or standards, and if they do, students are not made aware of them. (Ibrahim & Utaberta, 2012)

Architect Ashraf M. Salama has written a study that tries to derive several theories for integrating the knowledge into architectural design education (Salama, March 2008). For this purpose, a novel theory of knowledge integration was proposed as a means of achieving the desired result. After doing a contextual analysis, it was concluded that admission policies and skill sets were the most essential aspects in constructing a new theory.

Researchers believe a trans-disciplinary approach to teaching and learning could be the answer to traditional ways of education. As a means of achieving a balance between lectures and studios, students apply what they have learnt in particular design assignments guided by the same faculty members. Students focus on social and economic themes as well as history, as well as urban and climate challenges. The fusion of diverse types of knowledge into specific design tasks would be possible in such an environment.

A new theory of knowledge integration in architectural education has been proposed by a researcher who believes it can improve the future of architectural

education. Student's will get a deeper understanding and appreciation for knowledge types from other disciplines, which may be extremely different from architecture, but are nonetheless necessary for designing meaningful settings. (Salama, 2008)

Tayfun Y ld r m, et. al. experiment with various educational science sub disciplines titled as "education methods," "teaching techniques," "educational environment," "education tools," and "educational psychology." According to the authors, some of these components must be used simultaneously in order for creativity education to be successful. Some methods and techniques were used sequentially in the semester at Gazi University's Department of Architecture. The “mimesis” technique was tried during the experiment, which was part of the creative part of the design curriculum. Contemporary design drawings related to the design exercise were made available, and students were asked to draw inspiration for their new designs from these examples. At this point, the goal is to assess students' progress in design skills using the deductive mimesis technique. It’s concluded that technique is a time saving and a source of new ideas when developing new solutions. In architectural creativity education, taking inspiration from the main character of shown drawings rather than imitating them is a useful method.

Despite its success, it is clear that the “mimesis technique” is insufficient on its own and should be combined with traditional analytic-inductive methods in order to resolve the integration of the building's inner space (spatial configuration, structure, etc.) and outer form. (Yildirim et al., 2012)

Nik Lukman et. al. provide a broad overview of critical issues in Design Studio and propose a Bloom Taxonomy for Design Studio that can be used to ensure that Design Studio learning objectives are met

The researchers insist that students studying architecture in Design Studio are required to think critically, creatively, and pragmatically. Amalgamation of these three modes of thinking in Design learning is critical. With each new Design Studio level, the hierarchy and balance of these three modes changes. The importance of creativity

in the first and second years is emphasized, while practical approach is more important in the fourth and fifth years. (Ibrahim & Utaberta, 2012)

O .O. Olotuah et al. discuss the role of teaching and learning in the Architectural design studio in Nigeria as well as the role they play in propagating a sustainable design. To achieve this, the architecture curriculum must be revised, particularly the design studio, to incorporate more sustainability studies.

Review of the Design Studio of the Architecture Departments of the Federal University of Technology, Akure, and Covenant University, Ota, Nigerian institutions Architectural programmes and architectural practice are studied by the researchers. In architecture, the quality of the habitable environment is paramount. Since architects must understand the nature of human problems in their environmental contexts, architectural education aims to train professionals who have the intellectual ability to create relevant, expressive design solutions. Nigerian architecture schools' curricula acknowledge the importance of sustainability in the creation of the built environment. A few theoretical classes make this clear, but the design studio programme doesn't. According to the researchers, the curriculum has to undergo a significant restructuring in order to be socioeconomically and physically relevant as well as to address the urgent national demands of the country in terms of the sustainability of the built environment. In order to assure healthier living, better welfare, and more productivity of the populace's workforce, curricula must stay up with global sustainable development. (O. O. Olotuah, 2013)

As per Sawsan Saridar Masri, Building Construction Technology and Structural Design and Analysis modules taught to undergraduate architecture students will be examined to see if the knowledge and skills acquired are reflected into their studio work. Moreover, it aims to identify how modifications to the teaching methodologies and course delivery can strengthen the relationship.

The study focuses on course objectives, teaching structure, and integration in the design studio during Beirut Arab University's third-year architectural engineering program. It

is found that students' ability to integrate structural components is not properly seen in design exercise and profession.

As per the research, it states that in order to teach structural design to architects, a new pedagogical model is needed. For better output in the design studio, a series of exercises should be given to beginners to improve their understanding of the relationship between architectural form and structural forces and behavior. Students of architecture could learn structural forms and analysis from bio-inspired structures. (Masri, 2017)

Ar. Mahendra H. Sonawane and Dr. Vasudha A. Gokhale discuss the status of current architectural education in India. It investigates students' perceptions of teaching and learning in architecture institutes in the state of Maharashtra.

Using a comparison of traditional lecture methods with active learning methods, this study examines how students perceive traditional lecture methods versus active learning methods. This study is mainly based on a questionnaire as its tool. A Microsoft Excel spreadsheet was used to enter the data. IBM SPSS 21.0 for Windows was used for all statistical analysis (SPSS Inc, Chicago, IL, USA).

To conclude, the teaching method that included a lecture followed by a site visit received the highest mean rating scores. Lecture with discussion was the next preferred method. Lectures with chalk and board and PPT were not well received by the students. (Sonawane & Gokhale, 2016)

Architecture students were presented with an advanced structural integration collaborative model in the research paper by T. Fowler, Despite the fact that architecture students were knowledgeable about a wide variety of building structures in terms of the theory, calculations, and history of the materials, it was discovered that there were few opportunities for synthesis of the learned material and for exploring its application to holistic approaches for a building design project.

As an experiment, 9 design studio teams were able to push the boundaries of structural integration by creating integrated systems which were in sync with the

architecture project aspiration. As a consequence, students were able to create more holistic design projects that juggled the necessity to correctly analyze how these structural systems may improve their designs during project development with the architectural design goal. (Fowler & Rihal, 2019)

Sevinc Kurt, in his study paper, assesses and explores the potential of utilizing modern progressive computing technologies together with constructivist learning theory in architectural design processes that motivate students to be collaborative, interactive, process-oriented, and open-minded. Constructivism is Learning theory based on the notion that knowledge is produced by the knower in accordance with his or her experiences. Learners should be viewed as dynamic persons looking for purpose. Constructivism, which was rooted on Kantian principles, asserts that reality is created by the knower based on mental activity, according to Jonassen (1991; 10). Humans are interpreters and perceivers who create their own reality through these brain processes. Thinking is based on perceptions of physical and social events that can only be understood by the mind.

The constructivist learning theory holds that students learn by creating their own knowledge. According to "the constructivist position," learning is a process of creating meaning; it's how individuals interpret their experiences (Merriam and Caffarella, 1999, p. 260).

The emphasis is on creating a design process using a hybrid approach that effectively utilizes technology and constructivist learning philosophy. The instructional design aggressively encourages the use of the internet, virtual studios, digital studios, and architectural design software. (Utaberta et al., 2013)

Çikiş, Şeniz Çil, Ela, discuss the methods studio teachers use to evaluate students' work and performance at the fundamental design studios

Education assessment is necessary to make students aware about their strengths and weaknesses, what they should do to strengthen their practical abilities, technical comprehension, the caliber of their thoughts, and their capacity for research and

intention realization.

Assessment techniques for architectural education include both formative and summative evaluations. It is stated that during assessments, there is a possibility to ignore students' experiences and learning processes. It's also possible that the studio instructors' evaluation criteria aren't clearly defined.

It is found that despite the fact that one-on-one conversations between instructors and students are crucial for teaching and assessing, the majority of students think that reviewing the content is the finest part of learning. As part of ongoing research, a 30-question survey was being developed. The survey was carried out in four architectural institutes in Turkey that were randomly selected, with 37 people responding. It is recommended that it would be necessary to conduct additional fieldwork utilizing ethnographic research methods. Student perspectives and experiences on assessment processes and values are also being explored as part of this research. (Çikiş & Çil, 2009)

At each design phase in pedagogic design studios, Ashraf M. Soliman seeks to study the three key components of teaching and learning methodologies.
The three components initially defined are: methods of instruction and learning, tasks or study components, and design communication techniques.
Three paradigms for teaching and learning in pedagogic design studios were found in this study. These models were constructed using the natural break numerical value categorization approach and the overall rankings of the teaching and learning strategies from the design educator survey.
The models incorporate elements such as teaching and learning strategies, student assignments, study-related elements, and presenting strategies. The second model contains both "highest" and "medium" ratings, whereas the first model only includes methods, tasks, and procedures that are regarded as "highest" in terms of success or relevance. Each of the three classes is represented in the third model. (Soliman, 2017)

The research by Sibel Seda Dazkir and Ali Riza Arslan focuses on how interior design students hone their abilities to mentally picture 2D and 3D concepts of interior

drawings and produce technical drawings to convey their design ideas.
Several academic disciplines, including design, engineering, art, and architecture, place a premium on the ability to mentally see things and spatial relationships. Higher-order thinking and creativity, both of which are necessary in many industries, have been related to these skills.
The results of this study shows that pupils gradually acquire new abilities. Due to their lack of understanding and experience, students frequently copy drawings from others without realizing what they are doing. The results provide additional insight into the kinds of challenges that students faced during the learning process as well as how they overcome those challenges. It is advised that more study on students' mental 3D visualization processes be conducted with a larger and more varied sample size. (Arslan & Dazkir, 2017)

According to Francis Lyn and Ron Dulaney Jr., "A Case for Drawing" examines the role of hand and digital media in the academy as well as the primary benefits of drawing by hand in an environment that seems to be preoccupied with digital media and technology.
The aim of this study is to make a contribution to the process by examining how hand media have traditionally contributed to the architect's acquisition of design knowledge and design processes. Based on the initial survey results, it seems that the academy values both hand and digital media equally but pays more attention to the latter.
The paper demands that there is a need for further development of the survey, as well as the inclusion of a wider range of respondents, including established architects, architectural interns and students, in order to recognize that our media not only influences our work, but also ourselves and the possible differences of values between generations. For a better understanding of the reasons for responses, more objective research should be conducted. (Lyn & Dulaney, 2009)

Jeanne Pietig, the author and the researcher, shows how architecture can be used as a metaphor for thinking about education, including its nature, goals, and processes,

in order to make the connection between the two terms (Pietig, 1997).
The author states that Architecture is not only a useful metaphor for thinking about educational aims and processes, but it can also be the subject of interdisciplinary study in the school curriculum. Students must deconstruct the meaning of architecture from a variety of perspectives: artistic, social, and scientific. In addition, students should have the opportunity to experience architecture with their bodies, minds, and spirits. Study insists that teachers must be much more specific when creating classroom-friendly units. This is a creative process that can only be constrained by the teachers' will and imagination. (Pietig, 1997)

An extensive range of issues, including social, ecological, technological, economic, functional, ethical, and artistic considerations, must be resolved in the complicated process of architecture. Notwithstanding their diversity, all architectural problem-solving techniques have the requirement that they be spatially resolved. Magda Mostafa and Hoda Mostafa's article aims to examine how to best improve these spatial thinking abilities in young architects by taking into account their educational learning styles
Using a case study of the Architectural Engineering Program at the American University in Cairo, this research aims to evaluate these ideas.
In conclusion, it appears that this research supports many of the theories put forward in this paper, notably that students of architecture have greater spatial ability and learn more actively and visually than an ordinary student. A good spatial ability strongly corresponds with visual learning; a strong spatial ability less strongly connects with active learning. (Mostafa & Mostafa, 2010)

In this study work, Barbara de la Harpe et al. examine what exactly should be the emphasis of evaluation in studios for art, architecture, and design.

In order to conduct a thorough analysis for the study, 118 abstracts of journal papers in the fields of art, architecture, and design that were published within the previous ten years were examined. Content knowledge, technology, learning style/approach, and hard/soft skills & inventive practice, reflective practice, and inter-

discipline cooperation are some examples of the product, process, and person indicators for evaluation. The concept attempts to increase the studio's productivity, activity, and intellectual engagement while also increasing students' and academic staff members' personal satisfaction. The report also cautions that evaluations, especially the influence of grading, can have detrimental consequences on learning and morale in the studio.
This study reveals that a wide variety of variables are included in studio assessment. (Harpe et al., n.d.)

Elif Süyük Makakl and Serpil Özker analyze the attributes of basic design course, the units of the course curriculum and its importance in the architectural course curriculum in Turkey in their paper.
To help students understand the fundamentals of architectural language, Basic Design aims to guide the students with basic skills and knowledge required for design education. As a result of this course, they develop an understanding of geometry, perception and technology.
Researchers found that the first or second semesters of a four-year education in Turkey follow the Bauhaus approach. The authors insist that Technology of that time should be followed in Basic Design education, and technical facilities should be used more efficiently and student sensitivity should be developed by carefully defining the course's objectives, content, and methods.
In order to improve perception and assist students build a specific approach to design as open-minded persons, the learning environment for the course should promote students' discovery-based learning. (Makaklı & Özker, 2016)

Nangkula Utaberta et.al. in their paper, aim to study and evaluate the complete process of teaching pedagogy in an architecture studio. This study is an action observation and analysis of students in their second year Architecture Design Studio at the National University of Malaysia (UKM) on their learning and evaluation process in design studio.
To analyze and evaluate the entire process of teaching methods in architecture studio,

this paper was written. Using the architectural design studio as a case study, this paper attempts to develop critique session methods and evaluate the assessment of the studio. Then, propose a more precise and objective assessment method.These methods are extremely helpful to students in their learning process, because they require students to consult with the Critique Session in a gradual and continuous manner. This assessment was deemed to be a Criteria-Based Assessment by the students. (Utaberta et al., 2013)

One of the most serious issues in architectural education is that students lack the ability to implement theoretical knowledge in the practice. Due to their pre-university education's instilled habit of learning by rote, most architectural students struggle to emerge with their own design concepts. In this study by Hacer MUTLU DANACI, the emphasis is given on the rules of transferring theoretical knowledge into practice. (Danaci, 2015)

Findings in architectural education show that when students are given information first and then asked to come up with an original solution after a few weeks of learning and applying it, the results are often less than satisfactory, due to a failure to integrate knowledge and application. On the contrary if you provide the knowledge when the student needs it, the outcome of the design will be more successful. A certain amount of personal flair or creativity is, of course, necessary. In design courses, it has been observed that knowledge that is given at the right time increases the success ratio of the design result.

2.12 Chapter Summary

An attempt has been made to identify gaps and issues in the literature related to the teaching of architectural graphics and drawing in this thesis chapter. This was accomplished by reviewing the material that has already been written about the teaching of architecture, pedagogy, and practice. The study also examined existing literature regarding the educational objectives of various methods for teaching Architectural Design, architectural graphics and drawing, as well as the fundamental principles of

these techniques.

The review's first section examined the concept of educational research, followed by pedagogy and practice of the architectural profession.

Later, the theory of pedagogical approaches and types of Learning was explored.

2.13 Theoretical Framework

A crucial part of research, the Theoretical Framework offers direction and structure while assuring that the study is rooted in contemporary knowledge and successfully answers the research questions about the main theories and approaches and their application in architectural graphics and drawing.

Component	Key Theories/Approaches	Application in Architectural Graphics and Drawing
Foundations of Learning Theory	**Constructivism** (Piaget, Vygotsky): Active knowledge construction.	Hands-on activities, peer collaboration, and iterative design tasks.
	Experiential Learning (Kolb): Concrete experiences and reflection.	Real-world applications, sketching from life, and iterative refinement of drawings.
	Multiple Intelligences (Gardner): Visual-spatial intelligence.	Visual and kinesthetic learning methods, such as model-making and perspective geometry exercises.
Curriculum Development	Backwards Design (Wiggins & McTighe): Clear objectives and aligned assessments.	Develop skills in technical drawing, freehand sketching, and digital visualization.
	Bloom’s Taxonomy: Cognitive,	Progress from basic skills

	psychomotor, and affective domains.	(e.g., line drawing) to advanced tasks (e.g., complex designs).
	Interdisciplinary Approach: Blending theory, history, and technical skills.	Teach graphics in the context of architectural practice, emphasizing real-world relevance.
Pedagogical Strategies	Studio-Based Learning: Collaborative, project-oriented approach.	Foster peer-to-peer learning, iterative feedback, and professional practice simulation.
	Blended Learning: Integration of traditional and digital tools.	Combine freehand sketching with CAD, BIM, and virtual design environments.
	Problem-Based Learning (PBL): Real-world design challenges.	Use architectural problems to develop graphical solutions (e.g., multi-view drawings).
	Mastery Learning: Proficiency in foundational skills before advancement.	Ensure technical drawing skills are mastered before introducing advanced design concepts.
Assessment Framework	Formative Assessment: Continuous, feedback-focused evaluations.	Sketchbook reviews, iterative drafting exercises.
	Summative Assessment: Comprehensive projects with rubrics.	Evaluate accuracy, creativity, and coherence in design and presentation.

	Self and Peer Assessment: Reflective practices for critical thinking.	Foster deeper understanding and improvement through self-evaluation and peer feedback.
Integration of Emerging Technology	Digital Visualization Tools: Use of CAD, BIM, and parametric design software.	Introduce tools like AutoCAD, SketchUp, Rhino, and Grasshopper for advanced drawing tasks.
	Virtual/Augmented Reality (VR/AR): Immersive visualization techniques.	Enhance spatial understanding and presentation skills.
	AI and Machine Learning: AI-assisted design tools.	Enable optimization and exploration of complex design scenarios.
Cultural and Ethical Dimensions	Cultural Sensitivity: Diverse architectural styles and cultural contexts.	Teach respect for global architectural traditions and integrate diverse design influences.
	Sustainability and Ethics: Green architecture and responsible practices.	Promote environmentally sustainable and ethically sound design principles.
Theoretical Outcomes	Competence in technical, creative, and communicative aspects of architectural graphics.	Prepare students for professional practice with a focus on collaboration, innovation, and adaptability.

Table 4 Theoretical Framework

Source: Author

2.14 Identified Research Gaps:

This research review is talking about some significant gaps or deficiencies in the way architecture is taught. After reviewing the literature, a number of gaps that indicate areas that require more research and development can be found in the context of architectural education. To improve architecture students' educational experiences, these gaps must be filled. These are the main gaps found:

A. Pedagogy for Architectural Design Only: The research review discovered that a lot of research emphasizes pedagogy, or teaching strategies, especially for architectural design only. How to teach architectural graphics and drawing in conjunction with design is something they hardly ever cover, though.

B. Technical Curriculum Isolation: The architectural design process is not taught along with any of the present technical courses, such as those that teach building materials or construction techniques. Students study these disciplines independently as a result, which might make it challenging to understand how they relate to one another.

C. First-Year Graphics Curriculum Lacks Evaluation System: There is no effective method in place to assess students' learning in the first-year architectural graphics and drawing courses. Teachers may thus be unable to determine whether or not students are grasping the subject matter. Without feedback students are unable to get improved

D. Limited Architecture Education Exposure: Students have little opportunity to study about architecture in pre-college institutions. Because of this lack of exposure, they might not know what architecture is or why it matters. Preference for Teaching Design Over Technical courses: Teachers and other faculty members believe that teaching design is more significant than teaching technical courses. Technical issues may thus not receive the necessary attention.

E. Projections and Concept Visualization: A better grasp of the ways in which projections and conceptual visualization can be successfully included into the curriculum is required. Despite being acknowledged as an intellectual activity, little is known about the precise techniques and exercises that can help students become more proficient in visualizing.

F. Drawing as a Cognitive and Creative Activity: Drawing is recognized as a way to

experience space, but little is known about how to best utilize these cognitive and creative activities in architecture education. It is necessary to conduct additional research on the relationship between real and imagined forms in drawing in order to improve students' creative processes.

G. Curriculum Improvement: The study is expected to influence the teaching of architectural drawing and graphics, which will enhance the curriculum. This involves adjusting the goals, subjects, and results of the course to better suit the requirements of the industry and the needs of the students.

H. Thinking and Hands-on Design: The connection between cognitive processes and hands-on design work is emphasized, but the best ways to teach this relationship are not sufficiently explored. Building instructional approaches that connect the conceptual understanding needed for design with the actual process of creation is where the gap resides.

I. Differentiation in Drawing Architecture: The contrast between "drawing of an architect" and "architectural drawing" indicates a lack of knowledge regarding the practical applications and teaching methods of these two techniques. To elucidate the ways in which these differences affect students' learning and professional growth, more study is required.

In most of the papers, there are more attempts and methods of framing design studio pedagogy than in any other academic area, as it is the most important subject in an architecture curriculum. It is of utmost necessity to define and derive the parameters of an instructional model that can effectively teach other supporting (technical) subjects in architecture, as well as standardize the various inventive techniques into a workable one.

As educators, we believe that technical courses should be integrated into design courses in order to help students develop a broader design perspective and knowledge. Technical subjects are taught separately from the design studio, it has been noted. An important aspect of architecture studio is that there are strong interrelationships between the various subjects. For students of architecture to teach technical subjects that are equally important, a new pedagogical approach is required.

Pedagogical methods were only discussed in these papers. Multiple instructional strategies were used to help students understand the design environment, since creativity cannot be taught. Use these methods if you are an educator who believes that the process of design is more important than the final product! Along with the assessment criteria, there are other topics that are equally important for a better education and understanding of the design studio in its entirety.

Future research will be able to successfully address these crucial areas thanks to the deficiencies in the theoretical framework of architectural education that have been recognized.

2.15 Research Question

The research question derived from the literature review is 'How to identify the weaknesses in the curriculum and the parameters of effective Teaching and Learning of architectural graphics and drawing subject?

This study aimed to close the gaps by presenting empirical data on the teaching of architectural graphics and drawing subjects, examining the dynamics of the pedagogy of the subject, and determining the parameters that could be used to create a responsive model for teaching first-year architecture students.

2.16 Objective of the Study

To identify the aspects of the subject, architectural graphics, and drawing.

To identify and recommend the efficient models of teaching for architectural graphics and drawing.

CHAPTER - 3: METHODOLOGY

3.0 Introduction

A research process is designed to be unbiased and objective, with the aim of answering a question. It is typically conducted within the parameters of a collection of philosophies (approaches), procedures, methods, and techniques that have been tried and tested for their validity and reliability.

Philosophies refer to methodologies, such as qualitative, quantitative, and the academic field in which you were educated.

Validity is the result of adopting the right procedures to arrive at an outcome.

The quality of a measurement technique that offers accuracy and repeatability is referred to as reliability.

Being unbiased and objective means that you have considered all relevant factors, reached all necessary conclusions, and done so without introducing any personal biases or conflicts of interest. Bias is a deliberate attempt to either conceal or highlight something. (Dawson, 2002; Kothari, 1985; Kumar, 2005).

Chapter one provides an overview of the study's objective, aims, and research questions. As a result, this section of the study addresses the research philosophy that was chosen for it, explains the methodology and strategy, and introduces the research instruments that were created and are being used to further the goals of the study.

3.1 Research Philosophy

A research philosophy is an opinion about how information about a topic should be gathered, examined, and applied. It has to do with how knowledge develops and what kind of knowledge there is. Basic presumptions regarding a researcher's worldview and perceptions make up the research philosophy that is chosen. The research plan and the methodologies selected within it will be supported by these presumptions. Three basic research philosophies are identified in the literature on the topic of research philosophy: positivist (also known as scientific), interpretivist (also known as antipositivist), and pragmatism. (Adakawa & Garba, 2020)

Positivism is a philosophy that supports the concept that only information that is

"factual" and reliable is derived from observations, including measurement. The researcher's involvement in positivist studies is confined to compiling data and presenting an unbiased assessment of it. Stated differently, the researcher conducts the study as an impartial analyst, distancing himself from his own values. Research results in these kinds of investigations are typically measurable and observable.

Researchers caution against assuming a positivist approach to their study since it implies that they believe their research can be completely objective and that they are independent of it. When you conduct your research independently, you engage with your research subjects as little as possible. (Wilson, J. 2010) Stated differently, research employing the positivist paradigm is fact-based alone and views the world as external and objective.

Interpretivism, often referred to as interpretivist research, incorporates human interest into a study by having researchers interpret certain aspects of the study. Therefore, "interpretive researchers assume that the only way to access reality (given or socially constructed) is through social constructions like language, consciousness, shared meanings, and instruments." (Adakawa & Garba, 2020)

Research philosophy grounded in pragmatism recognizes notions as relevant only when they facilitate action. According to Saunders, Lewis, and Thornhill (2012), pragmatics "recognize that there are many different ways of interpreting the world and undertaking research, that no single point of view can ever give the entire picture, and that there may be multiple realities."

The research question is the primary factor that determines the research philosophy, according to pragmatic research philosophy. Depending on the nature of the research subject, pragmatics can incorporate both positivist and interpretivism viewpoints within the parameters of a single study.

In contrast to positivism and interpretivism, pragmatism research philosophy allows for the integration of many research methodologies and strategies within a single study, as demonstrated in the table below. Additionally, studies that adhere to a pragmatic research philosophy can incorporate the use of a variety of research techniques, including action, qualitative, and quantitative techniques.

Research Philosophies	Research Approach	Ontology	Axiology	Research strategy
Positivism	Deductive	Objective	Value-free	Quantitative
Interpretivism	Inductive	Subjective	Biased	Qualitative
Pragmatism	Deductive/ Inductive	Objective or Subjective	Value-free/biased	Qualitative and/or Quantitative

Table 5 Positivism, Interpretivism and Pragmatism

Source: Wilson, J. (2010)

Pragmatists contend that the approach that best fits the topic at hand and the objectives of the research should be adopted (Benbasat, 1984; Pervan, 1994b).

The foundation of this research is based on the notion that all methodologies have value when applied correctly and that, with careful management, research can incorporate aspects of positivist and interpretivist methodologies. Thus, the pragmatic research philosophy was implemented for this study. The overriding concern of this research is that the methodologies employed should be both relevant to the research question, as laid out in Chapter One, and rigorous in its implementation. It takes both an interpretative and a positivist philosophy to comprehend the character of the curriculum.

Identifying the crucial aspects of the curriculum of Architectural Graphics and Drawing I &II and recommending the improvement along with finding the teaching strategies for architectural graphics and drawing subjects is the focus of this study. This goal necessitated the use of positivist philosophy to gather feedback from teachers and students as well as interpretive philosophy based on in-person observations of lecture halls to determine instructional strategies. However, because subjectivity is frequently linked to interpretivist research orientation, the design and development of the data gathering instrument took a positivist, quantitative approach.

3.2 Research Approach

Research approaches refer to the clear, methodical strategies and procedures of inquiry

used in a study. They might range from general hypotheses to specific techniques for gathering, analyzing, and interpreting data that are best suited to the research issue. Quantitative research, qualitative research, and mixed research are the three main research methodologies that are recognized in the social and behavioral sciences. The primary method used in quantitative research is the gathering of quantitative data. In order to provide a causal explanation and make generalizations, science aspires to objectivity, reproducibility, and control. Generally, a sizable and representative sample size is used; however, single cases or lower sample sizes may be taken into account. Numerical data must be collected and analyzed.

Qualitative data acquisition is essential to qualitative research. It is an alternate approach to research. Content analysis, which involves an interactive and transactional interaction with the acquired texts, is the method used to analyze data (Rennie, 1998). The objective is to reconstruct the individual significance and/or experiences that the individuals have shared.

A mixed method approach to study is the one that gathers data using both quantitative and qualitative methods, integrates them, and creates original designs that may incorporate theoretical frameworks and philosophical presumptions. Mixed method research operates under the fundamental assumption that combining qualitative and quantitative methods yields a more comprehensive grasp of a study problem than each method working alone.

3.3 Research Approach – Survey

The purpose of this study was to analyze the curriculum and examine how Architectural Graphics and Drawing is taught and learned in order to find strategies for enhancing students' comprehension of the subject at Savitribai Phule Pune University in Pune, Maharashtra, India. The mixed method research described below was adopted. A quantitative assessment was conducted of the Architectural Graphics and Drawing subject at each of the chosen universities. Textual data came from teachers and students, oral interviews as well as the student academic portfolio using open-ended questions. By using content analysis, data was examined. This was accomplished by outlining and

clarifying the connections throughout the curriculum. A quantitative analysis was conducted to look at the ways that instructional methods influence learning results. Quantitative techniques were used to examine how learning inputs affected learning outcomes.

Based on a review of the literature, which included information on research procedures employed in related studies, the research strategy chosen for this study was survey. As a result, this strategy led to the adoption of three primary survey techniques: participant observation (to determine students' learning styles and responses to different teaching modalities), interviews, and questionnaire administration. Examining the curriculum and teaching of architectural graphics and drawing was the study's objective. Since so little is known about the pedagogy of architectural graphics and drawing, the study's approach is exploratory and descriptive. This implies that the quantitative approaches might be helpful in characterizing certain aspects of the teaching of architectural graphics and drawing.

There are several reasons why the survey is recommended. First, data from surveys can be subjected to quantitative analysis. Second, the survey approach has the capacity to generate a sizable volume of data quickly and affordably. Finally, data generated by the survey approach can be broadly interpreted. Primary and secondary sources of data were gathered for the research. The core data was gathered by surveying faculty members and students in several architecture colleges at the chosen universities.

Two primary domains were covered by the questionnaires: Content of the curriculum, and Pedagogy - teaching and learning methods.

3.4 Sampling Procedure

First year students and teachers teaching architectural graphics and drawing at a few architecture colleges affiliated with Savitribai Phule Pune University (SPPU) comprise the study population.

The study population comprises of the staff and students Six Colleges affiliated with Savitribai Phule Pune University (SPPU) Pune, Maharashtra,

3.4.1 Study Population

The sample should ideally be representative so that the researcher can accurately determine the attitudes and actions of the general community (Kumar, 2005; Dawson, 2002; Kothari, 1985). Given the abundance of statistical tools and formulas available for use in calculating the sample size, several statistical formulas were investigated for objectivity's sake, and the findings were contrasted as shown.

The selection of the sample population is based on the Intake of students in the First year. Each College has a different Intake, ranging from 40 to 120 in the first year.

As per Council of Architecture norms, each division has 40 students. Keeping this as a base, students randomly selected from four colleges and the study population of students was 240 and Total faculty population of 32 faculty was derived

The Sample Size is calculated on the Total population.

Slovin's formula is used to calculate the minimum sample size needed to estimate a statistic based on an acceptable margin of error.

3.4.2 Student Sample Size

As per the selection criteria of the Faculty from affiliated colleges of SPPU, the total Population of first-year students of the 4 colleges is 240.

As per Equation 1, the calculated sample size is 149 by considering

95% Confidence Level and +/- 5% margin of error

Equation 1 - $n = N / (1 + Ne^2)$, where:

n = Sample size N = Population size e = Acceptable margin of error

3.4.3 Faculty Sample Size

As per the selection criteria of the Faculty from affiliated colleges of SPPU, the total Population of the 4 colleges is 32.

As per Equation 1, the calculated sample size is 30 by considering

95% Confidence Level and +/- 5% margin of error

Equation 1 - $n = N / (1 + Ne^2)$ where:

n = Sample size N = Population size e = Acceptable margin of error

3.4.4 Sampling Techniques

Purposive sampling and random sampling were used to create the sampling strategy that worked best for the research of architectural graphics and drawing pedagogy. The two methods working together showed a lot of promise for producing a more thorough and representative analysis. Purposively (non-probability) choosing the universities only in Pune, India was the initial step in the selection process. Students studying in those colleges were then chosen using a random (probability) sampling technique. The faculty members who teach Architectural Graphics and Drawing in each college are chosen using purposive sampling.

A statistical test called the Kaiser-Meyer-Olkin (KMO) test, sometimes referred to as the KMO measure of sample adequacy, is used to assess whether data is appropriate for factor analysis. It evaluates how much of the variation between variables may be attributable to shared factors; higher KMO values suggest greater eligibility for factor analysis.

A more thorough description is provided below:

By finding underlying factors, factor analysis is a statistical technique that reduces the dimensionality of data. The KMO test assists researchers in determining whether their data is suitable for factor analysis.

The KMO test computes a statistic that shows the ratio of the total squared correlations between variables that were observed to the total squared partial correlations between variables.

KMO values fall between 0 and 1. Values near 1 (0.9 or above) generally suggest strong suitability for factor analysis.

• A range of 0.7 to 0.8 is regarded as appropriate.

• Values below 0.5 imply that the data may not be appropriate for factor analysis and that other approaches should be taken into consideration. Values between 0.5 and 0.7 are hardly acceptable.

KMO Test applied to the data -

This test checks for one of the assumptions of factor analysis. It indicates the pattern of correlations within the data set. A value close to 1 indicates that patterns of correlations

are relatively compact and so factor analysis should yield distinct and reliable factors. Values close to .9 are excellent.

The Value .934 indicates that the samples are adequate which is shown in the table below.

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.934
Bartlett's Test of Sphericity	Approx. Chi-Square	1225.531
	df	78
	Sig.	.000

Table 6 KMO and Bartlett's Test

Source: Author

The KMO test is frequently used in conjunction with Bartlett's test of sphericity, which examines the null hypothesis that there is no correlation between variables and that the correlation matrix is an identity matrix.

3.4 Unit of analysis

Since the study of the pedagogy of architectural graphics and drawing can be best understood from a practical perspective in which the participants' experiences and activities are able to provide confirmed and reliable data, it is appropriate that students and faculty in the selected architecture colleges be the unit of the study population. This is in accordance with the results of research conducted by Faoro (1994) and Vassigh (2004), who employed faculty members as the units of analysis in a survey on curriculum of other technical subject i.e. structures and students as the unit of analysis in an evaluation of a teaching approach. This study also employed students as the unit of analysis due to its cross-cutting research aims, which encompassed learning styles, teaching styles, and curriculum evaluation.

3.5 Data Collection

The three main tools utilized to collect the primary data for this study were the questionnaire, observation schedule, and interview guide. The research consisted of two sets of questionnaires: Appendix 1 for students, and Appendix 2 for faculty members

chosen for the study. There were both closed-ended and open-ended questions in the surveys. While respondents were able to provide lengthy replies and explanations where necessary, the closed-ended questions elicited precise responses. The measuring scale for the closed-ended questions was a 5-point Likert scale (1–5).

The open-ended questions gave the participants a chance to share their views on the topic under examination. The two surveys' questions were divided into parts based on how the variables were grouped according to the study's main research topics and conceptual frameworks.

For the in-person interviews, a prepared questionnaire was implemented. It was just a list of the interview questions that were asked. This was done to make sure that all interview sessions covered the same set of topics and an equal number of questions. In several cases, the questions were pre-formulated. The interviews were done in accordance with the standard interview format that was adopted. As a result, the researcher (interviewer) had more leeway to probe and gauge as needed and go deeper into any topics brought up during the interviews.

The purpose of the open-ended questions was to enable respondents to provide more in-depth explanations when their responses were difficult to compress into a few sentences. The purpose of the conversation strategy was to obtain specific data about the practices and methods of implementing the educational approaches to architectural graphics and drawing that are particular to each college. It included more details to support the information obtained from the questionnaire given to the faculty members. Essentially, the purpose of the observation plan was to document the observations the researcher made while on the field. The methods of lecture delivery, the nature of the course material, the educational environment, the students' reactions to different approaches to instruction, and other information were among the data that this instrument was intended to gather.

3.7 Academic Limitations

This study is limited to inputs from the Academic stakeholders, i.e., Students and Teachers only. Professional stakeholders such as Contractors, Architects, etc., are not part of this Study. Being an exploratory study, one can carry forward this study with

the inputs from Professional stakeholders.

Due to its exclusive focus on academic participants, the study has certain limitations in relation to the stakeholders. The salient features of this constraint are:

a. Emphasis on Academic Stakeholders: The study only includes feedback from academic stakeholders, particularly instructors and students who study architectural graphics and drawing at institutions connected to Savitribai Phule Pune University (SPPU). Understanding the curriculum's instructional components requires this attentiveness.

b. Professional Stakeholder Exclusion: This study does not include professional stakeholders like contractors and active architects. Their opinions may offer a more comprehensive view of the efficacy of the architectural curriculum and its conformity to industry demands, which makes their removal noteworthy. The study's scope might have been significantly increased by including these experts.

c. Consequences of the Limited Scope: The study may overlook important information that could guide educational strategies and curriculum development if professional stakeholders are not included. This restriction raises the possibility that the results mostly represent scholarly viewpoints without taking into account real-world architectural applications.

d. Exploratory Study: The study is described as exploratory, meaning that its goal is to obtain preliminary knowledge and insights. In order to improve the results and present a more thorough picture of architecture education, the researchers agree that professional stakeholders could be a useful addition to future studies.

e. Prospects for Future Research: By incorporating feedback from experts in the field, the researchers propose that future investigations could expand on their findings. A more comprehensive assessment of the curriculum's efficacy and applicability to actual architectural practice would be possible using this method.

In conclusion, even though the study offers insightful information from academic stakeholders, its shortcomings, such as the exclusion of professional viewpoints, highlight the necessity for more investigation to completely comprehend the practical ramifications of architecture education.

3.8 Data Collection and Analysis

To meet the aims and objectives of this study, appropriate methods for gathering and handling data are crucial. As a result, the following paragraphs define an extensive approach. The research's fieldwork was conducted from October 2014 to December 2014, and the data entry and analysis phases took place from January 2015 to April 2015. I collected the data on my own, with the help of a few assistants.

3.9 Data Treatment by Objectives

3.9.1 Objective 1 –

'To identify the curricular aspects of architectural graphics and drawing subjects'.

Data Characteristics:

Both qualitative and quantitative data are used to achieve this objective. The curriculum for architectural graphics and drawing is described, together with its input, method, and outcome, by the qualitative data. The information includes Course Objectives, Course Content with various Units (Topics), Course Outcome along with Teaching Scheme and Examination Scheme.

Data Source:

The data is sourced from the Syllabi, the Course content and Evaluation of the Curriculum of Architectural Drawing and Graphics subject is obtained from the various Indian Universities such as

i. Savitribai Phule Pune University (SPPU),
ii. Symbiosis School of Architecture, Urban Development and Planning, Symbiosis Open Skill University Pune, (SSPU)
iii. MIT School of Architecture, MIT Art Design and Technology University Pune, (MIT)
iv. College of Architecture, Bharati Vidyapeeth, Pune, (BVP)
v. Dept. of Architecture, Anna University Chennai, (AU)

vi. BMS College of Architecture, Bengaluru, Visvesvaraya Technological University, Belagavi. (BMS)

vii. Manipal School of Architecture and Planning, Manipal Academy of Higher Education, Manipal (MAHE)

viii. The Institute of Architecture and Planning Nirma University, Ahmedabad (NU)

ix. Institute of Design Planning and Technology, Sarvajanik University, Surat, (SU)

x. School of Planning and Architecture, New Delhi. (SPA)

Architectural curriculum at Global level

The architectural education system developed over time into four distinct yet overlapping systems. The structured formal architectural education system was first introduced by the French, then by the Germans, who introduced the idea of research in the field of architectural teaching. The United States took the lead in combining the two ideas in a university setting, adding the United Kingdom's idea of apprenticeship, also known as internship (Weatherhead 1941). This sparked the demand for more globally standardized architectural education standards.

The academic duration ranged from three to six years. A two-year additional Masters professional degree is always required after three years of architecture school in countries like Zimbabwe, Serbia & Montenegro, Belgium, and the United Kingdom. A minimum of five years is required in the majority of countries. The year constraints vary and are primarily determined by the number of courses that students must finish in nations like the United States and Canada.

A review of International Universities like Massachusetts Institute of Technology, Department of Architecture and Aarhus School of Architecture, Denmark, is carried out to understand the variations in the syllabus.

Analyzing the various curricular aspects of architectural education, it was found that the requirements for courses range widely, from an emphasis on art and design to more technical subjects like survey and building science. The architectural graphics and drawing curriculum is part of the Architectural Design studio. There is high variation in the curricular aspects across the countries. The core areas of curriculum include

Design Theory, Technical (construction) systems, Design Documentation (Architectural Drawing) and professional practice.

The syllabus of Indian Schools and Colleges is based on the guidelines by Council of Architecture, New Delhi. As per Council of Architecture guidelines for curriculum, the number of hours allocated for Architectural Graphics Skills –Manual and Computer are 360 hours. The syllabus content of Indian Schools and Colleges is primarily, Plane geometry, Orthographic projections of planes and solids, Sections of solids, True shapes and Scale etc.

Data Analysis: Curricular aspects

Comparative analysis of all the curriculum patterns of various Schools and Colleges of Architecture has been carried out to understand the respective course content, Evaluation and Examination system.

University / Curriculum	SPPU	SSPU	MIT	BVP	AU	BMS	MA-HE	NU	SU	SPA
Public (P) Private (Pr) Deemed (D)	P	Pr	Pr	Pr	P	P	Pr	Pr	Pr	D
Isolated (I) Clubbed (CL)	I	I	I	I	I	I	I	I	I	CL
Credit base Exam (C)	C	C	C	C	C	C	C	C	C	C
Paper (P) Sessional (SS)	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS
No of Sem. Graphics + CAD	I-III + IV	I, II + III	I-III + IV	I-III + IV	I + II	I, II + III	I, II + III	I-III + IV	I, II + III	I + II

Table 7 Comparative analysis of the Evaluation system of various universities.

Source: Author

3.9.2 Overall Observations on Comparative Analysis of the Curriculum of various Universities:

A course's syllabus or content are frequently linked to the term "curriculum," and people have a propensity to assume that if a course's content is specified, then the entire program of study is as well. Only content requirements are listed in the current Council of Architecture paper on "Minimum Standards of Architectural Education's academic standards. The syllabi are based on Council of Architecture guidelines, with minor variation in terms of implementation with respect to the course content and evaluation. This curriculum is taught within I to IV semesters Only.

There is No Theory Examination for this subject. Only Continuous Internal Evaluation (CIE) and Semester End Examination (SEE)

All Universities follow Choice Based Credit System. (CBCS)

Course Objective and Content and Outcome is very well defined by all Universities.

SPA New Delhi has clubbed the curriculum with Architectural Design in First Term only.

The review of the curriculum of foreign universities states that this Subject is integrated with various other subjects Design, History and treated as Skill Based learning.

To continue with the methodology, as mentioned earlier in point 3.3 Research Approach – Survey, a Questionnaire was prepared **(Appendix 1)** to identify and validate the need of development of the curriculum and Pedagogy for architectural graphics and drawing Subject.

1. The Questionnaire is addressing the Research Gap.
2. A staff questionnaire has been prepared to validate the Subject for Research.
3. The Questions are based on the discussion with the Experts, Curriculum and the Literature review.
4. The questionnaire is based on

• Pune University Curriculum for Architectural Graphics and Design subject.

• The Journal of Effective Teaching (The Journal of Effective Teaching, 2008)

• Analysis of architect's performance indicators in project delivery process (Analysis of architect's performance indicators in project delivery process: Friendly City 4 'From

Research to Implementation For Better Sustainability', 2018)

• Criteria-Based Assessment and Grading in Architecture Design Studio (Assessment and Grading in Architecture Design Studio, January 2012)

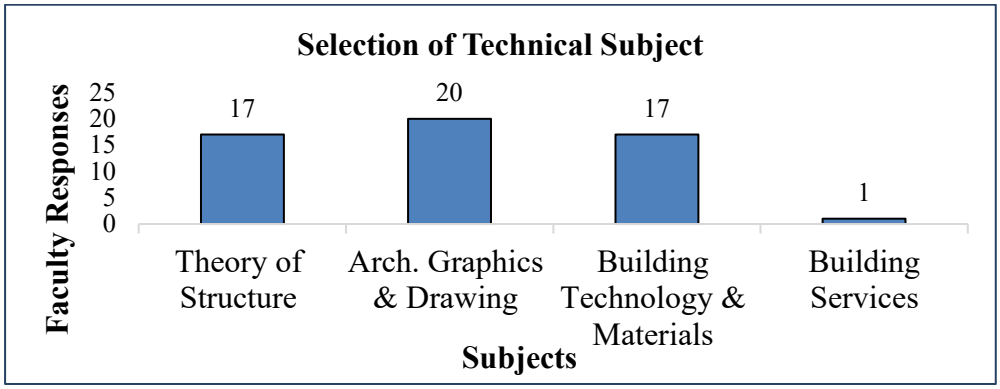


Figure 6 Selection of Technical Subject

Source: Author

The questionnaire, based on Likert Scale of 1-5, was sent to 56 faculty members who teach architectural graphics and drawing subjects to First for the last 3 Years in various institutes. The responses received were analyzed and validated through various tests.

It is observed from the responses that the passing out students are NOT industry-ready as far as the SPPU Curriculum is concerned.

Design Drawings are not communicating in a desired manner by integrating all technical subjects, and the outcome of students' design and technical drawings are not satisfactory.

3.9.3 Objective 2

To identify and recommend efficient Models of Teaching for architectural graphics and drawing subjects.

Data Characteristics:

To continue with the methodology, as mentioned earlier in point 3.3 Research Approach – Survey, a Questionnaire was prepared **(Appendix 2)** to identify the crucial aspects of the curriculum and then the efficient Models of Teaching for architectural graphics and drawing, on the basis of the identified research gap and the other research reviews. Both qualitative and quantitative data are used to achieve this objective. The

models for teaching architectural graphics and drawing are being described, together with its input, method, and outcome, by the quantitative data.

Data Source:

The data is sourced from the students' and faculty interviews conducted for the identification of the crucial aspects of the curriculum and then the efficient Models of Teaching for architectural graphics and drawing. The teaching learning methodology of the subject is derived subsequently.

The Course content and Evaluation of the Curriculum of Architectural Drawing and Graphics subject is also analyzed.

The Questionnaire to identify crucial aspects of the curriculum of architectural graphics and drawing was prepared on the following parameters.

1. A Questionnaire was prepared (Appendix 2) to identify and validate the crucial aspect of the curriculum for architectural graphics and drawing to identify efficient Models of Teaching (Pedagogy) for the Subject.
2. A staff questionnaire has been prepared on the basis of the identified research gap derived from the research paper reviews.
3. The Questions are based on the discussion with the Experts, Curriculum and the Literature review.
4. The questionnaire is based on
    - Pune University Curriculum for Architectural Graphics and Design subject.
    - The Journal of Effective Teaching, Vol. 8, No. 1, 2008, 21-32 ARCC JOURNAL / VOLUME 6 ISSUE 1
    - Analysis of architect's performance indicators in project delivery process: Friendly City 4 'From Research to Implementation For Better Sustainability' IOP Conf. Series: Earth and Environmental Science 126 (2018) 012106 doi:10.1088/1755-1315/126/1/012106
    - Criteria-Based Assessment and Grading in Architecture Design Studio, Research Gate, Article · January 2012, DOI: 10.1007/978-3-642-25908-1_30

The questionnaire based on Likert Scale of 1-5, was sent to the same 56 faculty

members who teach architectural graphics and drawing subject to First for the last minimum 3 Years in various institutes.

The survey reveals that students face challenges in understanding the aspects of the curriculum of architectural graphics and drawing and the course outcome of the subject is hampered. The lack of technical representation, the correctness of the drawing are some of the major concerns. The curriculum evaluation system also needs to be looked in as it is affecting the outcome of the students.

The responses received were statistically analyzed and validated through various tests. The Cronbach's alpha (L.M. Collins, 2007) value is derived, which is more than 0.7 shows that the internal consistency or the reliability of all the above questionnaires are acceptable.

The content of the curriculum i.e the Units as per SPPU curriculum, are validated by the faculty responses supported by statistical analysis. The units of the curriculum define the parameters for the students' understanding and the evaluation of those units / parameters.

Students' survey was conducted to measure the level of understanding of the units of the curriculum. Around 149 students from various institutes and over the years participated in the survey. It is observed that students face difficulties in certain units like scale drawing, 3 dimensional solids and their generation with respect to penetration, surface development etc. The students agreed that the approach towards sketching is very casual. They face challenges while sketching, developing their ideas etc.

A rubric for the evaluation has been developed for the assessment of the students drawing sheets. Rubric (https://www.cornell.edu/) is an assessing guide that evaluates and clarifies specific aspects and requirements of an assignment is called a rubric. A range of assignments, including research papers, group projects, portfolios, and presentations, can benefit from the usage of rubrics.

Teachers can assess assignments uniformly from student to student by using rubrics. Rubric reduces the amount of time spent on grading, both now and later.

It provides prompt, insightful feedback to students and encourages their learning in an

ongoing manner. They make assignment criteria and expectations clear for teachers as well as students. One can examine rubric outcomes to improve instruction strategies. Students can better comprehend assignment criteria and expectations with the use of rubrics. They become more conscious of their advancement and learning process. Rubrics enhance work by providing prompt, thorough comments.

The students' drawing sheets were evaluated on the basis of the rubric for uniform and unbiased assessment. The outcome of the students learning and teacher's model of teaching is evaluated. To have impartial assessment, grading of the drawing portfolio of one of the batches of 40 students was done by 3 experts. Two experts from the same institute and one from the other institute were involved in the assessment. The outcome was analyzed by Descriptive Statistics to come to a conclusion.

Data Analysis: efficient Models of Teaching

The data obtained was analyzed by,

(1) Pilot study for tool development - A test/tool was made to check the level of students' understanding in the subject of architectural graphics and drawing. Data was collected from 149 students. Based on this data reliability and factor analysis was done.

(2) B) Analysis of student's competency - Students' competency was checked by asking 3 experts to rate students' architectural graphics and drawing sheets.

Additionally, the mean, mode, range and other descriptive statistics were checked for the rating that students got from these scorers.

3.10 Data Processing

Data processing and analysis were carried out using a computer and the statistical package using reliability test, Factor Analysis, and various other tests.

The qualitative data, which came mostly from the observations and interviews, was analyzed using a non-statistical method called content analysis. The purpose of the responses and observation analyses was to find recurring trends and patterns in the topic under investigation.

3.11 Reliability and Validity Tests

The two most crucial factors in research design, methodology, findings, and results are validity and reliability. The consistency of results is referred to as reliability. The term "validity" describes how reliable or plausible the research is.

Cronbach alpha measures internal consistency reliability. Internal consistency analyzes whether all questions in a test measure the same underlying construct or concept. When the Cronbach Alpha (L.M. Collins, 2007) value is more than .7, the reliability is considered high. Here the value is more than .7 which shows a very high reliability.

As a result, the scale of measurement for this study has strong internal consistency, and the scales of measurement with the sample are dependable.

3.12 Justification for the Chosen Methods

Effective teaching techniques can have an enormous influence on students' comprehension of significant design concepts and technical skills, which makes "Development of Curriculum and Pedagogy for the Effective Teaching of Architectural Graphics and Drawing," exceptionally pertinent in the context of architectural education. Adopting the faculty and student survey method in the study is advantageous for a number of reasons. This justifies why this approach is appropriate for the subject:

1. Recognizing the viewpoints of stakeholders:

a. The Viewpoint of the Students: The curriculum and pedagogy are directly received by students. To find out which teaching strategies, resources, and methods work best from the perspective of the student, their input is crucial. Surveys can be used to gather information on students' experiences, difficulties, and opinions about what they think improves their architectural drawing and graphics education. With this understanding, one can modify the curriculum to better suit the needs of the students rather than depending just on institutional or theoretical presumptions.

b. Faculty Viewpoint: Teachers are the main individuals who implement the curriculum. Their input can assist in determining the advantages and disadvantages of the present teaching approaches, and they contribute knowledge and practical expertise. It will be helpful to improve the curriculum and pedagogy by learning how faculty

members approach teaching architectural graphics and the difficulties they have in delivering the content.

2. Empirical Evidence for Curriculum Development: Through staff and student surveys, we acquire empirical data that may be examined to find weaknesses in current teaching strategies and curriculum. Research is more firmly rooted in actual educational environments due to this data-driven methodology, which offers ideas for curriculum development or revision on a more tangible basis.

3. Determining Efficient Teaching Techniques: Teaching architectural graphics and drawing involves a variety of instructional strategies, including practical activities, digital tools, and conventional sketching techniques. By using a questionnaire, you may find out which approaches are most prevalent with both students and teachers. Designing a curriculum that supports the development of critical abilities including technical drawing, spatial visualization, design communication, and evaluation, is made easier with an understanding of these preferences.

4. Inclusive and Comprehensive Feedback: To ensure that the feedback is inclusive, a survey approach enables you to gather a wide variety of responses. In order to ensure inclusivity and recognize that all groups have an interest in the educational process, you should reach out to both teachers and students. This inclusive feedback can assist you in comprehending the diverse requirements of many groups and possibly identifying areas where professors and students might have different opinions, which may lead to additional research and curriculum improvement.

5. Quantitative and Qualitative Information: Surveys can produce both qualitative information, like open-ended answers, and quantitative information, such as rankings or ratings of various teaching strategies. Combining these two methods enables you to measure broad trends and give thorough explanations of issues and approaches that respondents believe are significant. In order to give a more complete picture, faculty members may offer detailed comments on teaching obstacles, while students may score the efficacy of various drawing techniques.

6. Encouragement of Curriculum Innovation and Change: Lack of awareness or

consensus around the necessity of change frequently impedes curriculum development. Data collection from both professors and students allows one to provide verifiable proof of the necessity for curriculum adjustments, which facilitates the justification and implementation of changes. Survey-supported research can serve as a compelling case for changing teaching strategies to better meet the demands of the modern world.

7. Benchmarking and Comparative Analysis: The surveys can be used to compare the best practices in other educational institutions with the existing curriculum and teaching methods, or to assess how architectural education is doing in various nations or areas. This comparison method can add depth to the research and offer creative solutions.

3.12.1 Conclusion: The chosen methods may acquire rich, varied perspectives from individuals who are actively participating in the teaching and learning process through applying the survey approach. By offering empirical information on the existing state of architectural graphics and drawing education and potential enhancements, it bolsters the research. It also fits with the Aim and Objectives of creating a curriculum and pedagogy that takes into account the field's changing landscape as well as the real-world requirements of teachers and students.

All things considered, the faculty and student survey approach is a crucial research instrument since it allows for the following:

The collection of candid, insightful input from both groups involved in architectural education.

The creation of an evidence-based curriculum that takes into account the requirements and preferences of important stakeholders.

Examine the current curriculum and teaching methods to determine their advantages, disadvantages, and potential areas for development.

3.12 Summary

In order to address the research methodology, this chapter clarified and described the step-by-step approach used to conduct the study. This chapter makes it quite evident

that the study used both qualitative and quantitative survey research approaches. The sample size, which was established by combining many statistical formulas, was 149 students and 49 teachers. The instruments utilized to collect the data were a questionnaire, an oral interview, and an observation schedule.

Three primary categories of variables served as the basis for the analysis: curriculum of architectural graphics and drawing, learning inputs, and students' difficulty level of understanding. Following data collection, a number of statistical tests were used to analyze the data, including factor analysis, KMO tests, descriptive statistics, and the Kruskal Wallis test. The findings of the tests and analyses, together with their ramifications, are presented in later chapters of this thesis.

CHAPTER – 4: RESULT ANALYSIS AND DISCUSSION

4.0 Introduction

This chapter's objective is to deliver as well as clarify the results and analysis of this investigation. In accordance with the two objectives of the study, the chapter is split into two primary sections. In the first section, the findings from the data review of the architectural graphics and drawing curricula at all the institutes evaluated are presented and discussed. The data on instructional methods is presented and discussed in the second section. A summary of the main conclusions closes the chapter.

The assessment of the worth and merit of a course, program, or topic of study is known as curriculum evaluation. (AboWardah, 2020)

The following are some notable examples of Guba and Lincoln's excellence and worth: What is meant by merit to be an entity's implicit, inherent, and application-free value is its intrinsic value. This suggests that context has no bearing on how merit is determined. Contrarily, worth describes the significance of an entity in relation to a certain setting or use. (Adakawa & Garba, 2020)

It is crucial to remember that various models of curriculum assessment have been created over time, since these two ideas serve as the foundational rubrics for curriculum evaluation. Stufflebeam's context, input, process, and product model; Scriven's goal-free model; Stake's responsive model; Eisner's connoisseurship model; Bradley's effectiveness model; and Tyler's objectives-centered model are a few of these. The Context, Input, Process, and Product (CIPP) model developed by Stufflebeam has been adopted for this study despite the fact that each of these models has strengths and drawbacks of its own. Its methodical approach, conciseness, and emphasis on decision making makes it suitable for administrators who are interested in improving education curricula.

As indicated in Table 4.1, the CIPP model was also used in this investigation because it aligns with the main questions that are being looked into.

Component	Parameters
Context	A review of architectural education, including technology education.
Input	Assessment of Course Content, Emphasis, and Sequence
Process	A synopsis of its year-by-year credit unit structure, the proportional weight of each credit in the overall architectural curriculum, instructional delivery techniques, and assessment method(s)
Product	Assessment results and higher order abilities were used to evaluate the learning outcomes of the students.

Table 8 The altered version of Stufflebeam's (CIPP) model for assessing architectural structures curriculum

Source: Author's Adoption of the CIPP Model (Glatthorn, et al., 2012) by Alalade, Gbenga Martins 2017.

4.1 Overall philosophy of Architectural Institutes based on Council of Architecture Guidelines.

The overall philosophy reflected in each architectural institute reflects the 'thought' of the school on which it is established. It is elaborated as follows:

i. An architectural school's exposure and program breadth should result in competent, skilled, and creative individuals who can handle a wide range of environmental, human, and other activity-related challenges.

ii. An architecture graduate should get training in the art and science of managing and coordinating the efforts of related professionals in the development of the environment, including planning, designing, building, commissioning, and maintaining.

iii. By suggesting various electives, every institution should seek to investigate the nation's abundant traditional and cultural architectural resources, both

nationally and locally.

iv. In continuation with the above, the curriculum should be adaptable to the evolving demands of architectural education resulting from a shifting social, technological, economic, and psychological landscape.

v. Creating a professional architect, equipped to handle all aspects of architectural design, from working drawings and schematic design to construction detailing and the creation of workshop drawings.

vi. The aim is to equip the students with the necessary knowledge and abilities to handle various management tasks, including organizing meetings on site, managing facilities, conducting post-construction assessments, and so on.

vii. Equipping the student with the necessary foundational knowledge and abilities is important as they can pursue advanced coursework in architecture or similar fields.

viii. Equip the student with entrepreneurial know-how and abilities so they can be self-sufficient.

4.2 Learning Goals: Subject Knowledge Framework

Every architectural institute that offers a Bachelor's degree program is allowed to customize the structure, content, and makeup of its modules or courses inside the Council of Architecture framework to suit its own unique needs. More than 100 course titles suggested by the Council of Architecture are available at architectural institutes of Indian universities which are divided into eight major instructional modules. It is anticipated that all programs will make sure students are taught the fundamentals of architecture, which include the following:

a) Architectural Design
b) Architectural graphics and drawing
c) History of Architecture
d) Building Materials and Construction Technology
e) Arts and Humanities
f) Environmental Science

g) Digital Technology
h) Management and Entrepreneurship Studies.

The curriculum, syllabus, course outline or content, teaching strategies, teaching aids, pedagogy, assessment system, etc. are all clearly specified in the western system of architectural education, in contrast to our situation, and ongoing revisions are a feature of the system itself. The Association of Collegiate Schools of Architecture (ACSA) is one of the best organizations for architectural education in the United States. Throughout Europe, architects are regarded as the "first professionals" due to their greater worldview and informational basis than other professionals and the fact that they are responsible for creating living environments. So, the crucial query is how to incorporate the issue and the subject matter into the educational framework. Questions about curriculum include how much and how long to teach, which disciplines to emphasize, how much design and related courses to teach in relation to "other" subjects, how to educate technology and the humanities, and other issues. Pedagogy, or the science of teaching, deals with questions such as how to educate, how much of the theoretical inputs/exercises are practical, how to motivate, how to evaluate, etc.
In this way, pedagogy is process based, whereas curriculum is more content oriented. Forming a curriculum involves taking into account multiple contexts while analyzing a culture and its high school education. Unwritten objectives of any pedagogy, however, include competence, inventiveness, awareness, sensitivity, humility, and creativity. (Miki, 2006)

4.2.1 Curriculum - Analysis and Result

Basic technical drawings that describe a building's construction are called architectural drawings. The elements are graphically represented through the use of symbols, letters, and lines. To keep the drawing's detail consistent throughout, these visuals follow a predetermined measurement scale.
With respect to the point no 3.8.1, the outcome of the faculty Survey (Appendix 1) is represented in the graph below.

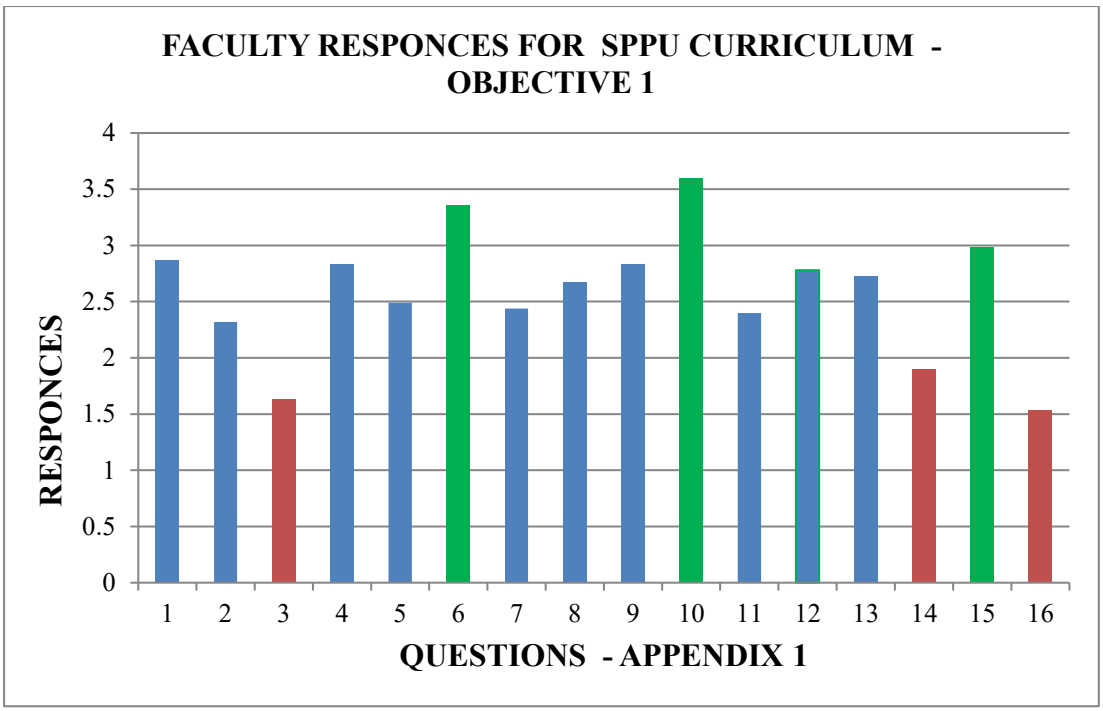


Figure 7 Faculty Responses for SPPU Curriculum.

Source: Author

The basic observations derived from the survey are as follows:

1. The architecture curriculum is not sufficient to prepare students to be industry ready.
2. Design drawings are drawn without integrating the technical subjects which leads to the lacuna in communicating the architectural design correctly.
3. Due to many factors, the outcome of students' design and technical drawing is not satisfactory. The factors include the evaluation and examination system of SPPU and the teaching models technical curriculum.
4. SPPU curriculum follows COA Guidelines.
5. Technical correctness of the drawing is more important than design drawing.
6. Faculty to student ratio prescribed by Council of Architecture and implemented by SPPU is sufficient.

Verifying internal consistency reliability - The Cronbach's alpha = 0.6906 = 0.7

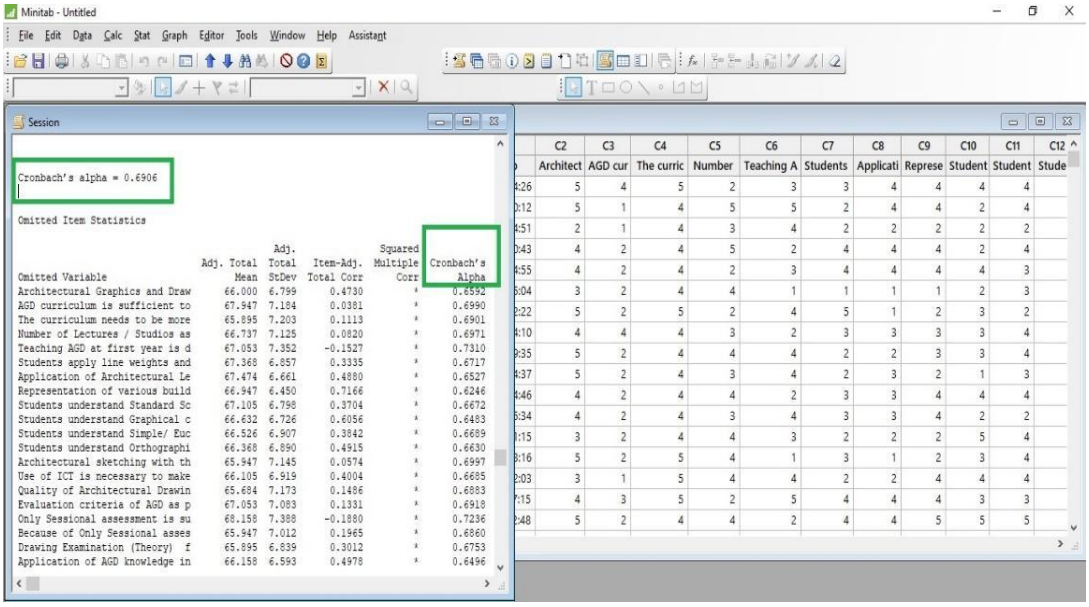


Figure 8 Cronbach alpha

Source: Author

Cronbach alpha measures internal consistency reliability. Internal consistency analyzes whether all questions in a test measure the same underlying construct or concept. The Cronbach's alpha value is 0.7 which shows that the Internal Consistency or the Reliability of all the above parameters are acceptable.

4.2.2 architectural graphics and drawing – Curriculum Analysis and Result

The most organic method of expressing an architectural component is through drawing. A single line that describes the building has a great deal of narrative potential and can convey information more fully than several pages of words on paper.

A questionnaire (Appendix 2) is being prepared to provide a response for the research objective.

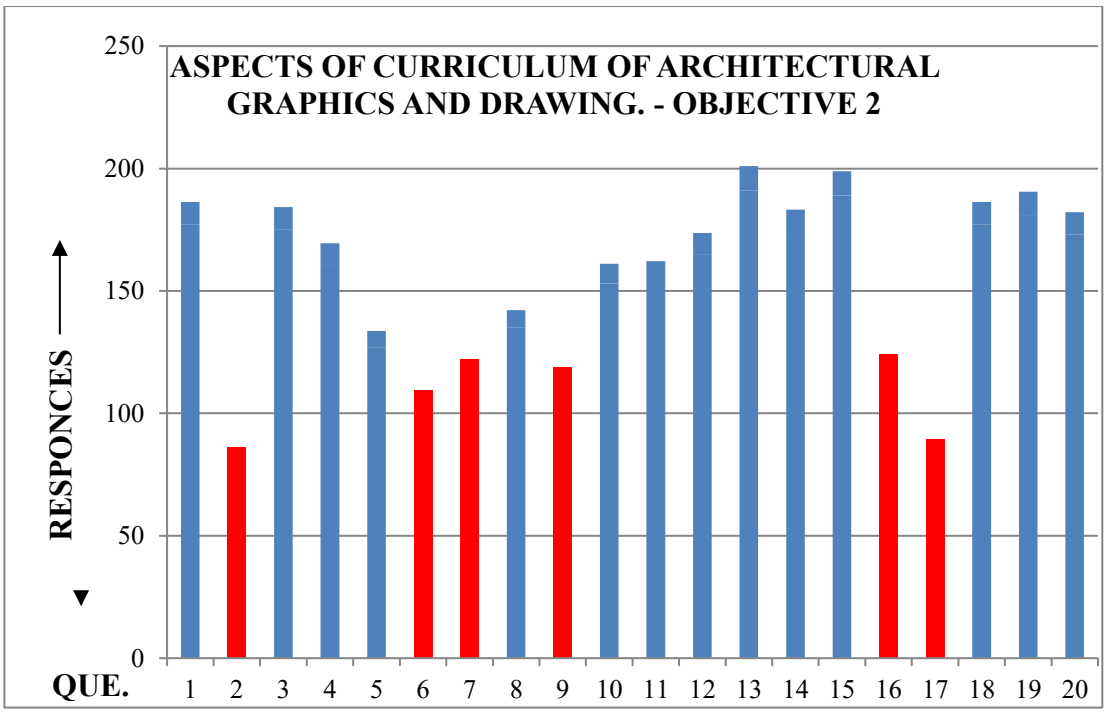


Figure 9 Aspects of architectural graphics and drawing Curriculum

Source: Author

1. Experts' opinion about architectural graphics and drawing (AGD) curriculum suggests that this curriculum is not sufficient to understand the subject totally in first year only.
2. Students do not apply line weights and graphics appropriately in their drawings.
3. Application of architectural lettering and dimensioning techniques by students is not appropriate.
4. Only sessional assessment is not sufficient.
5. Quality of architectural drawing is to be based on the correctness of the drawing.
6. Drawing exam (Theory) for AGD is necessary.
7. Minimum of 15 Architectural sketches with thrust on building. elements and built environment (indoor and outdoor) is very necessary.

Verifying internal consistency reliability - The Cronbach's alpha = 0.8290

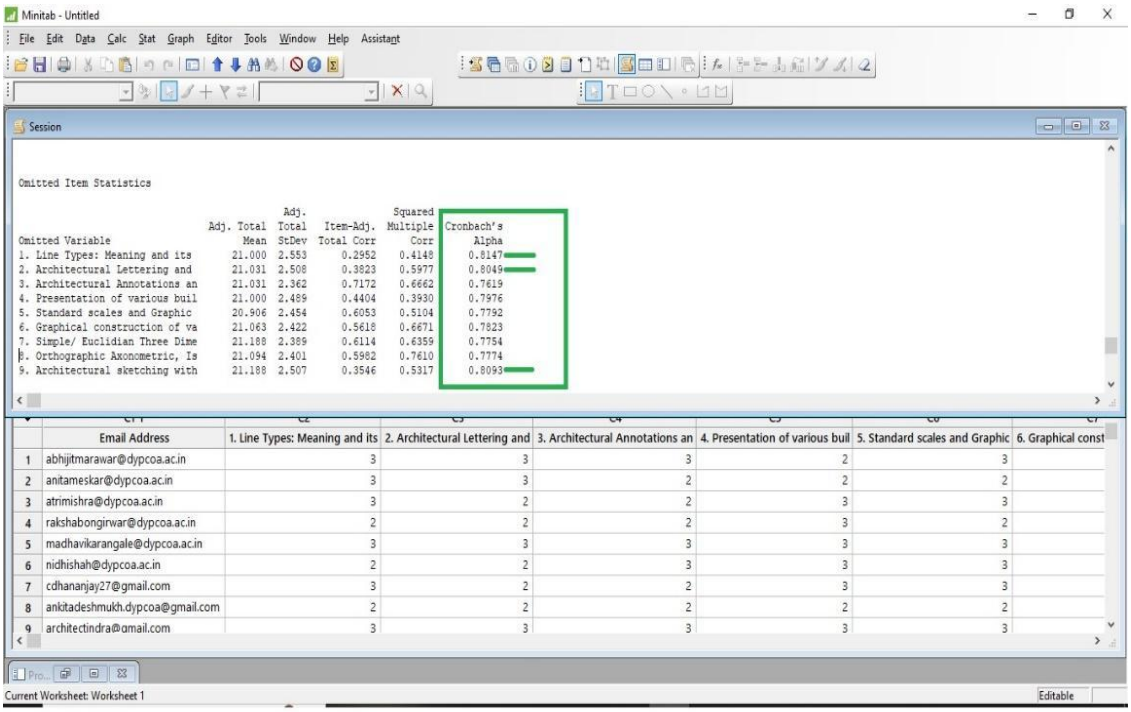


Figure 10 Cronbach Alpha 1

Source: Author

Cronbach alpha measures internal consistency reliability. The Cronbach's alpha value is 0.8290 which shows that the Internal Consistency or the Reliability of all the above parameters are acceptable.

4.2.3 Discussion on the Result

The main findings from the results regarding the architectural curriculum will be dissected in this section. In order to make the survey results easier to understand, each point will be presented in straightforward words.

1. Not ready for Industry: For starters, the architecture curriculum does not adequately educate students for careers in the field. As a result, students might not graduate with all the abilities and information required to function well in architecture profession. For instance, someone can be capable of designing structures but not be able to produce technical drawings will affect the execution of the project.

2. Design drawings' lack of integration: The second argument emphasizes how crucial technical aspects are frequently left out of design drawings, which are the visual blueprints for buildings. This implies that even while students may create stunning ideas, they may not represent the idea or concept correctly, which might cause miscommunications, making it difficult to convey the design precisely.

3. Evaluation System: According to the third finding, a variety of factors influence students' inability to produce high-quality technical and design drawings. The way that students are assessed and tested at SPPU (Savitribai Phule Pune University) is one important component. Exams that don't accurately represent real-world difficulties could hinder students' ability to learn. Architectural Graphics and Drawing, in particular, is a technical subject that cannot be fully understood by sessional examination alone.

4. Correctness of the Drawing: The fourth point highlights the significance of technical accuracy in drawings, which is more crucial than merely having a good design. This means that although students may be creative, they should also make sure that their drawings are correct and technically sound. A design that is aesthetically pleasing but has poorly communicated line types or graphics, for example, may cause major issues when it is built.

5. Faculty to Student Ratio: The final point addresses the Council of Architecture's and SPPU's established faculty-to-student ratio. A good ratio indicates that there are enough teachers to give each student individualized attention. This is significant because students can receive assistance with their inquiries and improve their learning when they have greater access to their lecturers. It is observed that the faculty-to-student ratio is not maintained in most of the private or government institutes due to financial concerns.

4.2.4 Reliability and Validity Tests

The two most crucial factors in research design, methodology, findings, and results are validity and reliability. The consistency of results is referred to as reliability. Validity refers to the extent to which the scale measures what it is intended to measure.

As a result, the scale of measurement for this study has strong internal consistency, and

the scales of measurement with the sample are dependable.

Particularly in a PhD thesis that focuses on curriculum and pedagogy development, reliability and validity are crucial ideas in educational research. These two ideas are relevant to the study in the following ways:

1. Reliability

A measurement tool's or process's consistency or stability is referred to as reliability. When it comes to research, which probably includes surveys, tests, instructional strategies, and student performance reviews, reliability ensures that the results are trustworthy and repeatable.

Where Study Reliability Is Crucial:

a. Assessment Tool: Assessing students' knowledge of architectural graphics and drawing through assessments or performance tasks requires that the results be consistent over time and among several groups.

b. Teaching Interventions: Reliability implies that the results should be comparable regardless of the teacher if this technique is used by several educators.

c. Instruments for Student Feedback: Surveys or questionnaires that are used to collect opinions from students must reliably represent their opinions without significant variations brought on by tool errors.

2. Validity

The term "validity" describes whether the tool or technique truly measures the parameters that it is intended to measure. The objective of the study is to ensure that the pedagogy and curriculum actually improve the efficiency of teaching architectural drawing and graphics.

Why Validity Is Crucial:

a. Content Validity: Based on industry and educational standards, this ensures that the curriculum covers all of the basic principles of architectural drawing, including line types, scales, projections, rendering, etc.

b. Construct Validity: Verifies that the method promotes the desired learning results, including comprehension, proficiency in technical drawing, and visualization.

c. Face Validity: Ensures that professionals in the sector (such as educators and

architects) find the techniques acceptable and successful.

d. Criterion validity is the process of comparing curriculum-based student results to predetermined standards or other effective initiatives.

To conclude, validity verifies that the methods are correct and significant in accomplishing goals and objectives, while reliability assures that the approaches are consistent and recurrent.

Both are essential to:

Establish credibility in research findings.

Make research adaptable and scalable for wider educational usage; and

Support the efficacy of the suggested curriculum and methodology.

4.2.5 Students' Level of Understanding regarding the aspects of the curriculum

As per the curriculum of SPPU for architectural graphics and drawing, as mentioned and termed as Units, a survey was conducted for students regarding their level of understanding the Units. Which unit students find difficult to understand and comprehend was analyzed.

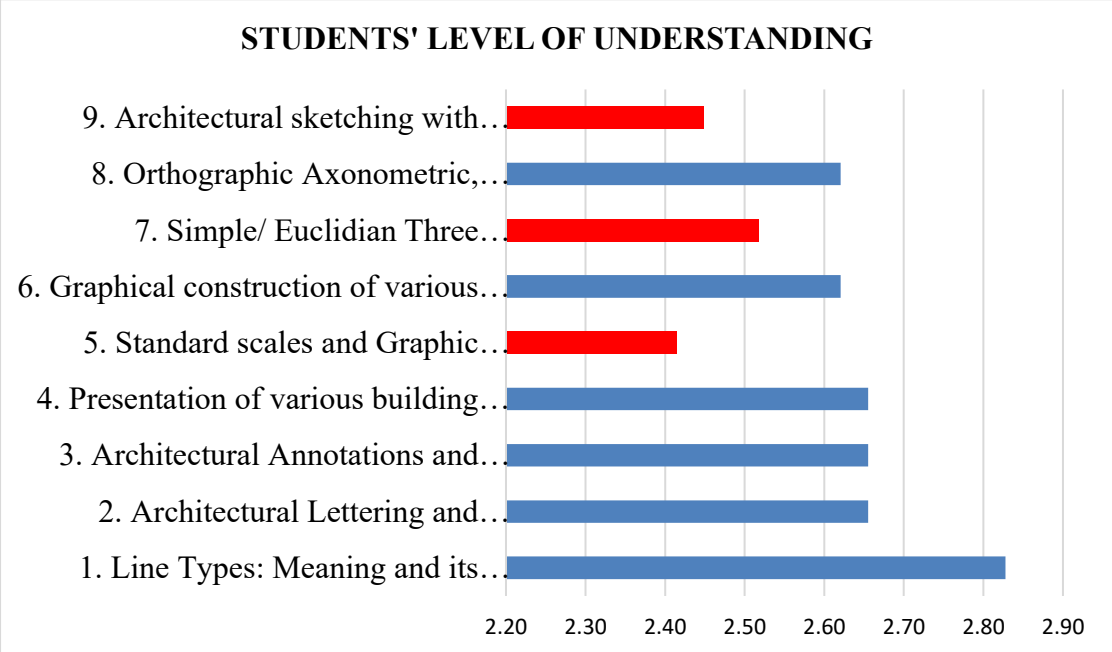


Figure 11 Students' level of Understanding

Source: Author

The major observations

1. As per the outcome of the survey regarding the level of understanding, students find all units easy to understand.
2. Standard and graphic scales and their application need more effort to be understood.
3. Students find difficulty in drawing Sketches.

Verifying internal consistency reliability - Cronbach's alpha = 0.9358

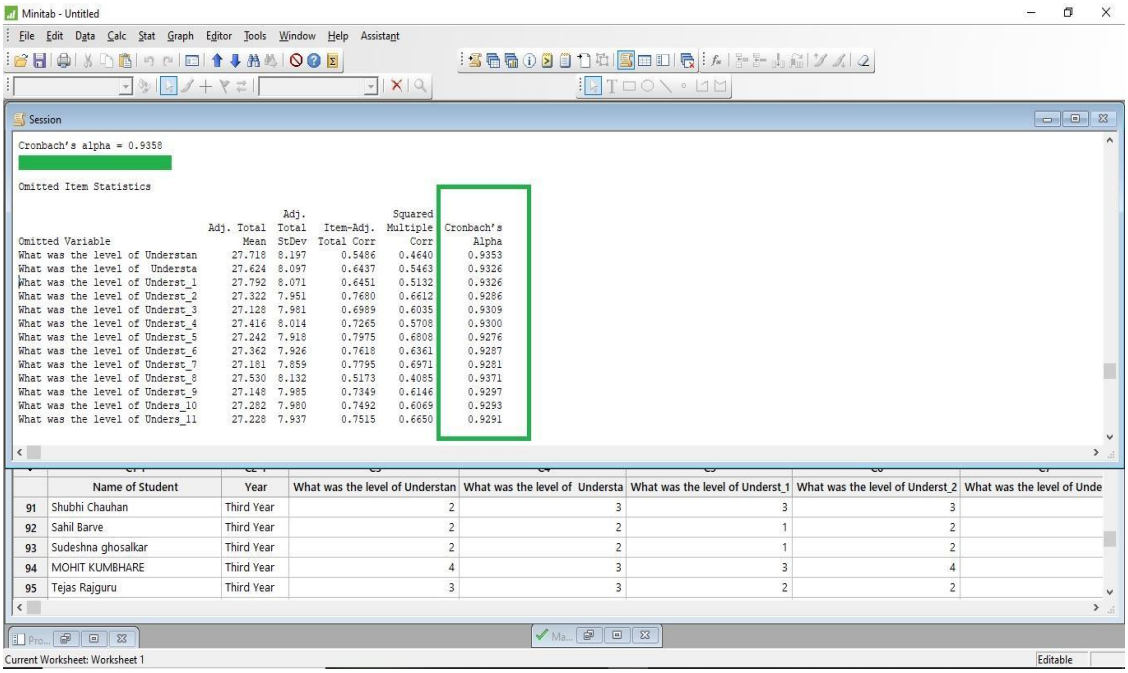


Figure 12 Cronbach Alpha 2

Source: Author

Cronbach alpha measures internal consistency reliability. The Cronbach's alpha value is 0.9358 which shows very high internal consistency or the reliability of all the above parameters are acceptable.

4.3 Process of Analysis

4.3.1 Pilot study for tool development

A tool was made to check the level of students' understanding in the subject of architectural graphics and drawing. Data was collected from 149 students. The process

of tool development requires three steps, viz., analysis of reliability, analysis of validity and factor analysis to finalize the test questions. The steps of establishing reliability and finalizing and grouping questions using factor analysis have been conducted in this study.

Reliability was very good, and factor analysis has generated two factors. By refining this tool, in the future, with further modifications, a tool or test to check the understanding or competency in this subject can be created.

1. Reliability-

Cronbach alpha measures internal consistency reliability. Internal consistency analyzes whether all questions in a test measure the same underlying construct or concept. When the Cronbach Alpha value is more than 0.7, the reliability is considered high. Here, the value is 0.93 which shows a very high reliability.

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.935	.934	13

Table 9 Reliability Statistics

Source: Author

The second way of calculating reliability is split half reliability. Here the test is divided into two parts and the correlation between these two parts is analyzed. The split half reliability coefficient is .88 for both the parts of the test.

Reliability Statistics

Cronbach's Alpha	Part 1	Value	.883
		N of Items	7[a]
	Part 2	Value	.885
		N of Items	6[b]
	Total N of Items		13
Correlation Between Forms			.839
Spearman-Brown Coefficient	Equal Length		.913
	Unequal Length		.913
Guttman Split-Half Coefficient			.912

a. The items are: Q1, Q2, Q3, Q4, Q5, Q6, Q7.

b. The items are: Q8, Q9, Q10, Q11, Q12, Q13.

Table 10 Reliability Statistics

Source: Author

2. Factor analysis

Factor analysis is a statistical method used to see which are the questions, which can be grouped together so that maximum variance in scores can be explained by a group of questions. In factor analysis, "maximum variance" refers to obtaining as much information as possible from the data. By explaining the maximum variance, factor analysis aims to group questions in a way that reflects the main patterns in people's answers. With this the most important underlying ideas or skills that the questions are measuring are selected and grouped so that the meaning conveyed through the data becomes easy to assess and comprehend. Essentially, it helps us understand the biggest, most meaningful trends in the answers.

The table of rotated component matrix shows the factor grouping done using factor analysis.

Rotated Component Matrix[a]

	Component	
	1	2
Q13	.838	
Q7	.800	
Q8	.792	
Q11	.772	
Q9	.752	
Q12	.726	
Q5	.719	
Q4	.646	.485
Q6	.646	.425
Q10	.423	
Q1		.852
Q2		.810
Q3	.415	.634

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.

a. Rotation converged in 3 iterations.

Table 11 Rotated Component matrix

Source: Author

- In this case it can be seen that questions 13,7,8,11,9,12,5,4,6 and 10 are measuring one dimension **Group 1** – Three Dimensional Orthographic Projections and questions 1,2 and 3 are measuring another dimension – **Group 2** – Two-Dimensional Plane Geometry

The process of breaking down a large number of variables into smaller numbers of factors is called factor analysis. With this method, all variables are extracted to have the largest common variance and combined into a single score. We can use this score as an index of all variables in subsequent study.

Additional outputs from factor analysis-

1) The correlation matrix shows the correlations between various questions (variables) and their significance levels.

Correlation Matrix[a]

		Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13
Correlation	Q1	1.000	.613	.462	.403	.315	.476	.404	.403	.457	.350	.360	.404	.343
	Q2	.613	1.000	.532	.572	.456	.534	.494	.442	.552	.332	.404	.455	.432
	Q3	.462	.532	1.000	.599	.486	.459	.480	.499	.433	.408	.480	.553	.448
	Q4	.403	.572	.599	1.000	.656	.548	.639	.589	.688	.465	.540	.571	.548
	Q5	.315	.456	.486	.656	1.000	.568	.561	.616	.692	.253	.491	.572	.554
	Q6	.476	.534	.459	.548	.568	1.000	.641	.574	.610	.328	.539	.573	.635
	Q7	.404	.494	.480	.639	.561	.641	1.000	.684	.689	.470	.672	.611	.706
	Q8	.403	.442	.499	.589	.616	.574	.684	1.000	.696	.364	.638	.593	.659
	Q9	.457	.552	.433	.688	.692	.610	.689	.696	1.000	.341	.596	.598	.625
	Q10	.350	.332	.408	.465	.253	.328	.470	.364	.341	1.000	.541	.441	.413
	Q11	.360	.404	.480	.540	.491	.539	.672	.638	.596	.541	1.000	.585	.670
	Q12	.404	.455	.553	.571	.572	.573	.611	.593	.598	.441	.585	1.000	.699
	Q13	.343	.432	.448	.548	.554	.635	.706	.659	.625	.413	.670	.699	1.000
Sig. (1-tailed)	Q1		.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
	Q2	.000		.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
	Q3	.000	.000		.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
	Q4	.000	.000	.000		.000	.000	.000	.000	.000	.000	.000	.000	.000
	Q5	.000	.000	.000	.000		.000	.000	.000	.000	.001	.000	.000	.000
	Q6	.000	.000	.000	.000	.000		.000	.000	.000	.000	.000	.000	.000
	Q7	.000	.000	.000	.000	.000	.000		.000	.000	.000	.000	.000	.000
	Q8	.000	.000	.000	.000	.000	.000	.000		.000	.000	.000	.000	.000
	Q9	.000	.000	.000	.000	.000	.000	.000	.000		.000	.000	.000	.000
	Q10	.000	.000	.000	.000	.001	.000	.000	.000	.000		.000	.000	.000
	Q11	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000		.000	.000
	Q12	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000		.000
	Q13	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	

a. Determinant = .000

Table 12 Correlation Matrix

Source: Author

2) KMO test -

This test checks for one of the assumptions of factor analysis. It indicates the pattern of correlations within the data set. A value close to 1 indicates that patterns of correlations are relatively compact, and so factor analysis should yield distinct and reliable factors. Values close to .9 are excellent.

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.934
Bartlett's Test of Sphericity	Approx. Chi-Square	1225.531
	df	78
	Sig.	.000

Table 13 KMO and Bartlett's Test

Source: Author

KMO is a test conducted to examine the strength of the partial correlation (how the factors explain each other) between the variables. KMO values closer to 1.0 are considered to be ideal, while values less than 0.5 are unacceptable.

3) **Scree Plot** -

The scree plot is a graph plotting each factor in a factor analysis (X-axis) against its associated eigenvalue (Y-axis). It shows the relative importance of each factor. This graph has a very characteristic shape (there is a sharp descent in the curve followed by a tailing off) and the point of inflection of this curve is often used as a means of extraction.

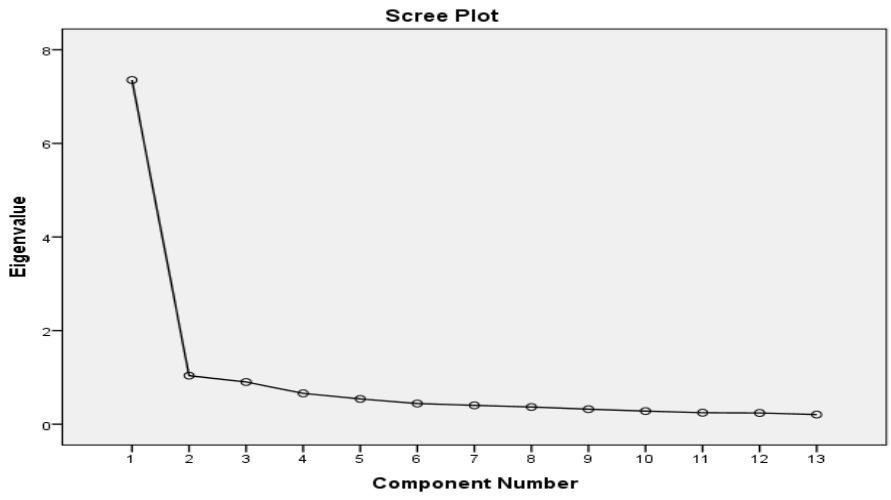


Figure 13 Scree Plot

Source: Author

4) Descriptive Statistics

The characteristics and value distribution of one or more datasets are summarized by descriptive statistics. With the help of traditional descriptive statistics, analysts may quickly assess the degree of value dispersion and central tendency in datasets. They come very handy when comparing and comprehending different data distributions. (Jay Lee 2020)

Descriptive Statistics

	Mean	Std. Deviation	Analysis N
Q1	1.95	.777	148
Q2	2.05	.819	148
Q3	1.88	.856	148
Q4	2.35	.880	148
Q5	2.55	.914	148
Q6	2.26	.842	148
Q7	2.43	.890	148
Q8	2.31	.917	148
Q9	2.49	.986	148
Q10	2.14	.926	148
Q11	2.53	.869	148
Q12	2.39	.862	148
Q13	2.44	.920	148

Table 14 Descriptive Statistics

Source: Author

A. Analysis of students' competency-

The competency of the students in this subject is assessed based on the evaluation done by the faculty members. This also shows how well the students are able to grasp and understand the curriculum. To assess whether the students' competency which shows grasping of curriculum was done accurately and reliably, this analysis was conducted. Students' competency was checked by asking 3 experts to rate students' architectural graphics and drawing sheets. To analyze the difference between the scores given by the raters, a statistical test of ANOVA had to be conducted. As the data was not

normally distributed, the non-parametric version of ANOVA, i.e. the Kruskal Wallis test was used to analyze this. Here, the independent variable was rating or 3 scorers and the dependent variable was the scores they gave. The null hypothesis that there is no difference between rating of scorers was accepted for all questions.

Additionally, the mean, mode, range and other descriptive statistics were checked for the rating that students got from these scorers. It was seen that mean for most questions was more than 3 for all questions and mode was 4. The range was 2 to 4. This shows that the present sample has received an average and above average rating.

The results show that there was no statistical difference between the scorer's rating for students i.e., the three scores had given similar ratings during checking.

1. **Descriptive Statistics**

Statistics

		Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10
N	Valid	123	123	123	123	123	123	123	123	123	123
	Missing	0	0	0	0	0	0	0	0	0	0
Mean		3.77	3.60	3.78	3.66	3.42	3.71	3.65	3.62	3.55	3.46
Std. Error of Mean		.045	.049	.046	.049	.056	.046	.048	.052	.052	.057
Median		4.00	4.00	4.00	4.00	3.30	4.00	4.00	4.00	4.00	4.00
Mode		4	4	4	4	4	4	4	4	4	4
Std. Deviation		.502	.541	.508	.548	.626	.514	.530	.574	.581	.627
Variance		.252	.293	.258	.300	.392	.264	.281	.330	.337	.393
Skewness		-1.072	-.403	-1.363	-1.004	-.568	-1.437	-1.074	-1.074	-.630	-.766
Std. Error of Skewness		.218	.218	.218	.218	.218	.218	.218	.218	.218	.218
Kurtosis		-.053	-1.331	1.038	.022	-.493	1.197	.195	.285	-.606	-.360
Std. Error of Kurtosis		.433	.433	.433	.433	.433	.433	.433	.433	.433	.433
Range		2	2	2	2	2	2	2	2	2	2
Minimum		2	2	2	2	2	2	2	2	2	2
Maximum		4	4	4	4	4	4	4	4	4	4
Sum		463	443	465	450	421	457	449	445	437	426
Percentiles	25	3.00	3.00	4.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00
	50	4.00	4.00	4.00	4.00	3.30	4.00	4.00	4.00	4.00	4.00
	75	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00

Table 15 Descriptive Statistics: Students' Grading by 3 Experts.

Source: Author

Overall mean is more than 3 for most of the questions, and the mode is 4, indicating average and above average scores being given to the students.

To test whether the scores given by 3 scorers are truly different, each scorer becomes an independent variable, and the scores given become the dependent variables. Here, there are 3 scorers, so the IV has 3 levels; therefore, ANOVA was used. But as the data is not normally distributed and the assumption of homogeneity of variance (variance in scores given in 3 groups will be the same) is violated (Kolmogorov-Smirnov Test $p<.05$), non-parametric version of ANOVA i.e., Kruskal Wallis test has been used.

2. Test to check normality- Kolmogorov-Smirnov Test

Tests of Normality

		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Scorer	Statistic	df	Sig.	Statistic	df	Sig.
Q1	1	.386	41	.000	.708	41	.000
	2	.369	41	.000	.712	41	.000
	3	.468	41	.000	.552	41	.000
Q2	1	.334	41	.000	.702	41	.000
	2	.345	41	.000	.762	41	.000
	3	.376	41	.000	.702	41	.000
Q3	1	.430	41	.000	.675	41	.000
	2	.467	41	.000	.574	41	.000
	3	.369	41	.000	.712	41	.000
Q4	1	.377	41	.000	.734	41	.000
	2	.390	41	.000	.722	41	.000
	3	.422	41	.000	.674	41	.000
Q5	1	.299	41	.000	.758	41	.000
	2	.288	41	.000	.795	41	.000
	3	.296	41	.000	.797	41	.000
Q6	1	.453	41	.000	.606	41	.000
	2	.416	41	.000	.667	41	.000
	3	.453	41	.000	.606	41	.000
Q7	1	.390	41	.000	.703	41	.000
	2	.390	41	.000	.703	41	.000
	3	.434	41	.000	.616	41	.000
Q8	1	.390	41	.000	.703	41	.000
	2	.402	41	.000	.689	41	.000
	3	.370	41	.000	.749	41	.000
Q9	1	.337	41	.000	.733	41	.000
	2	.402	41	.000	.709	41	.000
	3	.348	41	.000	.766	41	.000
Q10	1	.290	41	.000	.775	41	.000
	2	.378	41	.000	.694	41	.000
	3	.327	41	.000	.734	41	.000

a. Lilliefors Significance Correction

Table 16 Kolmogorov-Smirnov Test

Source: Author

The Kolmogorov-Smirnov test shows that the sampling distribution of the present sample is not the same as that of a normal distribution curve and thus it indicates that the data is not normally distributed and therefore non parametric tests have been used.

3. Inter-Scorer Agreement

Test Statistics[a,b]

	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10
Chi-Square	4.081	.789	2.951	.207	.053	.624	.358	.044	4.813	2.259
df	2	2	2	2	2	2	2	2	2	2
Asymp. Sig.	.130	.674	.229	.902	.974	.732	.836	.978	.090	.323

a. Kruskal Wallis Test

b. Grouping Variable: Scorer

Table 17 Inter Scorer Agreement

Source: Author

As Asymptomatic Significance is non-significant i.e., $p<.05$, there is no significant difference between the scores given by 3 experts to each participant. This retains the null hypothesis that there is no significant difference between the rating of the three scorers.

4.4 Hypothesis Test Summary

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.	Decision
1	The distribution of Q1 is the same across categories of Scorer .	Independent-Samples Kruskal-Wallis Test	.130	Retain the null hypothesis.
2	The distribution of Q2 is the same across categories of Scorer .	Independent-Samples Kruskal-Wallis Test	.674	Retain the null hypothesis.
3	The distribution of Q3 is the same across categories of Scorer .	Independent-Samples Kruskal-Wallis Test	.229	Retain the null hypothesis.
4	The distribution of Q4 is the same across categories of Scorer .	Independent-Samples Kruskal-Wallis Test	.902	Retain the null hypothesis.
5	The distribution of Q5 is the same across categories of Scorer .	Independent-Samples Kruskal-Wallis Test	.974	Retain the null hypothesis.
6	The distribution of Q6 is the same across categories of Scorer .	Independent-Samples Kruskal-Wallis Test	.732	Retain the null hypothesis.
7	The distribution of Q7 is the same across categories of Scorer .	Independent-Samples Kruskal-Wallis Test	.836	Retain the null hypothesis.
8	The distribution of Q8 is the same across categories of Scorer .	Independent-Samples Kruskal-Wallis Test	.978	Retain the null hypothesis.
9	The distribution of Q9 is the same across categories of Scorer .	Independent-Samples Kruskal-Wallis Test	.090	Retain the null hypothesis.
10	The distribution of Q10 is the same across categories of Scorer .	Independent-Samples Kruskal-Wallis Test	.323	Retain the null hypothesis.

Asymptotic significances are displayed. The significance level is .05.

Figure 14 Hypothesis Test Summary

Source: Author

The table above shows that the hypothesis of no difference, which is the null hypothesis, shows that there is no significant difference between the way the scoring for the students' competency has been done by the three experts. This indicates that a completely unbiased and truthful assessment of the subject's understanding and thereby the curriculum has been done as all three experts have given similar rating or scores to the students.

4.5 Research Question and Key Findings

The research gap in architectural education is addressed by the questionnaire used in this study. The aim of the above approach is to identify shortcomings in the current curriculum and teaching strategies, which directly relates to the research issue.

Two key facets of the research question—specifically, the subject of architectural graphics and drawing—are the focus of the current study. In the first part, the current curriculum for this subject as it is taught at Savitribai Phule Pune University (SPPU), Pune, is thoroughly reviewed and analyzed. This involves assessing the syllabus's organization, subject matter, and teaching methodology in light of the rules set forth by the Council of Architecture (CoA), India's statutory governing authority for architectural practice and education. The findings of the study determine the curriculum's strengths, weaknesses, and possible areas for improvement within the current framework by analyzing how closely it complies with industry demands and national academic standards.

The findings emphasize that students are not adequately prepared for industry demands by the current architectural curriculum. This discovery, which highlights a glaring curriculum flaw that requires attention, has a direct bearing on the study issue. The necessity of an architectural graphics drawing theory exam is underlined, indicating that the curriculum does not provide rigorous evaluation techniques to gauge students' knowledge and proficiency in this field. The findings recommend curriculum revision to include a wider range of teaching methods and more real-world applications. By addressing the noted shortcomings and enhancing the general efficacy of teaching and

learning architectural graphics and drawing, this suggestion is closely linked to the research question.

Based on the findings, students' prior educational experiences have a major impact on how they learn. This link is important for the research question because it highlights how teaching strategies should be modified to better suit students' learning and comprehension of architectural concepts.

Focusing on pedagogical practices, the second part of the research question is to determine, evaluate, and suggest an efficient teaching model for the instruction of architectural graphics and drawing. The subject's foundational significance in establishing critical skills like correct technical drawing and architectural communication means that the quality of its teaching strategies directly affects students' academic and professional growth. The study examines a number of teaching techniques, including conventional studio-based learning, to identify the findings.

According to the findings, architectural sketching is crucial, especially when it comes to building components and the built environment. This suggests that practical sketching tasks that relate theoretical knowledge to real-world applications should be a part of effective instruction. Similarly, correctness of the drawing is crucial as it communicates the meaning of each line drawn, graphics indicated in the drawing.

In summary, the findings are closely related to the research question, revealing curriculum deficiencies and outlining suggestions for improving architecture education teaching strategies. This link emphasizes the significance of continuous evaluation and modification of teaching methods to accommodate students' changing requirements.

4.6 Chapter Summary

The data analysis and results of this investigation were presented in this chapter. These include evaluating the Savitribai Phule Pune University's architectural graphics and drawing curriculum and the effectiveness of various teaching strategies

.

The following important conclusions were drawn from the data.

I. Initially, the objective of the architectural graphics and drawing curriculum as

a course of study is to introduce students to architectural graphics and drawing techniques and characteristics like scale, annotations, etc. Using a variety of graphic projection techniques, including cut sections, isometric, axonometric, and orthography, students will be able to express basic three-dimensional objects and construction components through technical drawings and to offer several drawing methods for documenting, examining, and conveying environments, buildings, and things.

II. Second, there is a possibility of different schools to implement the criteria in ways that are subjective to their philosophy and thought of the institute because the curriculum's content is based on Council of Architecture guidelines and appears to be broad rather than explicit and thorough. It was discovered that the curriculum sequences at the all universities under investigation were, more crucially, the same.

III. Thirdly, of the teaching modalities assessed, lectures were discovered to be the most prevalent, followed by submitting in the required drawing sheets. There was a good amount of usage of the experimental method, or teaching by doing. Its ability to support tangible learning as opposed to abstraction is what makes it so powerful. There appears to be a gap between what is taught in architectural graphics and drawing and the design studio, as evidenced by the majority of students' drawing sheets, which demonstrate that they do not apply what they learned in that class to their design studio work. Also, because there is no theory exam for this subject, students often took it lightly.

CHAPTER – 5: CONCLUSIONS AND RECOMMENDATIONS

5.0 Introduction

An attempt has been made to compile the main conclusions and issues from the research, together with their ramifications, in this final chapter of the thesis. First, a summary of the research is given. The study's main conclusions and a synthesis of the main concerns are presented next. Additionally, the study's consequences are given and analyzed. Before concluding remarks, the areas and potential for future research are addressed.

5.1 Summary of the Research

There is an abundance of literature on the design education aspect of architectural education, but not much is known about the other aspect, the technical education component, which consists of architectural graphics and drawing, structures and building material construction technology. The pedagogy of architectural graphics and drawing, which forms the basis of the technical aspect of architectural education, is particularly poorly understood.

Comprehending Architectural Drawings and Graphics is essential to an architect's education. However, the majority of architecture students are not prepared for the "delivery systems" (teaching methods) and "curricular content" (theory and pedagogy) that are currently in use. Traditional methods of teaching architectural graphics and drawing are difficult for both architecture professors and students to implement. This is starting to show itself to be ineffectual.

The array of research generally indicates that architecture students in Architecture Drawings and Graphics classes are not very motivated, which has resulted in poor interaction, weak understanding, and low memory of the topics covered in these programs. The development of the architect's language of communication is a more significant outcome of architectural drawings and graphics. This language influences architectural design decisions and has a compounding effect on enhancements to the built environment. Additionally, graduates' lack of technical preparation for the

profession poses a threat to architecture in the construction industry. This study was carried out based on this assumption and the requirement for a suitable grasp of the pedagogy of Architecture Drawings and Graphics in architectural education. This thesis presents the results and activities of the research.

As previously said, the goal of this study was to find strategies to increase students' interest in and comprehension of the course by looking into the teaching and learning of architectural graphics and drawing. In order to do this, the following study objectives were delineated in Chapter One of this thesis:

(i) To identify the curricular aspects of architectural graphics and drawing subject and

(ii) To identify efficient Models of Teaching for architectural graphics and drawing subjects by teachers.

After defining the aim and objectives of the research, Chapter Two reviewed relevant literature in an effort to place the findings of this study into the larger context of current knowledge. Numerous theories and concepts related to learning sciences, architectural education in general, and technical education in architecture in particular were found through the literature search on the pedagogy of architectural graphics and drawing.

A review of the literature proved that architectural pedagogy is made up of design and technology, with architectural graphics and drawing being a smaller part of technology. It was essential to create a conceptual framework that addresses both theoretical and conceptual issues pertinent to the study in order to try and determine direction, emphasis, and limits for this investigation from the variety of concepts and theories found.

Presenting a framework based on current as well as relevant supporting notions was the subject matter of Chapter Three. Creating this framework served as the foundation for data collection, analysis, literature research, and discussion of the findings' implications and outcomes.

The methodologies adopted for the research design, data collecting, presentation, processing, analysis, and interpretation of results were to be outlined in addition to the framework for collecting data, analyzing it, and discussion of findings and conclusions. It was observed that the study employed both qualitative and quantitative research

methods, with students and teachers from the several architecture colleges serving as the data gathering and analysis units. The chapter also listed the primary data collection tools utilized in this study as the questionnaire, interview guide, and observation schedule. In order to analyze the data collected from the fieldwork and literature search, both descriptive and inferential statistics as well as content analysis tools were implemented.

The results of this research (objective by objective) were presented in Chapter four. The results of the study were discussed, along with the interpretation of the findings and their consequences, in this chapter. The presentation of a summary of the study's significant findings, a synthesis of the study's main curricular aspects, aspects of teaching models and their implications, suggestions for future research topics, and final conclusions were covered in the last chapter.

5.2 Limitations of the study

The study is restricted to the academic programs and establishments affiliated with Savitribai Phule Pune University (SPPU). This is significant since SPPU has the largest number of architectural colleges in Maharashtra adopting a single curriculum and assessment system, with 23 of them. This focus ensures consistency in the data collected from these universities.

Only first-year students are the study's target population. According to the SPPU curriculum, teaching architectural graphics and drawing takes up the first two semesters of the Bachelor of Architecture (B. Arch.) program. By concentrating on this specific group, the study intends to gather data relevant to the foundational stage of architectural education.

The study specifically examines hand-drawn drawing activities and architectural graphics. Since digital drawing and software applications are introduced in the second year of the B. Arch. curriculum, they are not included in the current study. This limitation allows for a detailed analysis of conventional sketching techniques.

Only input from academic stakeholders—that is, students and teachers—is included in this study. This study does not include professional stakeholders like architects,

contractors, etc. Since this study is exploratory, it can be continued with professional stakeholders' feedback.

5.3 Summary of Key Findings

To conclude with respect to **Objective 1- 'To identify the curricular aspects of architectural graphics and drawing subject',** the following key findings are derived. These key findings are based on the Units stated in the curriculum of Savitribai Phule Pune University.

1. The Architecture curriculum is not sufficient to prepare students for Industry.
2. Design Drawings are drawn without integrating the technical subjects which leads to the lacuna in communicating the architectural design correctly.
3. Due to many factors, the outcome of students' Design and Technical drawing is not satisfactory. The factors include the evaluation and examination system of SPPU and the teaching models technical curriculum.
4. SPPU curriculum follows the Council of Architecture Guidelines, which is revised every five years.
5. Technically Correctness of the Drawing is more important than Design drawing.
6. The faculty student ratio prescribed by the Council of Architecture and implemented by SPPU is sufficient, but fewer faculty members are appointed at the institute level.
7. Experts opinion about architectural graphics and drawing (AGD) curriculum suggests that this curriculum is NOT sufficient to understand the subject TOTALLY in the First Year only.
8. Students DO NOT apply line weights and Graphics appropriately in their drawings.
9. Application of Architectural Lettering and dimensioning techniques by students is NOT Appropriate.
10. Only Sessional assessment is NOT sufficient.
11. Quality of Architectural Drawing is to be based on the Correctness of the Drawing.

12. Theory Examination (based on the Drawing) for architectural graphics and drawing is necessary.
13. Architectural sketching with thrust on building elements and built environment (indoor and outdoor. Min. 15 nos.) is very much necessary. It is observed that sketching is given less importance and taken casually by the students.

5.4 Contribution to Knowledge

Although the research approach of architectural graphics and drawing was examined in this study in a general sense, it has made specific contributions to knowledge in the following areas:

i. It has found helpful factors for identifying the curricular aspects of the curriculum for architectural graphics and drawing.

iii. The research has determined which aspects of efficient models of teaching (mostly contributing factors) predict learning outcomes in architectural graphics and drawing.

5.5 Area of Further Study

This study, which focused exclusively on the architecture colleges at Savitribai Phule Pune University in Pune, Maharashtra, is definitely a pioneer in the field of curriculum development and instructional models for architectural graphics and drawing. Consequently, it is advised that more research be done in the following areas:

i. Future research on this topic should include other architectural educational institutions in India and beyond in order to spot trends and patterns.

ii. A thorough investigation of how students perceive and perform in architectural graphics and drawing could be the subject of additional research.

iii. architectural graphics and drawing viz-a-viz design studio assessment methods to find potential convergence or divergence spots.

iv. How the development of the curriculum affects students' learning outcomes for architectural drawing and graphics.

5.6 Recommendations

The following are the study's recommendations, which are provided in light of the consequences of the findings and the closing remarks:

A. A design studio-oriented approach should be prioritized while reviewing the architectural graphics and drawing curriculum; that is, the subjects should be pertinent to design studios.

B. Learning outcomes should be defined in the curriculum since it is important to acknowledge that instruction does not always translate into learning. Individual courses, semesters, and the course as a whole should all have their own definitions for these outcomes. If these outcomes are reflected in the work of the students, it is possible to assess the effectiveness of a course by looking at how these outcomes are defined.

C. A comprehensive description of curriculum should be defined and articulated by each college, as required by the regulatory framework. The college should be granted considerable latitude in terms of its curriculum if it is to be enabled to strive for excellence. An architectural program must have adequate academic freedom to maintain and develop its unique curriculum and structure in order to fulfill the industry academia gap.

D. The teaching style or styles should be developed with the students' assessed learning styles and comprehension level in mind. This means that experiential learning and tangible methods that encourage hands-on experience should be used. Project-based learning, also known as learning by doing, problem-based learning, using models, group work, and site visits, can all help achieve this.

E. The introduction of the subject to the students must start with the Name of the Subject, i.e., architectural graphics and drawings. It means one must explain the meaning of each and every word or the definition of the word to make them understand what they are going to learn in the subject. For example, there is always a misinterpretation of the word Drawing with Design for a first-year student. It must be clear to students that Drawing is Technical, whereas Design is Creative with respect to the curriculum.

The Following Recommendations were derived to cater **Objective 2 – 'To identify and recommend the efficient models of teaching for architectural graphics and drawing'.**

F. Exercises are to be given in Written format to the students so that they will be able to visualize the object placement with respect to HP (Horizontal Plane) and VP. (Vertical Plane) In such cases students will discuss among each other or with the faculty to understand the placement. This will develop curiosity among the students and will improve their visualization too. This overall approach will help students to draw correct drawings of the object.

   It is very necessary for the students to understand the terminology of an object whenever a written Question is stated for the students to visualize.

   The object terminologies are stated as below.

Sample questions:

Q.01. a) Draw a Square of side 5000 MM to the scale of 1:50, 1:100, 1:200

(OR)

b) Draw the plan and elevation of a square plane of 64 mm sides

i) When one of its diagonals is parallel to both planes, and the other makes 40 degrees with the H.P.

ii) With two of its sides parallel to both planes, and its surface making 45 degrees with its H.P.

Q. 02. a) A hexagonal pyramid, base 40 mm side and axis 80 mm long, is resting on its base on the ground with two edges parallel to V.P. It is cut by a section plane, perpendicular to V.P., inclined at 45 degrees to H.P. and intersecting the axis at a point 30 mm above the base. Draw the plan, front and side elevation of the cut pyramid and the true shape of the section.

(OR)

b) A hexagonal prism of base 30 mm side and height 85 mm, has a face on the ground and the axis parallel to V.P. It is cut by a vertical section plane which makes an angle of 45 degrees with V.P. and which cuts the axis at a point 30 m from one

of its ends. Draw the plan and elevation of the cut prism, and the true shape of the section.

Q. 03. Draw an Isometric view of the given object. (Plan Elevation and Side elevations of the object with all dimensions to be given)

G. The Evaluation and Examination systems of SPPU need reforms.
   The Theory Question paper to be on similar Guidelines with a combination of written questions and drawn questions.

H. The Theory examination was part of the curriculum till 2008. After the revision of the syllabus, it was canceled. The Question paper should be of 3 hours with a maximum of 100 marks with a minimum of 50 marks for passing (as per other theory subject examination)

I. The use of digital tools, such as 3D software, in the classroom should facilitate the creation and simulation of visual understanding, which will improve students' comprehension of architectural drawings and graphics.

J. The Quality and Correctness of the Drawing must be ensured. It is recommended that the Correct and appropriate use of each and every line type must be drawn to ensure the correctness of the drawing.
   According to Wakita et al. (2003), lines can be classified as light, medium, or dark. By varying the lead and pressure, each of these types can be further divided as follows:

   - Light Lines: The lines used in drawings to help with font height are often the lightest lines used. It should be very difficult to see these lines. Leaders, break lines, and dimension and extension lines have lines that are somewhat lighter than guidelines but still quite dark.
   - Medium Lines: Medium-weight lines in architectural drawings are used for dashed lines that represent hidden or dotted lines, as well as object and center lines.
   - Dark Lines: Border lines, cutting plane lines, necessary sections, and details are all made using the dark lines.

K. Hidden or Dotted Lines: Dotted lines are used to indicate the hidden part of the object or the portion above the sectional plane. (When a building plan is drawn at window level, any projection above or the balcony / roof line is shown in dotted.) Architectural lettering is used to convey concepts and explain features that are difficult to convey through drawings alone since using words instead of drawings is really a more efficient and clear method of communication. It is recommended that the degree of stylistic variance must not be such that reading letters and words becomes challenging or time-consuming. Architectural lettering aims to convey ideas fast and effectively.

L. Sketching improves Observation skills and Visualization of students. Students' casual approach is a major concern which is mainly because of lack of guidance from the experts and the lack of sketching skills of the faculty. It is recommended as the practice of sketching aids in the 3D visualization process by improving hand-eye coordination. It's crucial for students to draw credible sketches by precisely capturing shapes, and accurately perceiving proportions is necessary for accurate shape drawing. The relationship between an object's height and width, or the width of a building, is what is referred to as proportions. By taking a few easy procedures, the students can quickly measure proportions in the field. They must first learn to perceive spaces and buildings as basic geometric shapes like squares, rectangles, and circles. Since depth perception requires both eyes, these are simpler to see if a designer flattens their field of vision by shutting one of them. In order to compare the height and width of the object or space, the students should next use a pencil as a measuring stick to determine the ratio of height to width. They should then drop the pencil horizontally while maintaining the same arm lock (Bower, 2016).

M. Various principles of teaching are explained in the Theory of Teaching. One can identify some of the principles with respect to the subject and try to implement those principles with the relevance of the subject. Following principles of teaching and its relevance with architectural graphics and drawing – I & II is recommended below:

1) Principle of Definite Aim:

The best way to start a lesson is with an unambiguous objective. Lack of a defined objective could cause the teacher to stray from the subject and give inconsistent, imprecise training. There won't be much learning if the lesson is arranged haphazardly and arbitrarily. If education had no defined objective, even the best programs would be ineffective. Students and teachers can both benefit greatly from having a defined goal. Engaging, fast, accurate, and definitive instruction and learning are made possible by it.

- **Relevance with Architectural Education:**

Subject: architectural graphics and drawing – I & II

The study of this subject will begin with the definite aim of making students understand the language of Architecture and its importance of their thoughts for Architectural Design.

The study includes:

a. The achievable lesson plan of the subject must be prepared and implemented thoroughly.

b. The meaning and definitions of various terminologies which are listed below related to the subject must be taught to the students before starting the topics.

(2) Principle of Activity:

Teaching is ineffective if the students are not participating actively in the class.

Making the student physically and mentally engaged helps to make learning more dynamic and faster. Teaching can be facilitated if students actively participate in the learning process and put what they're learning into practice. Self-activity is the best way for students to learn, but it needs to be psychologically sound. The rigidity of the courses is eliminated through experiential learning, which places students in real-world situations. The students gain both quantitative and qualitative knowledge by fully engaging in the activity. The only knowledge that enters his/her life is that which he/she learns on his/her own. Therefore, the goal of instruction should be to provide students with as many possibilities as feasible.

- **Relevance in Architectural Education:**

Subject: architectural graphics and drawing – I & II

Explanation: Students are asked to make models of the 3 D Objects which will help them to visualize the object from 360 degree. The working drawing of the existing project can be discussed on site with respect to the drawing.

The exercise conducted in Padmashree Dr D Y Patil College of Architecture, Akurdi Pune is shown below.

Students were asked to make 3D models of the object and then the models are opened with respect to the vertices marked.

This will make students understand how the 3D object is formed and its correlation with respect to the vertices.

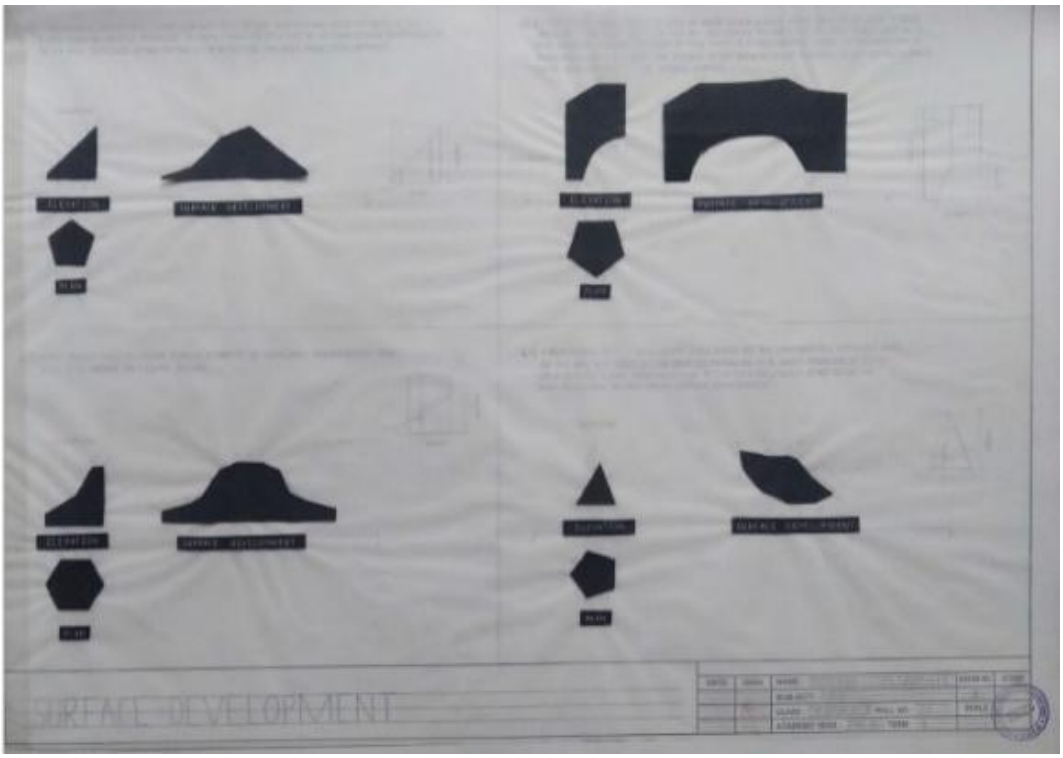


Figure 15 Development of Surfaces Exercise

Source: Students' academic work

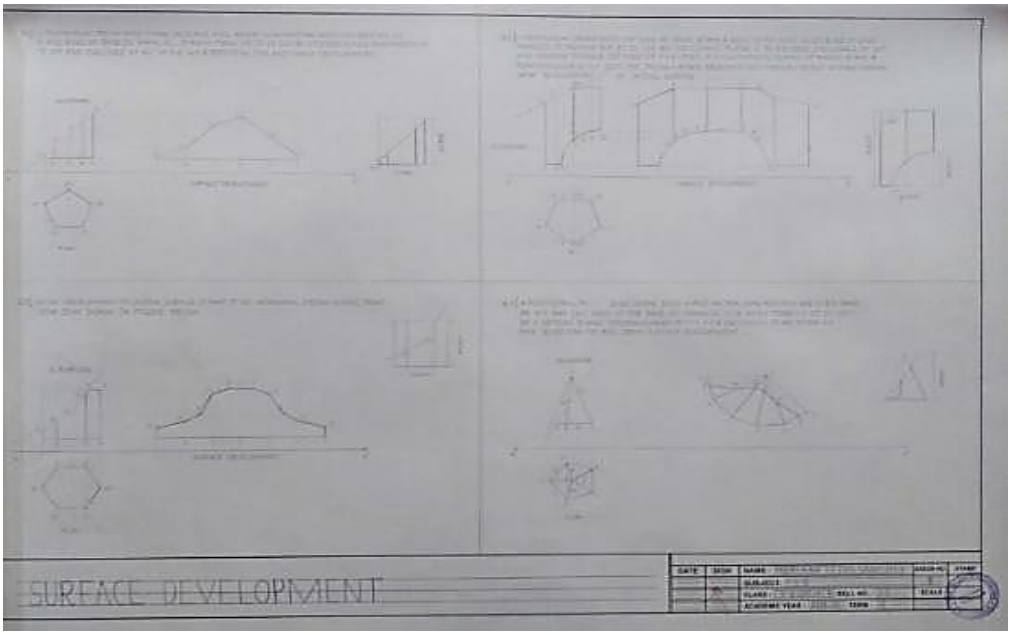


Figure 16 Development of Surfaces Exercise

Source: Students' academic work

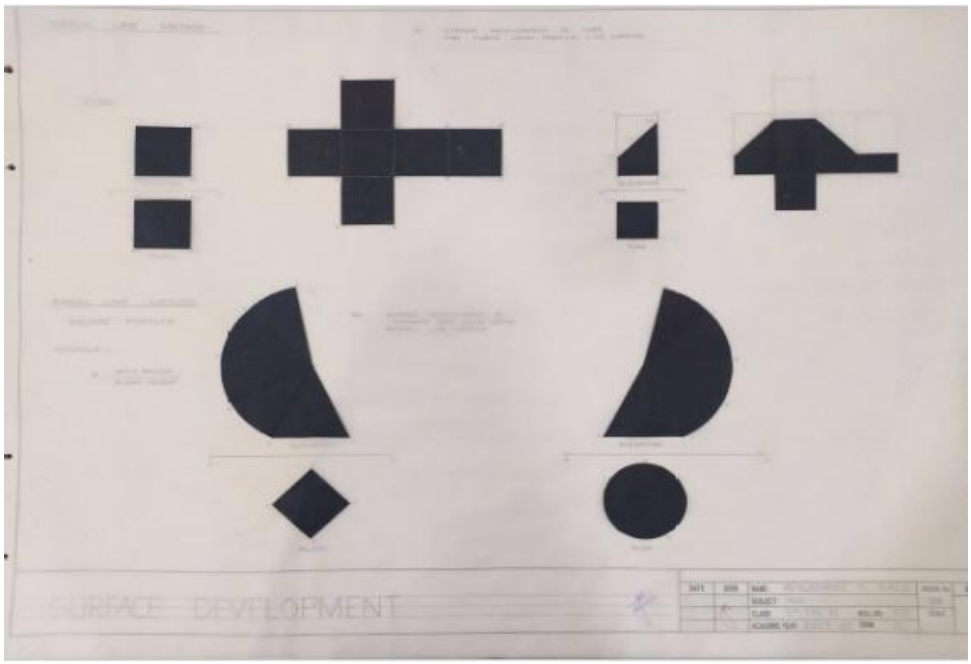


Figure 17 Development of Surfaces Exercise.

Source: Students' academic work

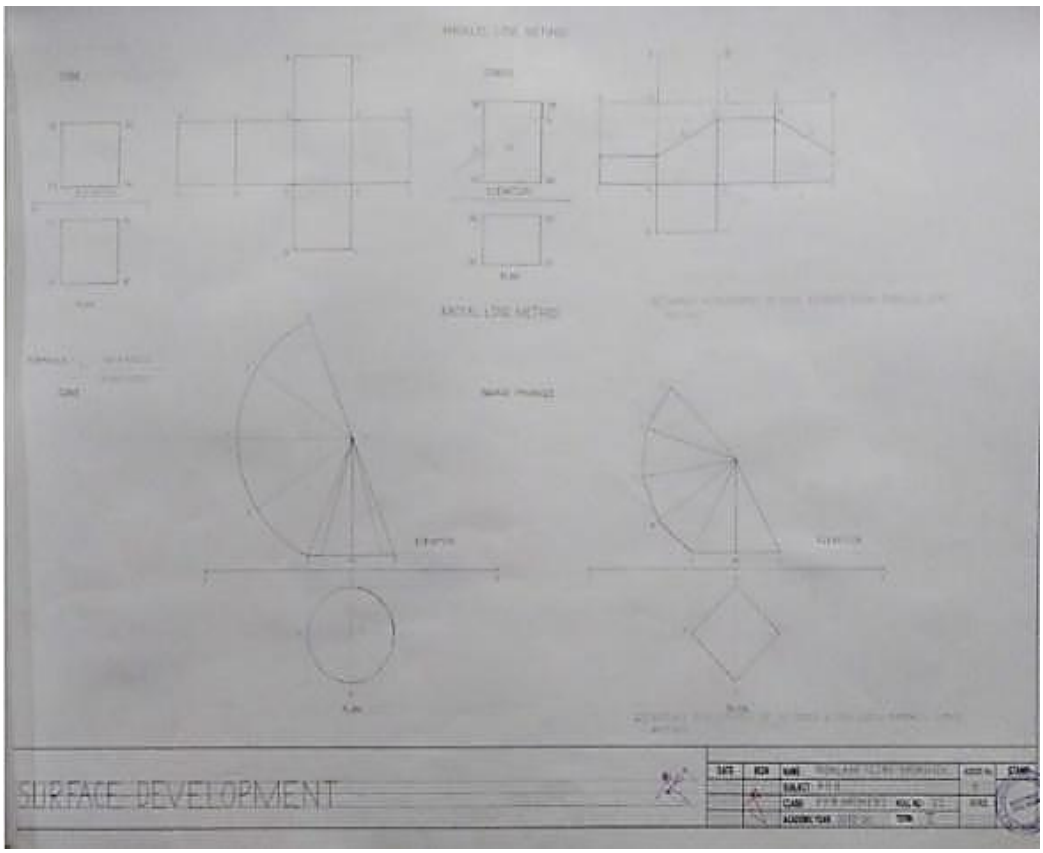
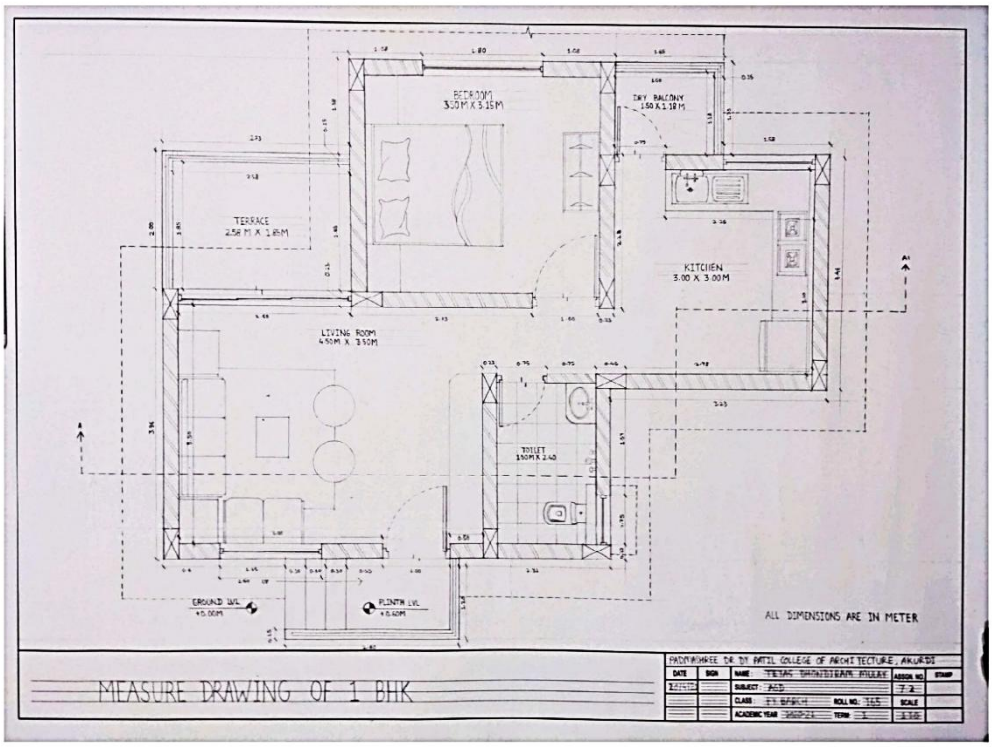


Figure 18 Development of Surfaces Exercise 1

Source: Students' academic work

A small exercise of Measured Drawing was given to the students to understand the practical situation. Students were asked to measure a small structure and asked to draft the same correctly. They were asked to apply the line weight, Line types, graphics, Lettering, and dimensioning techniques, etc.

The outcome of the project was satisfactory, as most of the students tried to draw it correctly. Though it was a deliberate attempt and students were guided to draw the sheet. However it is necessary that the same methodology of drawing must be implemented in Design as well as another technical drawings. These drawings communicate correctly and do not create confusion about the execution of the project.



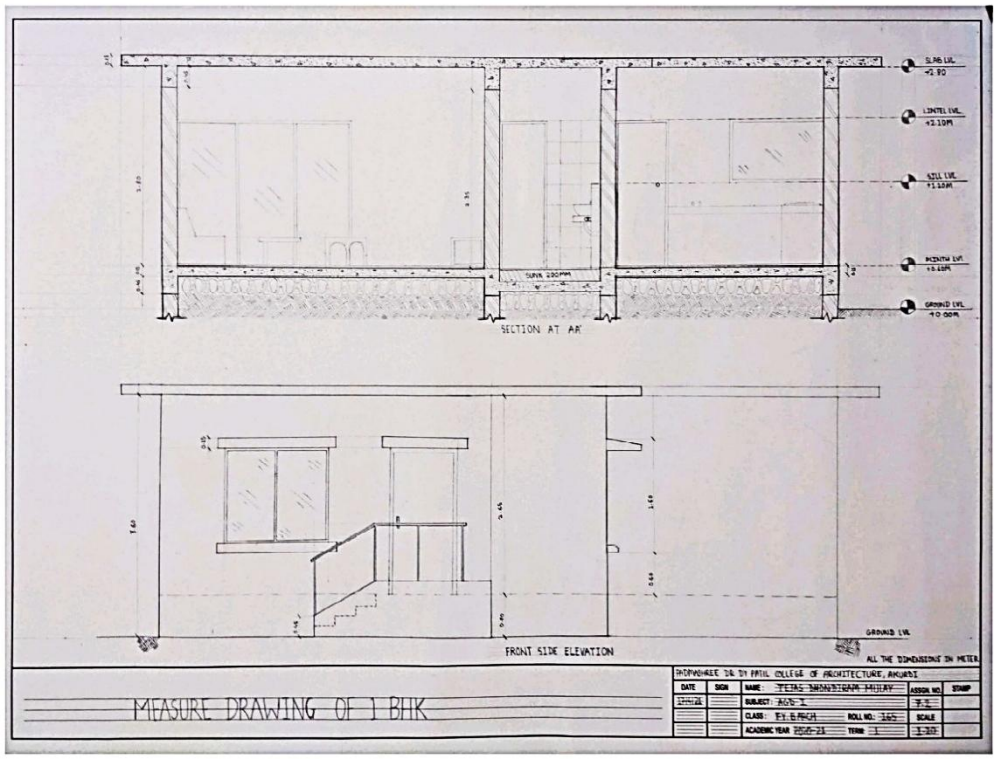


Figure 19 Measured Drawing 1

Source: Students' academic work

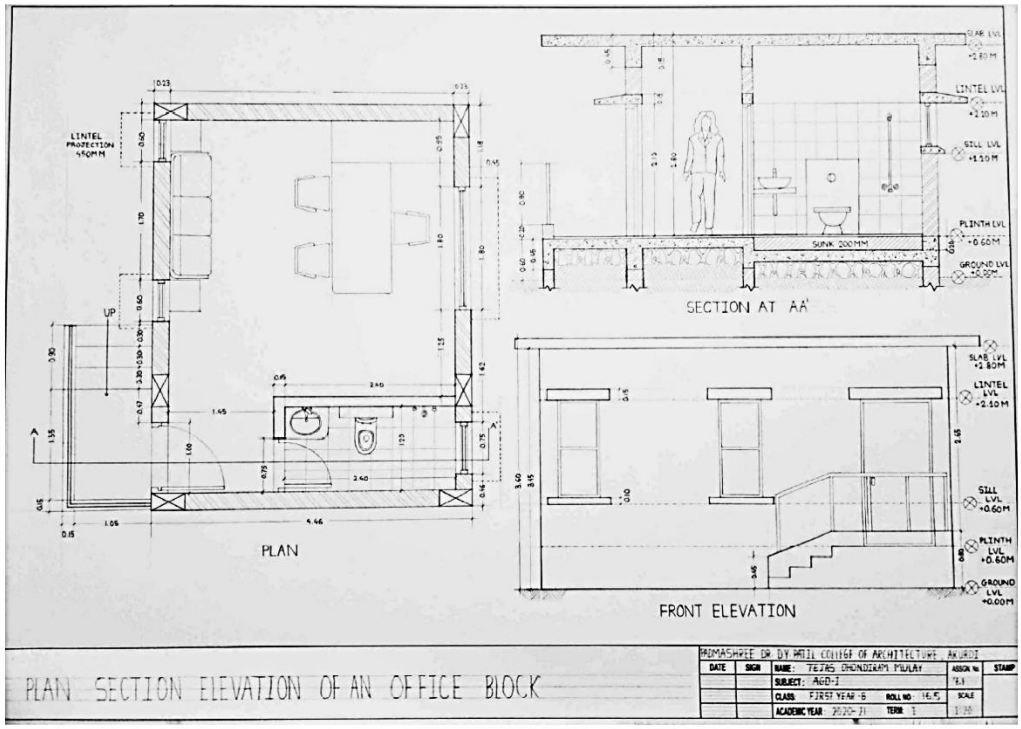


Figure 20 Measured Drawing 2

Source: Students' academic work

3) Principle of Motivation:

It is believed that a successful teaching-learning process depends on the motivating principle. It's said that half the war is won if the students are sincerely motivated for the lesson. Motivation is the fuel that drives the mind's engine. Motivation not only facilitates learning but also makes it feasible. It grabs a child's attention, and if the child is truly engaged, he will pay attention, which promotes effective learning. Therefore, educators should create compelling learning environments to effectively engage students.

- **Relevance in Architectural Education:**

Subject: architectural graphics and drawing – I & II

Explanation: Students should be very well informed about the Noble profession of Architecture along with the message that they are learning the Universal Language in this subject which is globally accepted. It is much more necessary to be able to convey

your idea, than to be a good designer. One must inform students that Architecture is the only profession which deals with each and every aspect of human being may it be the comfort, or the environment or the economy and sustainability or the social status and so on.

(4) Principle of Interest:

From the perspective of the learner, the principles of interest and motivation are equally crucial. The teacher has complete control over how engaging a lesson can be, and when students take an interest in a subject, they learn it more quickly and efficiently. The instructor must make an effort to maintain the pupils' interest. Should a pupil get disinterested in a certain subject at any point, they will not only not divert their focus but also become antagonistic toward the teacher. Getting people interested will help them learn more easily.

- **Relevance in Architectural Education:**

Subject: architectural graphics and drawing – I & II

The Staff must be very well acquainted with the knowledge of the subject then only he/she will be able to make the subject interesting by explaining to them how a wrong indication of a line or a graphic leads to totally different / opposite meaning which may lead to confusion. At times if the students are informed what is wrong than what is right, students remember it better.

N. Students need to be taught how to portray what they observe because they will be joining architecture following their 12th-grade exam and will not have a curriculum in place for their education. Learning to draw begins with the observation of space, structures, and objects. Acquiring representational abilities requires having an "architect's eye" for things. Particularly in the early phases of the learning process, continuous practice and guided observation are crucial tutoring strategies.

O. It is important to utilize interactive computer platforms, software, models, animations, and graphical representation, among other visually complex media.

Even while alternative approaches hold promise, many practical and theoretical issues remain to be answered.

5.7 Chapter Summary

The opportunity it gives students to explore and extend their horizons is more important than the curriculum itself. In my opinion, children gain confidence in the learning environment because of the associations and flow of the curriculum rather than the courses themselves or a collection of them. The ability to distinguish between knowledge and information is becoming more and more important in the course of professional education.

With only a few minor variations, the curriculum format is nearly the same across the nation. It is necessary to identify some issue areas. With the exception of site visits for assignment purposes, on-site experience is essentially nonexistent in all curriculum. Most schools either don't provide humanities or arts and crafts classes, or they only offer them infrequently.

Since this is where the learning happens, pedagogy is the central concept in all education. Learning becomes a joint endeavor between the instructor and the student. I believe it is important for us as teachers to periodically consider whether or not we are learning alongside our students. Curiously, the verb "teaching" is not a direct verb in the majority of Indian languages; instead, it is derived from "learning." This results in the academic and educational spheres being distinguished philosophically.

We'll need to rephrase a few questions once we've had this conversation. Which is more crucial: a curriculum or an approach to teaching? What systems exist to maintain the motivation and encouragement of educators? To what extent does the architectural quality of a learning environment matter? And which is more crucial—serving the needs of the local and regional communities that support education, or those of the globalizing world?

II शिल्पिलक्षणम् II

भवन्ति शिल्पिनो लोके चतुर्धा स्वस्वकर्मभिः ॥
स्थपतिः सूत्रग्राही च वर्धकिस्तक्षकस्तथा ।
प्रसिद्धदेशसङ्कीर्णजातिजो ऽभीष्टलक्षणः ॥
स्थपतिः स्थापनार्हः स्यात् सर्वशास्त्र विशारदः ।
न हीनाङ्गोऽतिरिक्ताङ्गो धार्मिकस्तु दयापरः ॥
अमात्सर्योऽनसूयश्चा तन्द्रितस्त्वभिजातवान् ।
गणितज्ञः पुराणज्ञः सत्यवादी जितेन्द्रियः ॥

(सयमतम् ५ अध्याय।)

This Sanskrit verse describes the four essential skills required for the successful erection of an edifice. In ascending order, taksaka, the stone or wood cutter, vardhaki, the meson or the carpenter, sutragrahin, the master mason or supervisor, generally the disciple or the son of the architect, and finally, the Sthapati, the architect. High intellectual, moral and ethical standards are set for the architect. He must be a man of quality, physically sound, just, compassionate, learned in mathematics, incorruptible, familiar with ancient authors and well versed in all forms of knowledge (Sarva Shastra visharada). We can also interpret this to mean the four stages a person has to go through, and the skills required to graduate to the highest level as an architect.

Thus coming back to the above shloka, we educate our students to transform them into *Sthapati, the architect* which means *Sarva Shastra visharada.*

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Appendix 1

Staff Questionnaire about the curriculum

Questions	Likert scale				
	Strongly Disagree [1]	Disagree [2]	Neutral [3]	Agree [4]	Strongly Agree [5]
Do you think that Formal Teachers Training is necessary for teaching in Architecture Colleges before joining the institute?					
Are you of the opinion that Faculty should teach Same curriculum at least for 3 years?					
Do you think that the passing out student is Industry ready as far as SPPU Curriculum is concerned?					
architectural graphics and drawing is purely Technical subject.					
Do you think that Technical subject is more challenging than					

Design Subject?					
Does the SPPU curriculum follow COA Guidelines?					
Does COA Guidelines need Revision?					
Are you of the opinion that more emphasis is necessary on Sketching skill of the student?					
As per your opinion do you think AGD is very important for the Holistic output of the Design Studio?					
Are you of the opinion that Technically Correctness of the Drawing is more important than Design?					
Do you think that Faculty Student ratio as per COA is sufficient to teach Architectural Curriculum?					
Do you think that content of the					

curriculum of AGD for SPPU is sufficient.					
Do you think that Curriculum of Design and Technical Subjects need to be Integrated with each other?					
Are you of the opinion that Design Drawings are Drawn with integrating All technical subjects?					
Are you of the opinion that Evaluation of AGD curriculum of SPPU need Revision?					
Are you of the opinion that Outcome of Students' Design and Technical drawing are Satisfactory?					

Appendix 2

Staff Questionnaire to Identify Crucial Aspects of Curriculum

Sr. No.	**Staff Questionnaire**	Strongly Disagree [1]	Disagree [2]	Neutral [3]	Agree [4]	Strongly Agree [5]
1	architectural graphics and drawing (AGD) is a Technical Subject					
2	AGD curriculum is sufficient to understand the subject TOTALLY in First Year only					
3	The curriculum needs to be more elaborated					
4	Number of Lectures / Studios as per curriculum are sufficient					
5	Teaching AGD at first year is difficult					
6	Students apply line weights and Graphics					

	appropriately in their drawings					
7	Application of Architectural Lettering and dimensioning techniques by students are appropriate.					
8	Representation of various building materials and building components are appropriate.					
9	Students understand Standard Scale and Graphic scales and their applications.					
10	Students understand Graphical construction of various plane geometrical shapes					
11	Students understand Simple/ Euclidian Three Dimensional					

	Solids' and their generations					
12	Students understand Orthographic Axonometric, Isometric etc. projection systems for Solids and Sections.					
13	Architectural sketching with thrust on bldg. elements and built environment (indoor and outdoor). Min. 15 nos. is very much necessary					
14	Use of ICT is necessary to make them visualize the object					
15	The quality of Architectural Drawing is to be based on the Correctness of the Drawing					

16	Evaluation criteria of AGD as per examining body is Satisfactory					
17	Only Sessional assessment is sufficient					
18	Because of Only Sessional assessment, students are taking this subject very casually.					
19	Drawing Exam (Theory) for AGD is necessary					
20	Application of AGD knowledge in Architectural Design is reflected.					

Appendix 3

Assessment Rubrics:

Name of Student: **Year and Batch:**

Faculty:

Parameters	**Needs to Improve [1]**	**Satisfactory [2]**	**Good [3]**	**Very Good [4]**	**Excellent [5]**
Line types: meaning and application.	Too much Variations in line Types and Line weights	Variations in line Types and Line weights	Average Variations in line Types and Line weights	No Variations in line Types and Line weights	Correct representation of line Types and Line weights
Evaluation					
Architectural Lettering and dimensioning techniques	Too much Variations in Lettering and dimensioning techniques	Variations in Architectural Lettering and dimensioning techniques	Variations in Architectural Lettering and dimensioning techniques	No Variations in Architectural Lettering and dimensioning techniques	Correct Architectural Lettering and dimensioning techniques
Evaluation					
Architectural annotations	Too much Variations	Architectural	Architectural	Architectural	Architectural

and conventions	in Architectural annotations and conventions	annotations and conventions	annotations and conventions	annotations and conventions	annotations and conventions
Evaluation					
Presentation of various building materials and building components.	Too much Variations in Presentation of various building materials and building components.	Presentation of various building materials and building components.	Presentation of various building materials and building components.	Presentation of various building materials and building components.	Presentation of various building materials and building components.
Evaluation					
Standard and Graphic scales and their application	Drawing reflects No Understanding about scale and application	Drawing reflects partial Understanding about scale and application	Drawing reflects Understanding about scale and partial understanding of application	Drawing reflects Understanding about scale and application	Drawing reflects perfect Understanding about scale and application

Evaluation					
Graphical construction of various plane geometrical shapes	No Understanding of construction of Planes	Partial Understanding of construction of Planes	Understanding of construction of Planes	Understanding of various ways construction of Planes	Perfect Understanding of various ways construction of Planes precision in drafting
Evaluation					
Simple/ Euclidian Three Dimensional Solids' and their generations	No Understanding of Three Dimensional Solids' and their generations	Partial Understanding of Three Dimensional Solids' and their generations	Understanding of Three Dimensional Solids and Partial understanding of generations	Understanding of Three Dimensional Solids and their generations	Perfect Understanding of 3 D Solids and understanding of generations and precision in drafting
Evaluation					
Orthographic Axonometric, Isometric etc. projection systems for Solids and	No Understanding of projection systems for Three Dimensional Solids'	Partial Understanding of projection systems for Three Dimensional	Understanding of projection systems for Three Dimensional Solids' and	Understanding of various projection systems for Three Dimensional	Perfect Understanding of various projection systems for Three Dimension

Sections	and Sections	Solids' and Sections	Sections	Solids' and Sections	al Solids' and Sections and precision in drafting
Evaluation					
Architectural sketching with thrust bldg. elements and built environment (indoor and outdoor). Min. 15 nos.	Sketches are less than 05. Missing proportions, line weight, shade and poor overall sketch quality.	Sketches are less than 15. Tried proportions, Average line weight, shade and overall sketch quality.	Sketches are 15. Proportionate, sketches with acceptable line weight, shade and overall sketch quality.	Sketches are more than 15. Good proportionate, sketches with quality line weight, shade and overall sketch quality.	Sketches much more than 15. Excellent proportion, sketches with best quality line weight, shade and rendering. Extra efforts on dynamic views.
Evaluation					

Appendix 4. List of Publications and Conferences

Sr No	Title of paper with author names	Name of Journals/ Conferences	Published date	ISSN no/vol no, issue no	Indexing In Scopus/Web of Science /UGC-CARE List
1	Identifying Crucial Aspects of Architectural Graphics and Drawing Curriculum (2019 Pattern): A Case Study of 'Savitribai Phule Pune University', Pune, Maharashtra Author: Ar. Chaudhari Dhananjay Dr. Raminder Kaur	International Journal of Cultural Studies and Social Sciences	2024	ISSN 2347-4777 Vol-20 Issue-2 No. 18 Pages – 127-132	UGC-CARE
2	Challenges of Teaching Architectural Graphics and Drawing Subject: A Case Study - 'Savitribai Phule Pune University', Pune, Maharashtra	Journal of Asian Architecture and Building Engineering	Review Completed Submitted 11/12/23	ID– JAABE2312804AP	Scopus

3	Analysing Teachers' Teaching Methodologies and Students' Understanding for the subject of Architectural Graphics and Drawing Author: Ar. Chaudhari Dhananjay Dr. Raminder Kaur	Educational Administration : Theory and Practice	2024	ISSN 2148-2403 Volume-30 Issue-4 Pages- 44-49	Scopus
4	Significance of Architecture, Graphics, and Drawing in Architecture Design Studio Authors: Ar. Chaudhari Dhananjay Dr. Mahendra Joshi	European Chemical Bulletin	2023	ISSN 2063-5346 Vol – S 3 Issue - 12 Pages – 1723-1729	Scopus
5	Challenges of Teaching Architectural Graphics and Drawing Subject: A Case Study -'Savitribai Phule Pune University. Authors: Ar. Chaudhari Dhananjay Dr. Mahendra Joshi	International Conference on 'Future of Skills in Architecture, Design, Planning and Allied fields.	2023		Conference Paper Presentation