

A Comparative Pedagogical approach in Vernacular Architecture: Theoretical method vs PBL method

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Abstract:

The paper examines the comparative pedagogical approaches and corresponding learning outcomes in the course Vernacular Architecture in the undergraduate program of Architecture at REVA University, Bengaluru, India. The first adopts the conventional theoretical approach where instructional principles of the course are delivered through direct method, while evaluation is done through a semester end written examination. The second approach adopts Project based learning (PBL) where the course content is delivered through experiential and collaborative learning through a social environment, done by means of a Vernacular documentation study with direct applicability in the corresponding Design Studio.

Vernacular architecture is based on local needs, availability of materials and reflects local traditions. It is an architecture that is indigenous to a specific time and place and showcases the best examples of Climate responsive architecture. Sustainability is defined as avoidance of the depletion of natural resources in order to maintain an ecological balance. In Architecture, we can interpret sustainability as building with materials that are local, with minimal energy consumption yet offering thermal comfort, while serving the lifecycle pertaining to the need.

Surveys were conducted post completion of the course to understand learning outcomes and student satisfaction in both methods. The outcomes from the study suggests that Sustainability in Architecture is well comprehended and results in enhanced learning through the PBL method as it delivers the important link between 'theory' and 'praxis'.

Keywords: Vernacular architecture, sustainability, project-based learning, Blooms taxonomy

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1. Introduction

Vernacular architecture is normally taught in schools of architecture as a conventional theory-based course, heavy in content, attempting to give a broad perspective on the diversity of styles across India.

Emphasis is placed on understanding spatial planning of the units represented through plans, sections and details, the settlement pattern, construction techniques and response of built forms to Climate.

The theory-based approach has its limitation, in that the relevance of learning about vernacular and its application in today's architecture is left untouched and unexplored. This approach also fails to highlight the feature of Sustainability or low carbon foot print that is a vital learning from vernacular architecture.

The practical approach is through the pedagogy of Project based learning (PBL) which is highly successful in bridging the gap between 'Theory' and 'Praxis', especially in a discipline like Architecture which is a synthesis of Art and Science and draws from the Humanities, Management and Building technology.

The paper starts with a brief insight into current research in PBL for architectural studies, setting the basis for the pedagogical model proposed in this paper. This is followed by a detailed description of the two methods, participant survey and findings for each method. The last part of the paper discusses the findings and scope for further research.

The paper is limited to establishing the correlation of pedagogical tools to learning outcomes through the course delivery and does not examine the evaluation methods.

2. Objective

The objective of the paper is to

- Compare theoretical method vs. PBL method for the course Vernacular Architecture

- ii. Evaluate learning outcomes using participant survey through both methods
- iii. Present and discuss the findings and suggest a pedagogical toolkit through an integrated PBL model

3. Background Study: PBL and Architecture Education

Project Based learning is rooted in the Constructivist theory (Dewey et al, 1973) which states that learning is by doing and experiencing, learning is by trial and error and puzzlement and more importantly learning is through interactions of the self with the environment. It has 3 main domains of learning:

- Cognitive: Using the intellect to learn by themselves
- Content: The Theory or content that is given by the Faculty to help in solving the problem.
- Social: The learning that comes from interaction with peers in a social environment.

Architecture Studio pedagogy historically relies on cognitive and intuitive learning. There is a large component of learning-by- doing through models and through trial and error in the interactive process of design where in flaws in the planning are reworked several times to arrive at a satisfactory solution. Recent studies have revealed that PBL can be successful in multi-disciplinary courses such as Software technology with architecture design studio (Kuhn 2001), PBL in social work education (Fulmer K.2017), PBL approach for structural engineering and architecture (McCrum P. 2017).

This is encouraging as architecture also borrows from many other disciplines and a similar methodology can be adopted for Vernacular architecture that is closely related to Environmental engineering and Sustainability. This paper deploys a similar approach (Integrated PBL, Banerjee and De Graaf 1997) by presenting a problem in the Design studio and delivering the content of the vernacular architecture course simultaneously, whereby the outcomes in the problem presentation are unique to each individual.

4. Instructional Principle I- Direct or Theoretical Method

The course Vernacular architecture was delivered in 2017 and 2018 as a theory-based approach to students of the 5th semester B. Arch at REVA University Bangalore. It was a 4-credit elective course with 52 hours of teaching spread over a 16-week semester.

The students learned about Vernacular architecture as a process, the different approaches to studying vernacular architecture, elements that constitute, methodology to study vernacular and the need for architects today to understand traditional construction techniques of the past.

Examples from different geographical regions of India, from single cell units to the multi cell mansions of the Nattukottai Chettiars were detailed out. Instructional environment was the classroom, with use of visual aids like PPT and videos. Inquiry based learning (Constructivist theory, Dewey et al 1970) that involved students researching few topics and presenting their understanding to the class as a seminar was also attempted (Flipped classroom, King 1993, Peer instruction Mazur 1997). Still other examples were understood with the help of models (Learning by doing, Dewey 1938) as seen in Table 1, figures 1and 2



Fig 1: Panel on differences and similarities of houseboats in Kerala and Kashmir, source: Aishwarya and Chinmayi, 5th Semester, REVA University. Pedagogical tool- learning by discovery.



Fig 2: Comparative study on Courtyards in Vernacular architecture, source: Deeksha and Meghana, 5th Semester, REVA University. Pedagogical tool- learning by discovery

4.1 Faculty Role in Course Delivery

Pedagogy adopted in delivering the course was innovative and diverse in nature, taking into account differentiated learning and outcomes that matched the Blooms levels of Taxonomy. The same is discussed in the table 1 below.

Table 1: Pedagogy in the Theoretical approach to the course

2016 & 2017

METHOD ADOPTED	PEDAGOGICAL TOOLS	BLOOMS TAXONOMY LEVEL
Research paper readings-around the world in a nutshell	Inquiry based learning	Analysis
Model making/panel presentations: Fig 1,2	Learning by doing, learning by discovery	Comprehension
Use of exit cards	Safe environment assessment	Knowledge
Use of videos	Sensorial learning- visual and aural	Knowledge
Invited lecture from expert faculties	Enhancing course delivery	Comprehension
Walk through a vernacular settlement	Experiential learning	Comprehension

Source: author

4.2 Survey Responses

A survey was conducted among students post completion of the course using the theoretical approach. Questions posed were aimed at understanding initial response to the course; topics that were retained and recalled the most; understanding of the spatial planning, dimensions, terminology through drawings; course delivery method that made the most impact; learning from the examples discussed and finally if they were convinced about sustainability in Vernacular architecture. Some of the pertinent responses are shown below.

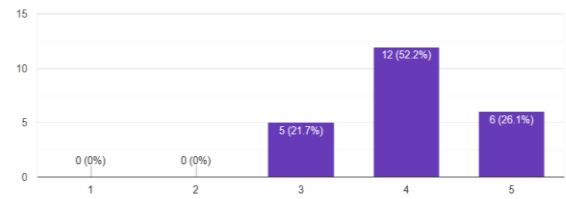


Fig 3: Overall understanding of Plans, sections and elevations of the various vernacular styles across India on a scale of 1 to 5

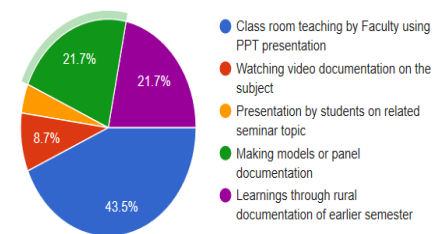


Fig 4: Medium of course delivery that impacted most on learning

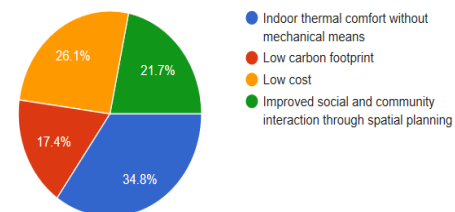


Fig 5: Feature or element in Vernacular feasible to achieve in design

When asked where they perceive maximum opportunity to apply their learning in design, 47% responded for Resorts and Eco-Tourism, 21 % for low rise community housing, 17% for Residential in non-urban context and only 13% for public buildings. When asked if the course inspired them to work with architects who practiced sustainability, 100% answered positively.

Finally, when asked what methods could have been introduced to make the course more relatable, 73% responded with live experiments at a vernacular site to measure temperatures, humidity, and thermal gain, making prototypes and testing using simulation software.

4.3 Summary of Findings

From the survey it can be inferred that the instructional principle of direct method has its benefits in that dissemination of information on all topics are equal and a good understanding of spatial

planning is achieved. The learning is further reinforced through the hands-on approach of making panels or models (Fig 1,2). Students rate high on memory recall on all topics. This goes to prove that the Blooms taxonomy level of Comprehension is satisfied. However, the students did not rate high on application of learning and also on understanding of Climate responsiveness and sustainability in Vernacular architecture. The lack of practical experience at a site is attributed to this.

5 Instructional Principle -II: PBL Approach

An alternate method was adopted in 2019 with students of the 4th semester by the same Faculty member. The opportunity to integrate Vernacular architecture (Integrated PBL, Savery 1995) within the design studio presented itself whereby a new pedagogical approach of Project based learning was attempted. The problem was to study the Vernacular settlement at two locations in the Udupi district. 74 Students accompanied by 4 faculty members were taken to Barkur and Brahmavar, two ancient settlements that date back in History to the Tuluva dynasty in coastal Karnataka. The climatic region was classified as Hot-Humid with high annual rainfall and high summer temperatures.

5.1 Project Brief:

The 16-week semester was divided in four stages:

i)**Pre-site visit:** Direct briefing to students, procuring necessary base maps, instruments, grouping of students according to allotted tasks prior to visit.

ii)**On-site:** Detailed outline of multiple tasks and activities during the period of stay at the chosen location. Faculty intervention at end of each day to help tally, correlate and understand the data recorded.

iii)**Post site visit Studio Documentation:** Translation of learning at site into report, video, drawings. Analysis of findings that make the basis for delineating the problem.

iv)**Detailed solution development using PBL:** using the method of studio pedagogy in the Lodge design whereby the learnings from the documentation and analysis is applied into the Design. This ensures a holistic learning and connection between theory and praxis

5.2 Activities to achieve Learning Goals:

The vernacular documentation was carried out over two days at both locations. Students conducted primary survey with questionnaire on living conditions, occupation, infrastructure, age and condition of houses; collected secondary data from Taluk office on demography; Landuse, street character, activity mapping, identification of nodes, interaction spaces; detailed documentation of religious heritage to study linkages in history, community and culture; detailed documentation of residential typologies in terms of Plans, sections, elevation and details of different income and occupation characteristics; vernacular methods of construction details and materials both structural and non-structural; video documentation of the settlement; climatic analysis focussing on passive methods adopted that improve indoor thermal comfort through spatial planning. The figures below represent the activities carried out at the location.



Fig 6: Measuring and sketching at temple Brahmavar, experiential learning



Fig 7: Mediated learning: Faculty discussing the data collected at site and reinforcing the learning

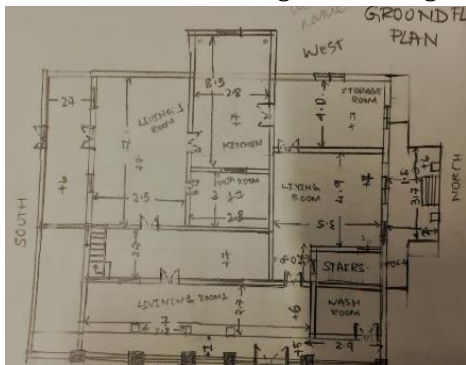


Fig 8: On-site sketching Residential typology- translating into plan



Fig 9: Understanding shading and Sun path in Temple courtyard, Discovery learning.

5.3 Formulation of project brief:

After the completion of the on-site study, a site was identified for proposing a Lodge at Barkur to facilitate accommodation of tourists during the 'Alupotsava' festival and during annual temple 'Rathotsava' festival. The total site area was 900sqm and the design constraint was to utilise 50-60% ground coverage and

achieve a solution to accommodate the space program. The purpose was to present students with a problem that was specifically 'Context-driven', which is the basis for all Vernacular architecture as stated earlier in the paper. The table below gives a brief description of spatial requirements for the problem

Table 2: Design requirements of the project

S.NO	DESIGN REQUIREMENT	AREA IN SQM
1	Reception lobby, waiting, manager room, luggage room, tourist information kiosk	60
2	Restaurant, kitchen	100
3	Rooms- single, executive, luxury- 20 no with attached toilets	400
4	Multi-purpose hall for small gatherings	150
5	Circulation spaces, services and ancillary	200
6	Parking for 15 cars and 50 two wheelers	250
	Total built-up area spread over 2/3 floors	About 1200-1400 sqm

Source: author

5.4 Faculty role in Course Delivery:

The pedagogical strategies deployed during the pre-site visit, on-site study and post site visit studio work can be summarised below.

Table 3: Pedagogy Deployed from stages 1 to 4 of Project

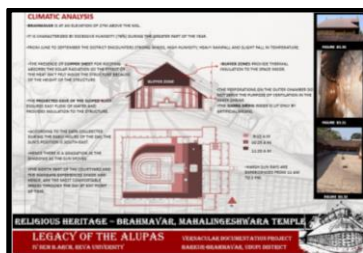
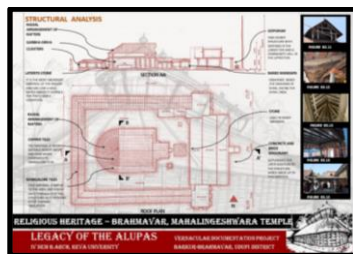
Fig 10,11 Analysis of Study: Religious heritage, typologies, Construction details, Street study, source: Students of 4th Sem REVA University

5.6 Differentiated Learning: Design solutions through

METHOD ADOPTED	PEDAGOGICAL TOOLS	OUTCOMES
Pre-visit context sensitisation- familiarising students with geographical area, delineated study area, task allocations, creation of base maps	Collaborative and cooperative learning	Tasks allocated were completed as per expectations on-site as students worked on their inherent skills
Lecture on Climatology by subject expert- Passive methods in Hot-Humid regions using examples	Direct method, Integrated PBL	Students were able to identify the role of materials and passive methods in achieving indoor thermal comfort
On-site work: video documentation, interviews, public performance viewing of Yaksha gana, primary survey, measured drawings of religious and residential typologies: <i>fig 6,7,8</i>	Experiential learning/ Sensorial learning / learning through environment/ Theory of multiple intelligences	Understanding impact of socio-economic structure, sustainability, culture, traditions, climate on the spatial planning of residential typologies, street character and vernacular style
On-site measurement of indoor-outdoor temperatures, humidity, wind direction, speed using weather monitoring station, measurement and observation of shadow patterns: <i>fig 9</i>	Discovery learning	Deeper understanding and validation of learnings through lecture on climatology
Post-site visit studio work: Translation of drawings from paper to software by Intensive workshop on AutoCAD, adobe photoshop conducted by faculty members	Direct method- using software lab /Integrated PBL	Creating a software data base of all drawings eased sharing among groups for analysis and made end semester output simpler and more enhanced.
Mid-semester Jury by expert on cultural landscape of the region to review analysis of findings - Religious heritage, Landuse and street character, Residential typologies, Construction techniques and Climatic analysis were the broad topics: <i>figures 10, 11</i>	Inquiry based learning/ Mediated learning experience	Comments specific to each group on the data analysed by external expert helped understand in totality the connections in the documentation exercise among the groups. Positive reinforcement of the work by an external member increased confidence and enhanced final output
Support through expert sessions on Structures, services, climatology at the design resolution stage	Mediated Learning	Outcomes were differentiated: Higher thinkers integrated the learnings from all cross disciplinary courses into the design while others could integrate only few
Detailing the design problem: Site analysis and climatic understanding, integrating services like water supply, sanitation, electricity, resolving high temperature and sun angles owing to orientation, assuring wind flow and ventilation, understanding roof forms: <i>fig 12,13</i>	Iterative learning/ learning through social interaction/learning by trial and error	The analysis helped students to come up with a strong concept that was responded to context in terms of materials, form, spatial planning. Applying the learnings into the design completed the learning cycle

Source: author

5.5 Problem presentation by students: Analysis and Design



PBL Method

Solutions offered were unique to each student with varying levels of complexities achieved, taking into account the collaborative learning at site, in the studio and subsequent analysis. Lectures given in short capsules also helped in the

design development. All were presented in the form of drawings and models.



Fig 12,13: Design Solution to Problem: Graphical representation, Students of 4th Semester, REVA University

Table 4: Level of complexity achieved in Problem solving by students using PBL method

SL	PROBLEM CHALLENGE	SOLUTION - MODERATE ACHIEVERS	SOLUTION-HIGH ACHIEVERS
1	Hot-Humid Climate: High rainfall	Courtyard planning, sloped roofs	Passive cooling through water bodies, Jaali openings for forced air, elevation of living spaces on stilts, design of shading device as per sun angle
2	High Thermal gain	Use of local materials Laterite walls with Lime plastering, deep eaves projections, High Plinth	Balconies for buffer, clear-storey openings, double insulated walls, filler slabs for roofs
3	Response to Context-surrounding temple, temple Kalyani	Replication of Colonnaded verandah as seen in temple, use of Gajaprastha profile in Plan	Conceptual abstraction of temple form, staggering in plan, relation of built unbuilt, ground water recharge to facilitate water table near Kalyani
4	Horizontal and vertical planning, façade treatment in heritage precinct	Mangalore tiles, timber columns in elevation, staggering of plan with courtyards	Achieving connectivity through semi-open corridors, changing quality of light, use of local materials

Source: author

5.7 Survey Findings

A post course completion survey was undertaken to assess how the pedagogical tools impact learning outcomes in the PBL method.

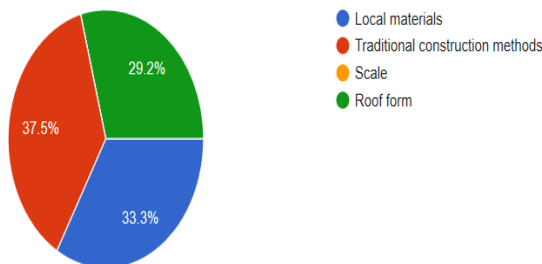


Fig 14: Visual quality of Vernacular experienced

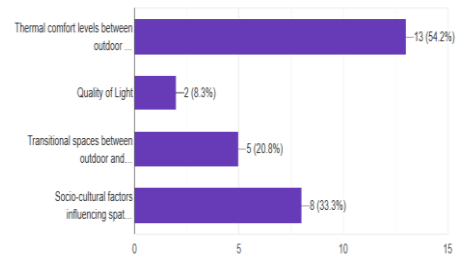


Fig 15: Physical quality of vernacular experienced

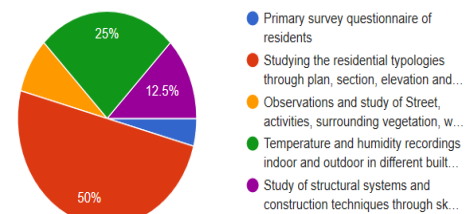


Fig 16: Method deployed that had most impact on learning outcome

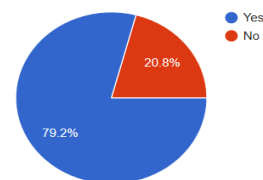


Fig 17: Whether the problem offered the opportunity to apply the learnings

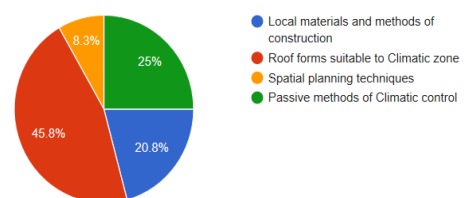


Fig 18: Element applied in problem presentation

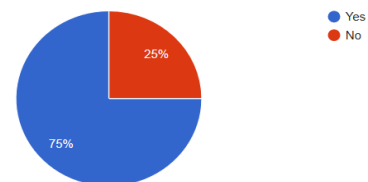


Fig 19: Efficacy of providing Climatology theory lecture in problem resolution

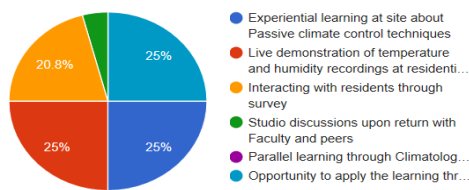


Fig 20: Pedagogical tool deployed that maximised learning outcomes

5.8 Summary of Findings:

The PBL method validates the constructivist theory that learning through social interactions (Vygotsky1978) results in understanding multiple issues at once. Certain intangible elements like Socio-cultural factors reflected in spatial planning were internalised by students only when physically placed in the learning environment.

Interactions with the residents through primary survey helped many students perceive the sustainable eco system existing and to attempt similar solutions in their design problem, like open wells and maintaining the larger temple tanks.

Similarly, Passive methods of Climatic control were easily understood and replicated in the Design solution instead of resorting to solutions like air-conditioning. The most important findings through the survey was that a strong correlation of theory to practice was achieved in the PBL method as all students tried at least one or more elements of Vernacular to be applied to the Design problem as can be seen in table 4. Moderate achievers applied direct methods, while some high achievers applied a combination of active and passive methods of climate control with innovative solutions for shading devices and roof insulation.

6.1 Conclusion and Recommendations:

The findings on learning outcomes of both approaches reveal that in the conventional method the learning outcomes are good communication skills through drawings, sound knowledge on diversity of styles across regions and broad awareness on Climate responsiveness of Vernacular architecture.

In the PBL method, using the toolkit of pedagogical approaches, students presented the extended learnings by applying the knowledge to the Lodge design. Features like passive methods for Climate control, use of local materials, contextual learnings through roof forms and interpreting the local features in a modern representation were evident in the Design.

Another important reflective learning for the students in the PBL method were the intangible aspects like socio-cultural factors, relation of built to un-built and scale.

The objective of the research and the premise that the PBL method would bring them closer to understanding Sustainability in Vernacular architecture was validated as seen in the innovative passive measures for preventing thermal heat gain, Green walls and orientation towards prevailing winds. Furthermore, this method encourages continued learning, leading to further research by the individual, as observed in the innovative shading device design attempted by the higher achievers.

6.2 Scope for further research:

The experiment with contrasting approaches was successful as the Faculty member handling the course was same and had conducted two rural documentation studios in different Climatic zones in Karnataka. This pilot study can be replicated to other theory-based courses which can be integrated into the Design studio with an end goal of application through the modified PBL practice.

Further, this pilot study has opened up possibilities of taking the analysis to the next step by introducing the simulation software for assessing building performance. Since the documented drawings are available as AutoCAD drawings, the same can be tested by students using simulation software like Design Builder to assess the performance level and energy efficiency of the building and assess sustainability in Vernacular architecture. The same simulation model can be applied to the Design solutions proposed, where students have suggested innovative modern-day solutions like green walls, shading devices and new materials based on the learnings from vernacular study. This will reinforce faith in the traditional vernacular methods and encourage them to build using this knowledge that will be the new sustainable architecture of tomorrow.

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