Towards Holistic Well-Being: Designing Interactive Spaces for Students in Vertical University Environment

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Abstract: *With the emergence of new learning and employment opportunities in urban areas, cities are experiencing rapid densification which has resulted in land scarcity and congestion, compelling governments and construction industries to adopt vertical growth strategies. The transition from expansive, land-intensive campuses to compact, self-sufficient vertical universities has become a pressing necessity. A vertical university is envisioned as a high-rise structure that integrates all essential academic and non-academic functions like classrooms, laboratories, libraries, student housing, recreation, and administration within a consolidated vertical form. However, building upwards should not come at the expense of social interaction and mediated spaces as they significantly contribute to character development, peer bonding, and informal learning practices. Against this backdrop, this research aims to benefit students aged between 16-23 years by proposing a design framework for interaction zones in vertical universities by analyzing the spatial configuration of social spaces through the space syntax method, with the goal of embedding these zones seamlessly into students' daily routines .The study classifies the social spaces according to the nature of space, function & activity. It investigates the design elements, spatial arrangements, and interactive features that stimulate and enrich the learning experiences. The research fetches results through primary survey of students as respondents and secondary literature reviews and case study. Overall, the study benefits students by creating environments that tend to foster community by integration of visibility and accessibility aspects*

Keywords: Vertical university, interaction zones, Spatial configuration, Students' wellbeing, informal learning, peer collaboration, Visibility

1. Introduction to Vertical University

According to NAAC-UGC, an institution of higher learning providing facilities for teaching and research and authorized to grant academic degrees is called a university. Vertical university is built upwards in the form of skyscrapers or tall buildings housing different universities and ancillary spaces. Thoughtful design of such spaces ensures that vertical universities foster holistic growth—academically, socially, and personally. (Ibrahim, 2013) Furthermore, the growing influence of information and media as powerful socialization institutions offers new resources and opportunities for students' cognitive and personal development. (Martsinkovskaya, 2019)

The spatial configuration surrounding the core of a vertical building defines both the scale and the character of students' activities. Vertical universities must integrate collaborative zones, green terraces, breakout areas, and recreational hubs at different levels to promote social interaction, emotional comfort, and a sense of belonging. Natural light, ventilation, and visual connectivity become crucial design elements in reducing fatigue and supporting cognitive performance, while active circulation routes such as stairways and open lounges can encourage movement and physical activity.

2. Problem Statement

The current development situation forces the individual to use all his potential abilities for self-realization and personal growth within the framework of those social conditions and the culture in which he grows and develops. (Martsinkovskaya, 2019). The major problems that undergraduates face in a vertical university are listed below:

- Vertical Isolation
- Sick building syndrome
- Restricted collaboration
- Classroom-bound learning only

3. Aim

To develop design strategies for enhancing students' well-being & analyzing their spatial configuration in vertical university environments.

4. Research Questions

- What is the need for a vertical university in the urban setting?
- What is the need & importance of the interaction zones in the holistic well-being of students?
- How are the social zones in the vertical high-rise building planned in the current vertical university?
- In what ways does the spatial configuration of social spaces influence students' movement patterns and scale of social activities?
- How the strategies would contribute to foster informal learning among students?

5. Objectives

- To understand the need for a vertical university in an urban setting.
- To understand the role of interaction zones in promoting healthy social interactions among students and fostering informal learning.
- To analyze the ongoing trends within the construction of Vertical universities.

- To evaluate the spatial configuration of such social zones in a vertical high-rise building.
- To propose a holistic framework for the design and management of vertical institutes that integrates **social, cognitive, psychological, and physical well-being.**

6. Scope & Limitations

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- The study is limited to vertical university high-rise educational buildings.
- The study deals with the students of age group from **16-23.**
- The study focuses on cognitive, social, psychological and physical well-being of the students.
- The research conclusion is derived from case study analysis and practicality, Economic viability is not considered.

7. Methodology

By identifying the need and vertical isolation along the floors in the vertical university, the study employs primary surveys from students as respondents and **Space syntax analysis** for the secondary data from literature. Through these methods, a tailored study of factors like spatial arrangement, connectivity, and visibility affecting the students' movements and social interaction is done. Space Syntax analysis through axial maps and visibility graphs further deciphers circulation patterns, segregated zones, and interaction potential within case-study campuses. The study concludes by understanding the necessary design considerations and proposing a framework for social spaces in vertical university.
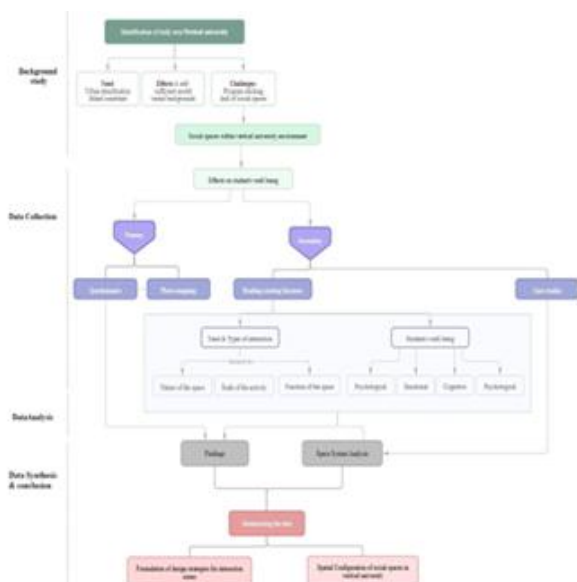
8. Literature Review

8.1 Introduction to vertical university

The vertical university is a response solution for the rising demand for higher education and land constraints in urban cities. The transition from large courtyards to a single high rise building with integrated green terraces and captivating social spaces that develop student character and encourage collaboration. A vertical university is sustainable as it consolidates academic, residential, and recreational functions within a compact footprint, reducing land use in dense urban areas.

8.2 Interaction zones in vertical university

George Mead, the American philosopher & sociologist briefly developed the theory of social behaviorism which suggests that identity is shaped through continuous interaction. In this vast open information landscape, universities act as formative spaces that mold students' character. The openness of the modern information space, its limitlessness, is increasingly affecting the formation and development of personality. (Kobzeva, 2020, #) In vertical universities, social spaces become even more crucial due to spatial and economic constraints, requiring thoughtful, space-efficient integration to ensure both formal and informal learning thrive within a self-sufficient environment.

An interaction zone or a social space is a virtual or physical space where people gather and interact. Social space is a space that goes beyond geographical boundaries and is shaped by social interaction. In university where different projects, hand-on workshops, practicals and team projects are crucial part of curriculum spaces should be curated to fulfil the varied need of the work. The non-academic spaces in the university helps to combat stress and foster team-work. Ultimately, they nurture social, emotional, cognitive, and physical well-being, shaping students into confident and well-rounded individuals. These spaces help in:

Encouraging collaboration & peer bonding: Moving away from home for the sake of higher education can arise feeling of homesickness and isolation. Socializing builds friendship and unity in the community. Peer to peer learning is very important for overall growth of a student as it builds confidence, promotes engagement and reduces isolation

Osmosis method of learning: Within academic contexts, this method reflects how students internalize skills, values, and practices not solely through formal instruction but through continuous observation, peer interaction, and immersion in a culture of learning.

Vertical university -a self-sufficient model: Within a vertical university, learning, living, leisure, and livelihood are interwoven into a self-sufficient loop, creating a high-rise ecosystem that accommodates educational, recreational, and social functions within a single structure. The inclusion of in-house facilities supports students in meeting their academic, social, and personal needs within the same building, thereby reducing external pressures and enhancing safety and security.

8.3 Types of Interaction zones in vertical university

a) **Based on nature of the space**: Social spaces can be classified based upon the level of openness. Open spaces like terraces, sky gardens, or semi-open spaces like atriums, shared balconies, offer environmental exposure as well as relaxation zones. The enclosed spaces like cafeteria, lounges support focussed and controlled

activities. Mediated spaces are the transitional zones blurring the boundaries between formal and informal education thereby strengthening the learning ecosystem.

b) **Based on the scale of activities**: Social zones are also classified by the activity it supports ranging from intimate scale like quiet corners, reading pods, or study nooks to medium scale spaces like multipurpose rooms or workshops for small activities collective community zones like auditorium.

According to research field surveys and audio diaries, **Crook and Mitchell** gave four types of social engagement in learning scenarios:

- **Focused Collaboration**: Occasions of traditional and relatively intense joint problem solving.These are likely to be planned and strongly outcome-oriented.
- **Intermittent Exchange**: Whereby students convene for independent study that permits an occasional and improvised to-and-fro of questioning or commentary.
- **Serendipitous Encounter**: Chance meetings with peer in which study related issues

- **Ambient Sociality**: Students identify the importance of simply 'being there' as participants in studying community. (Crook & Mitchell, 2012,)

c) **Based on the function of the space:** Social spaces is a broad term that encompasses a variety of well-designed spaces that caters physical exercise and creative expression to intellectual exploration and cognitive mapping. A vertical university must therefore incorporate flexible & multipurpose environments where spaces can shift functions like a courtyard used for sports, performances, and informal gatherings. The design should also incorporate light, greenery and ergonomic layouts to enable deeper interaction and community building. (Table 1.1) The major functions are:

- Interaction & Collaboration Zones
- Recreational & Leisure Zones
- Cultural & Creative Zones
- Green & Wellness Zones

Table 1.1: Types of interaction zones

No.	Activity	Scale of activity	Function of the space	Type of engagement	Nature of the space
1	Waiting	1-4 persons	Foyer, Corridor	Serendipitous encounter	built-covered
2	Having snacks, coffee	2-8 persons	Café, Canteen, Mess	Serendipitous encounter	Semi-open-built
3	Casual meet with friends	2-8 persons	Garden, Hostel Common rooms, Indoor balconies, Playgrounds	Serendipitous encounter	open, built
4	Play Games	2-20 persons	Libraries, Classrooms, Courts	Intermittent collaboration	built, open
5	Group study	1-12 persons	Working studios	Exchange	built, semi-open
6	Exhibition/festival, cultural, etc. programmes	1-100 or more	Auditoriums, Oats	Ambient Sociality	Semi-open, built, open
7	Seminar/Workshop	1-100 or more	Lecture halls, Oats, Auditoriums	Focused collaboration, Intermittent exchange	Built, semi-open

8.4 Characteristics of Interaction zones

The characteristics of the spaces defines the interaction quality and quantity of the students. Spaces which do not need wayfinding but constitutes the transition from indoor to outdoors are more likely to be used by students. Some of the characteristics of the spaces are as follows (Fig 1.1)

Figure 1.1: Characteristics of social spaces

8.5 Student's well-being

Well-being is defined as the quality of people's lives and their standard of living, which is a multi-dimensional construct that comprises both objective, material components and subjective, psychological facets. (PISA, n.d.)

The holistic development of student in physical strength, cognitive mapping and understanding and ability to conquer emotional stress and behaviour constitute students' well-being. The dimensions of the students' well-being constitutes:

a) **Cognitive:** Cognitive is based on how information is processed and judgements are made. It constitutes the mental abilities of child and positive learnings. It involves **mental alertness**, motivation to learn, and opportunities for intellectual growth. The universities are the backbone in shaping the cognitive well-being of students. Some of the key-components of cognitive well-being include attention, information processing speed, concentration, memory & problem solving & planning.

b) **Psychological:** Psychological well-being refers to a person's overall mental and emotional state, including their sense of purpose, self-acceptance, autonomy, positive relationships, and ability to cope with challenges. It goes beyond the absence of mental illness and focuses on feeling fulfilled, resilient, and emotionally balanced

c) **Emotional:** Emotional wellbeing is about recognizing, experiencing, and managing a wide range of thoughts and feelings in a constructive way. (university, 2022). Early models proposed that social support helps people adapt to pain by mitigating emotional and behavioral distress through supportive interactions in a transactional

process—pain prompts distress, which elicits social comfort.

d) **Physical:** Physical well-being refers to the optimal functioning of the body, where an individual maintains good health through regular physical activity, balanced nutrition, adequate rest, and preventive healthcare. It involves having the energy, strength, and endurance to carry out daily tasks efficiently without undue fatigue. The relationship between human health, overall well-being, and the natural environment is widely recognized.

Table 1.2: Types of well-being

Aspect	Cognitive Body	Psychological	Emotional	Physical
Definition	Mental abilities related to processing, attention, memory, and problem-solving	Mental state including purpose, autonomy, relatedness, belonging, and resilience	Managing and expressing emotions constructively through social support, emotional regulation, and regulation	Optimal body functioning with activity, nutrition, rest, and nature
Key Components	Attention, concentration, speed, information processing, memory, problem-solving	PERMA model – Positive emotion, Engagement, Relationships, Meaning, Accomplishment	Emotional regulation, self-esteem, social support, coping mechanisms	Movement, fitness, rest, sleep, exposure to green spaces, nutrition
Design Strategies	Quiet zones, varied lighting, intuitive layouts, collaborative spaces, atriums	Open lounges, interactive spaces, visual openness, celebration zones, greenery, inclusive atriums	Lounges, terraces, natural light, atriums, greenery, inclusive design	Rooftop sports, active stairs/escalators, movement-friendly vertical design, fitness zones
Impact	Enhances focus, retention, critical thinking, and academic performance	Builds identity, belonging, resilience; reduces stress and isolation	Improves emotional bonding, self-esteem, reduces stress	Boosts health, focus, reduces stress from sedentary lifestyles; counters inactivity

8.6 Impact of social spaces on Student's well-being

Many philosophers have theorised the importance of communication with peers and teachers in learning concepts, sharing knowledge and problem solving practises. The social spaces on campuses significantly shape student well-being by fostering belonging, reducing loneliness, and supporting stress recovery through social interaction and restorative environments. This holds across informal learning spaces, green/public areas, and flexible, collaborative zones that align with students' social and emotional needs. John Dewey interactions and communications focused on enhancing and deepening shared meanings increase the potential for learning and development. (Nickerson, 2024).

Figure 1.2: John Dewey learning theory (Ref.: Cloke, 2023)

8.6.1 Collaboration and peer bonding: Peer collaboration is a type of peer learning situation in which students work together, face-to-face, in a classroom towards shared understanding called convergence. (Alexander, 2010, #). Through peer learning students develop positive relationships thus making learning more effective. One of the examples of peer bonding is "Walk and Talk" activity, where students pair up and chat about their interests or science content, helping them connect both socially and academically.

8.6.2 Emotional connectedness: The students coming from different backgrounds and competing against each other which complies to build positive relations among peers. Spaces that inculcate visible sight lines and comfortable zones repeatedly encounter peers in familiar and meaningful contexts, helping them form stable emotional bonds. Research supports that spaces that balance privacy with social visibility, provide opportunities for informal contact, and integrate restorative features contribute to higher perceived connectedness and lower loneliness.

8.6.3 Health and fitness: The rapid shift from physical learning methods to digital media and software has significantly increased their screen time duration. Regular movement through activities like sports, walking, or using active circulation spaces improves cardiovascular fitness, reduces fatigue, and boosts energy levels. These spaces also support psychological and emotional well-being by lowering stress, improving mood through endorphin release, and providing opportunities for social interaction and teamwork. Students' exposure to the green spaces should be increased to induce calming effects which in turn helps to improve concentration. The absence of greens and outdoor spaces can lead to Nature-deficit disorder as proven by Richard Louv in his book, 'Last child in the woods'. Richard Louv directly links the lack of nature in the lives of today's wired generation—he calls it nature-deficit—to some of the most disturbing childhood trends, such as the rises in obesity, attention disorders, and depression. (Louv, 2016).\

8.6.4 Informal learning: Informal education, also known as incidental or unstructured learning, refers to the process of acquiring knowledge and skills through everyday experiences, interactions, and self-directed learning. It occurs outside of formal educational settings and is typically characterized by its unstructured nature, self-motivation, and focus on personal growth and development. Informal learning is driven by individual curiosity, interests, and motivations. Learners take ownership of their learning journey, seeking out information and experiences that align with their personal

goals. Informal learning emphasizes experiential learning, where knowledge and skills are acquired through hands-on experiences, observation, and participation in real-life situations. (fig 1.3)

Figure 1.3: Impacts of informal learning (Ref.: Khandoker, 2024

9. Case Study Selection Criteria

- **Urban context:** Areas having need for a high rise urban educational model to cater the land scarcity.
- **Vertical university:** The building should fall under the category of high-rise building constituting 10-15 floors where different universities or different branches of same universities are stacked one above the other.
- **Social space integration:** The building should not be merely the lego blocks of classrooms but should be adorned with semi-open terraces, playing courts and other facilities supporting overall well-being of students.
- **Informal learning**: Evaluating how these social spaces contribute for educating students, integrating play and exploration elements into the learning environment, encouraging hands-on experiences and curiosity.
- **Design features**: The spaces in the university should be arranged in such a way that it comes under maximum visibility envelope. Unique design features that help students to collaborate and engage with each other enabling peer to peer interaction.

Case Study

Nanyang Technological University (NTU) – The Learning Hub, Singapore.
- Location: Jurong West, Singapore
- Architect: Heatherwick studio
- Year of completion: 2015
- Built up area: 22,000 sq.m
- Height: 8 storey

Figure 3.1: NTU building (source: Fernández, n.d.)

3.1 Introduction

Located within NTU's dense urban campus, The Hive demonstrates land optimization through verticality, addressing spatial constraints typical of expanding universities in urban contexts. The building comprises 12 eight-storey towers arranged around a central atrium, forming a vertically interconnected cluster. The design eliminates conventional corridors, promoting fluid circulation and spontaneous encounters. The petal shaped design of the structure with no straight walls justify the design motive of promoting social interaction and small scale learning. The architectural language emphasizes openness, transparency, and informality, embodying a shift from one-directional teaching to peer-based collaborative learning. The coloured and tactile surfaces, relief on the core walls adds ornamental beauty to the structure. The design blends academic and social zones across floors, creating continuous vertical interaction. Circulation routes spiral upward, encouraging visual and physical connectivity between levels- promoting chance encounters and informal learning. The main focus of the design was to eliminate dead & dark corridors and make spaces that are well-lit & well-ventilated throughout the day.

3.2 Social Zones

The structure challenges the mile long murky corridors that connect the lecture halls. The outcome is a structure that interweaves both social and learning spaces to create a dynamic environment more conducive to casual and incidental interaction between students and professors. (Heatherwick studio, 2015)

Figure 3.1, 3.2: NTU interior : (Fernández, n.d.)

- **Central Atrium as a Social Core** –The Hive's central atrium acts as a spatial and social connector, visually linking all 12 towers and encouraging encounters across levels. This open core creates a sense of collective belonging and constant visual engagement among students and faculty.
- **Informal Interaction Zones** –Each level integrates open lounges, breakout pods, and circulation balconies that blur the boundary between formal classrooms and casual meeting spots. These areas support informal learning, group discussions, and social bonding.
- **Collaborative Learning Pods** –The 56 tutorial rooms are arranged as round pods, eliminating the hierarchy of front and back, and promoting peer-to-peer communication. This fosters equality, engagement, and group participation.

3.3 Special Features

The façade features curved concrete panels with ribbed textures that give the building its distinctive organic character. The twelve interlinked towers are clad in sand-coloured precast concrete, echoing the tones of natural earth and creating a warm, tactile appearance that contrasts with the glass-and-steel skyline of Singapore. The curved design itself acts as shading devices for optimum comfort. Moreover, the perforated and layered façade design contributes to a sense of openness and permeability, visually connecting interior learning spaces with the surrounding campus. This transparency enhances students' sense of comfort and belonging, reinforcing the building's role as a socially engaging and climatically responsive vertical university.
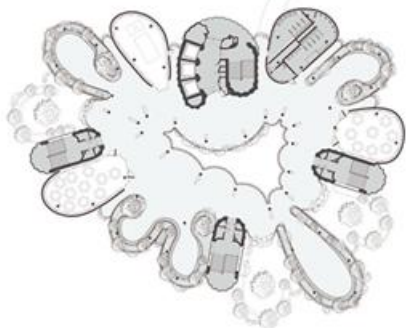

Figure 3.3: NTU first floor plan: (Fernández, n.d.)

Transparency and Connectivity: The structure is fully permeable due to the columns, grand central atrium and less defined walls. Visual connections across floors, and interlinked pathways encourage movement and visibility, transforming the building into a living social organism rather than a static educational structure.

10. Data Collection and Analysis

The collection of relevant data was achieved through primary sources in the form of surveys and secondary sources through reading existing literature and suitable case studies of vertical universities.

Primary: The primary data collected through the questionnaire from students as respondents focuses on the need and design of the interaction zones in the vertical university. Analysis reveals that students typically spend about 30 minutes in existing social spaces which is enough for short interactions like in corridors but insufficient for extended engagement like lounges indicating gaps in comfort, environmental quality, and functional diversity. Cafeterias emerge as the hotspot for social interaction. The minimal use of playgrounds raises concerns about physical health and obesity. The survey also reveals that current layouts restrict interaction between departments and year groups, which is a critical drawback in vertical universities where cross-disciplinary collaboration is essential. Students' curriculum expresses a need for multifunctional spaces that support both relaxation and academic activities such as group discussions and collaborative work. Maximum students prefer spaces having ambient lighting, natural light, varied furniture and lots of greens that soothes mind and body.

Secondary: The secondary data was collected through already existing literature and floor-plan space syntax analysis of different vertical universities. The results had shown that accessibility and visibility axis from the social spaces greatly influence student movement pattern. high-rise academic environments, the biggest challenge is the *vertical disconnect* which suggests that students rarely move across levels, leading to isolated social spaces. **Global Integration** identifies floors or zones that function as overall social hubs. **Local Integration** highlights which spaces attract short-range interaction, such as floor lounges, study pods, or corridor seating. Higher integration values typically indicate stronger social activity and better accessibility. It guides where interaction zones should be placed, how they should be visually connected, and how to reduce vertical isolation. The result is a more coherent, interactive, and community-driven high-rise campus.

11. Discussions and Findings

The social spaces in the vertical university are not just spaces but a critical hotspot of activities which catalyses the counteraction of vertical isolation, foster inter-disciplinary action and support the holistic development of students. Spaces that caters to support and uplift physical as well as mental health of students in the stress-filled environment are mandatory for overall character development.

The designing and spatial planning & zoning of transitional spaces like connecting corridors, main circulation core, spaces dedicated for different scales of activity affects the usage time and well-being of students.

Social interaction in vertical universities is primarily driven by spatial visibility, proximity to circulation, and the degree of integration. Designing social spaces in highly connected and visually open locations significantly enhances student engagement, reduces vertical isolation, and supports emotional and academic well-being.

The overall setting of the social spaces like ambient light, natural light, cross-ventilation, comfortable and modular furniture and moderate privacy with semi -open boundaries attracts students to spend more time in that social setting.

12. Design directives

a) Placing social spaces strategically at high-node interaction zones such as atriums, lift cores and circulation stairways will help the students to communicate, interact and socialize daily and hence counter vertical isolation.

b) Ensure flexibility in social space layouts with movable furniture, informal seating clusters, and adaptable configurations suitable for academic and recreational use.

c) Embed social spaces within academic routines by positioning them adjacent to classrooms, studios, and libraries so they become part of daily movement patterns.

d) Maximize visual connectivity through double-height volumes, transparent partitions, and open sightlines to encourage spontaneous encounters.

e) Integrate heller -up staircase instead of conventional staircase that fosters engagement among peers and creates spontaneous recreational spaces.

f) Designing open spaces,green terraces or balconies right outside the lecture halls & classrooms which would help to create informal learning.

g) Creating a hierarchy like public, semi-public and private and a variety of social spaces at different levels rather than assigning a special amenities floor.

h) Vertical Meandering: Create a clear, engaging, and inviting path (a "vertical street") from the main entrance to the vertical circulation elements and up to the major sky lobbies.

Figure 5.1: Heller up stairs at University at Brighton

13. Conclusion

This research demonstrates that the success of a vertical university depends not only on efficient stacking of academic functions but, more importantly, on the thoughtful design and spatial configuration of its social spaces. Findings from surveys, case studies, and Space Syntax analysis reveal that students thrive in environments that are visually open, highly connected, and integrated along vertical circulation paths. Social spaces—whether lounges, cafés, corridors, or terraces—serve as critical hotspots that counteract vertical isolation, support informal learning, and enhance emotional and psychological well-being.

The study concludes that social spaces in vertical campuses must be multifunctional, nature-integrated, flexible, and strategically positioned at high-integration nodes to ensure routine use and cross-floor interaction. Incorporating visual connectivity, greenery, active circulation, and multi-scalar gathering zones fosters a sense of community, reduces stress, and supports holistic student development. Ultimately, the research provides a spatial framework that can guide the design of future vertical universities toward becoming collaborative, emotionally supportive, and socially vibrant academic ecosystems.

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Volume 14 Issue 12, December 2025
Fully Refereed | Open Access | Double Blind Peer Reviewed Journal
www.ijsr.net

Paper ID: SR251220224655   DOI: https://dx.doi.org/10.21275/SR251220224655   1724

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Volume 14 Issue 12, December 2025
Fully Refereed | Open Access | Double Blind Peer Reviewed Journal
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Paper ID: SR251220224655   DOI: https://dx.doi.org/10.21275/SR251220224655   1725