

Developing of an Expert validated Unified Learner Feedback Scale for Online and Offline Educational Environments

David Campbell

Manipal University Jaipur

Mohit Totuka

`mohit.totuka@jaipur.manipal.edu`

Manipal University Jaipur

Durgesh Batra

Manipal University Jaipur

Research Article

Keywords: Educational measurement, scale development, learner feedback, higher education, psychometric validation, online & offline learning, feedback scale

Posted Date: October 13th, 2026

DOI: <https://doi.org/10.21203/rs.3.rs-10896620/v1>

License:   This work is licensed under a Creative Commons Attribution 4.0 International License.

[Read Full License](#)

Additional Declarations: No competing interests reported.

Developing of an Expert validated Unified Learner Feedback Scale for Online and Offline Educational Environments

First Author: David Campbell ^[0000-0003-0525-8150], Associate Professor, Manipal University Jaipur (MUJ), District Jaipur, India.

Corresponding Author: Mohit Totuka ^[0000-0003-2361-1851], Assistant Professor – Senior Scale, Manipal University Jaipur (MUJ), District Jaipur, India. Email: mohit.totuka@jaipur.manipal.edu

Third Author: Durgesh Batra ^[0009-0001-4178-2315], Professor, Manipal University Jaipur (MUJ), District Jaipur, India.

Abstract

The University Grants Commission (UGC) requires absolute similarity between degrees conferred on students through online and offline learning programmes in India, as per the National Education Policy (NEP) 2020. This paper presents the first instrument designed directly in response to this UGC parity mandate within the current national context. The paper discusses the design and psychometric validation of a common instrument applicable to learners in both online and offline settings. Through the inclusion of relevant parameters, the proposed instrument fills a gap in the field by enabling the evaluation of learning experiences across offline and online modes using a single tool. The research followed an iterative procedure involving multiple rounds of expert review to establish the validity and relevance of the constructs, followed by empirical validation. In the qualitative phase, a two-round content analysis and consensus process (Nominal Group Technique and Delphi) was used, in which experts evaluated ninety-seven initial dimensions for their online and offline relevance and conceptual overlap. Redundant and converging items were consolidated, and confounding variables were systematically excluded, compressing the pool into nine mutually exclusive, high-order common constructs. This process established robust content and face validity through structured expert consensus prior to deployment. The resulting instrument is then empirically validated through Exploratory Factor Analysis and Confirmatory Factor Analysis to confirm construct validity. The study provides a validated instrument for institutional benchmarking that enables institutions to adopt measures for achieving educational parity in accordance with their requirements.

Keywords: Educational measurement, scale development, learner feedback, higher education, psychometric validation, online & offline learning, feedback scale.

Introduction

In the era of digital transformation, the landscape of higher education has undergone a paradigm shift, moving from conventional classroom-based instruction to a diverse ecosystem that now includes online, blended, and hybrid learning environments. This transformation has been accelerated by technological advancements and catalyzed further by global crises like the COVID-19 pandemic that forced institutions worldwide to adopt online platforms (Adedoyin & Soykan, 2020). As a result, the need for equally rigorous quality assurance mechanisms across different learning modalities has become more urgent than ever.

In India, the University Grants Commission (UGC) has taken a progressive step by officially declaring that degrees obtained through online modes are equivalent in academic value to those earned through traditional, offline means. The National Education Policy (NEP) 2020 of India and the University Grant

Commission (UGC) have positioned online and offline modes of education as equivalent, particularly in terms of academic rigour, outcomes and recognition. As per the UGC public notice (F. No. L-912Ot8 (DEB-II) dated 23rd February 2018), “... *The Government of India ... recognising and treating the Degrees/Diplomas/Certificates awarded through distance mode at par with the corresponding awards of Degrees/Diplomas/Certificates obtained through the formal system of education...* ” From the qualification dimension, as per UGC notice 1-12/2023 (DEB-1) dated September 23rd, 2023, “... *Degrees ... awarded through ODL mode ... shall be treated as equivalent to degrees...offered through ... conventional mode...*” Also, those learners who are enrolled to any university in regular mode (physically meant to attend classes), they are eligible to do forty percentage credit through online courses, as per UGC notification dated 25th March 2021 REGD. No. D. L.-33004/99 . This approach ensures inclusivity +

and flexibility; it also introduces a critical dilemma - how can institutions ensure that the quality of education that students experience and teaching effectiveness remain consistent across both modalities? If the learning outcomes are considered equivalent, it becomes essential that the mechanisms to measure student perceptions and experiences also reflect this equivalence.

Existing feedback systems and evaluation models often fall short of this requirement. Most tools are designed for either online learners (e.g., DELES (Walker & Fraser, 2005), OSE (Dixon, 2025)) or blended formats (e.g., BLQS (Ballouk et al., 2022), BLAS (Bervell, 2021)), and are not adaptable to the diversity of learning modalities prevalent today. Furthermore, many of these tools are either too context-specific (Precel et al., 2009; Varlamis and Apostolakis, 2010), theoretically rigid (recel et al., 2009) or lack psychometric validation (Lewis and Sireci 2022); rendering them inadequate for comprehensive use in diverse institutional settings. therefore, the present study tries to establish a scale through which, feedback from both: online and offline learners could be taken. Unlike existing scales, the proposed scale is developed intentionally to bridge the gap between online and offline learning environments. It focuses on core experiential dimensions that are common to all learners, irrespective of the delivery mode.

Several well-established scales have been developed to systematically capture learners’ perceptions of the learning environment. The Classroom Environment Scale (CES) by Moos & Trickett (1974) is designed to assess the social climate of classrooms, measuring them through constructs such as teacher support, student involvement and rule clarity. The Learning Environment Inventory (LEI) by Walberg & Anderson (1968) emphasizes students’ affective and interpersonal experiences, which include satisfaction, cohesiveness and friction among peers. For higher education settings, the College and University Classroom Environment Inventory (CUCEI) (Fraser et al.) capture dimensions such as personalization, innovation and individualization. The What Is Happening in This Class (WIHIC) questionnaire given by Fraser, McRobbie & Fisher (1996) focuses on constructivist variables like equity, student involvement, and cooperation. In online contexts, the Distance Education Learning Environments Survey (DELES) by Walker & Fraser (2005) measures constructs such as instructor support, student autonomy and critical voice, reflecting a constructivist pedagogy. Collectively, these instruments provide valid means to assess the multidimensional nature of learning environments from the learner’s perspective. Out of the common scales used, CES, LEI, CUCEI and WIHIC are meant to target traditional classroom settings; DELES for online learners; and CLES is designed to evaluate constructivist learning environments.

The researchers do believe that if degrees earned online and in regular mode are to be considered equal in value and learning results in accord with recent educational policies like India's National Education Policy (NEP) and guidelines from the University Grants Commission (UGC), then the quality and structure of the learning environments in both formats must be similar. The learning environment that encompasses dimensions such as instructional design, teacher support, student interaction and cognitive

engagement plays a critical role in influencing learner satisfaction and academic achievement across educational settings (Walker & Fraser, 2005; Fraser, Fisher, & McRobbie, 1996).

While online and traditional classroom environments differ in their modes of delivery, they fundamentally share the same pedagogical objectives and respond to similar learner needs (Taylor, Fraser, & White 1994). This convergence underscores the necessity for a unified framework capable of evaluating the learning experience across modalities. If both online and traditional classrooms want to develop similar academic skills, then the tools used to measure learning should be clear and consistent, regardless of how the classes are delivered. Therefore, the development of a singular, robust measurement scale for learning environments that is applicable to both online and offline settings is not only logical but essential. Such an instrument would support the consistent assessment of instructional effectiveness, inclusivity, and learner engagement, thereby reinforcing the academic equivalence of degrees awarded irrespective of the modality.

Despite the proliferation of learning evaluation models and feedback mechanisms, none offer a unified, validated and learner-centric tool that functions equally across online and offline learning environments, to the best of researchers' knowledge. Most existing tools are 1. mode-specific (online only or offline only), 2. institution-centric rather than learner-focused, or 3. not inclusive of modern elements like digital engagement, access inequality, or personalized learning outcomes. Furthermore, current models do not support comparative studies between different learning modalities using a shared framework. This limits institutional ability to assess the real impact of delivery mode on learning outcomes. Thus, there is a critical need for a comprehensive, scalable, and psychometrically robust scale that 1.) aligns with national (Indian) educational policy, 2.) is flexible across modalities and disciplines and 3.) centres on learner feedback and perceived outcomes.

To overcome these limitations, researchers proposed the following research questions:

1. What are the various theories and scales for evaluating learning environments at present?
2. What are the different dimensions of educational learning environments as described in various theories and scales?
3. What are the various clusters or groups or new dimensions that could be created by taking together similar dimensions present in various theories and scales for learning environments? Hence, coming up with enhanced dimensions.
4. What are the questions that could be inculcated into the groups or new dimensions, keeping in mind that they should be catered to both online and offline learners?

Based on the research questions, the following objectives are targeted in the present research:

1. To explore various theories and established scales in literature for learning environments
2. To find various dimensions of various theories and scales in literature
3. To club similar dimensions in various theories and scales into new dimensions
4. To propose items that could be given in a questionnaire for new dimensions that could be responded to by offline, online and blended-learning learners

Literature Review

Historically, the evaluation of teaching and learning has been guided by several theoretical models. Among the most widely recognized is the CIPP (Context, Input, Process, Product) Model (Stufflebeam, 1971), designed primarily for program evaluation. While robust for administrative and institutional assessments, it lacks the nuance to address individual learner experiences, especially in digitally enabled settings. Similarly, the Kirkpatrick Model (1994) provides a framework for evaluating training outcomes yet does not account for variations in learning environments or student perceptions (Iqbal et al., 2021).

In recent years, tools such as the Distance Education Learning Environments Survey (DELES) (Walker & Fraser, 2005) and the Online Student Engagement Scale (OSE) (Dixson, 2015) have emerged to evaluate specific dimensions of online education. The Blended Learning Quality Assessment (BLQA) (Panigrahi et al., 2024) and Blended Learning Acceptance Scale (BLAS) (Bervell, 2021) have attempted to assess hybrid models but are limited to blended contexts and not fully suited for either exclusively online or offline learners. Moreover, they often overlook student-centred factors such as emotional engagement, real-time feedback and perceived educational outcomes.

Some institutions rely on custom-built feedback forms or general satisfaction surveys, but these often lack psychometric validation and comparability across modalities (Sitzia, 1999). The absence of a comprehensive, flexible and validated model that incorporates technological access, content quality, engagement, and outcome-based evaluation poses a significant barrier to equity in assessment.

Furthermore, while various studies have advocated for student-centred evaluation tools (Biggs et al., 2022; Ramsden, 2003), very few models account for the accessibility and digital divide, especially among learners from diverse socioeconomic or geographical backgrounds (Selwyn, 2016). This challenge is particularly relevant in countries like India, where both infrastructure and learner readiness vary widely.

Crucially, UGC's declaration of equivalence between online and offline degrees raises an important question: *If the degree is the same, why not the feedback mechanism?* This contradiction presents a serious institutional gap in aligning policy with practice. A single, well-validated tool that can function across platforms and programs is now more essential than ever.

Dimensions of Educational Learning Environments

The concept of dimensions of educational learning is not old. It refers to the gamut of conditions in which teaching and learning happens. It not only includes internal but also includes external conditions of any institution that could impact the learning experience of any learner. This may include any sort of physical location, social interaction with others, psychological context or may be teaching pedagogy that is been used (Jawaid & Aly, 2024; Perkkilii & Lehtelii, 2007; Gabryś-Barker, 2019). To be more precise, it is more oriented towards social, psychological and pedagogical contexts that impact students' achievement, attitude and belief (Perkkilii & Lehtelii, 2007). It can also be looked like a social system that encompasses learner, learners' interactions with others, systems and the reason of interacting with all (Faruque et al., 2017).

In literature, there are many dimensions of learning environment that are discussed and studied. One of the dimensions is '**Physical and Digital Space**'. It encompasses physical space where actual learning occurs for example classroom for theoretical lectures, laboratories for practical sessions or virtual spaces (like online sessions) (Gabryś-Barker, 2019; Cheers et al., 2012).

Another dimension that comes is '**Psychosocial Dimension**'. This dimension inculcates personal, social and organizational factors that could learning. It covers relationships between learners and teachers (instructors, facilitators, etc.), the social atmosphere and the overall support system available to learners (Jawaid & Aly, 2024; Gruppen & Fogarasi, 2021). Apart from the mentioned elements, it also covers affective aspects of learning i.e. **students' well-being** and the **emotional climate** of the learning environment (Gabryś-Barker, 2019; Gruppen & Fogarasi, 2021). 'Psychosocial Dimension' can be further divided into two dimensions – first is '**Psychological dimension**' and '**social dimension**'. Psychological focuses on individual psychological characteristics such as resilience grit and 'growth mindset' that are important to grow and learn (Closs et al., 2022). Apart, Psychological dimension also includes emotional and cognitive engagement (Zhu et al., 2020) and Mental Well-Being (Schunk & 2012). The social dimension focuses on the interaction among stakeholders that foster critical thinking, skills to solve problems and sense of belongingness that is vital for development (Al Yakin, 2025). The dimension also inculcates community of learners through participation and collaboration and highlights

teacher-student relationships and peer interactions in creating a supportive and engaging learning environment (Al-Barakat et al., 2025; Olofsson & Lindberg, 2006). All this enhances motivation and engagement that results into better learning outcomes (Zhu et al., 2020)

The next dimension, that is available in literature is **Pedagogical Dimension**. This dimension is strategy to facilitate learning through teaching methods, curriculum design and educational activities. Its components are effective teaching and continuous curriculum development ((Jawaid & Aly, 2024; Perkkilii & Lehtelii, 2007; Closs et al., 2022). Pedagogical dimensions constitute from the activities that are used to engage students and promote active learning, for example, problem-based learning, experiential learning, etc. (Cheers et al., 2012; Closs et al., 2022).

Technological dimension is another dimension of learning environment that specifies integration and utilization of digital and information technologies to facilitate an educational process (Ustunel & Tokel, 2018). The dimension incorporates usability and functionality of the technology used in the learning environment and includes aspects such as the ease of use, reliability and accessibility of technological tools (Chang et al., 2015). Hence, technological dimension can be considered as a mediator among learning materials, peers, learners and instructors. Therefore, we can consider technological dimension as an environment (Wan & Fang, 2006) that provides a premise for students for learning (Ustunel & Tokel, 2018), is high on usability for learners (Chang & Wang, 2015), aligned with pedagogy (O'Sullivan & Samarawickrema, 2008) and helps in student engagement (Sun, 2016).

The **organizational or administrative dimension** of the learning environment refers to the systematic and strategic approach top management takes to create, implement and control learning processes that enhance both individual and collective capabilities. This dimension is responsible for the policies, structures and cultural elements that support learning at various levels within the organization (Feld, 2010; Pokharel & Choi, 2015).

Another dimension, that could be seen in literature is **cultural dimension**. Culture does influence learning environment. For example, it can influence design and content of the curriculum (Kang & Chang, 2016), teaching and learning pedagogy (Kang & Chang, 2016; Stolen, 2022), learning spaces like classrooms (Latrous & Khadraoui, 2020), Interpersonal Relations i.e. between faculty and learner (Latrous & Khadraoui, 2020), communication style (Latrous & Khadraoui, 2020); Haag et al., 2007) and Cultural Sensitivity (Ouyang et al., 2025; Thomas, 2009).

Tools, models or theories to develop educational learning scales

For developing a sustainable scale to capture educational learning, it is essential to explore already established theories and models for educational learning. They provide a structured approach to develop a scale to capture different dimensions of education like physical, social, pedagogical, etc.

The CIPP Model (Context-Input-Process-Product), was developed by Stufflebeam in 1971, is a comprehensive learning environment evaluation framework that is mainly focusses on educational institutes and covers four key dimensions i.e. Context, Input, Process and Product (Stufflebeam, 1971). **'Context'** is to evaluate over all objectives of the institute (Dizon, 2023; Toosi et al., 2021). **'Input'** is assessing the resources allotted to achieve the overall objectives of program, for example, assessing faculty, facilities and financial support of the institute (Toosi et al., 2021). **'Process'** focusses on evaluating how well resources are being utilized or implemented and could be assessed through teaching pedagogy, student engagement, etc. In the last, **'Product'** includes outcome and effectiveness of the program (Toosi et al., 2021). The CIPP model has been the premise to develop measurement scales. For example, Hakan and Seval (2011) developed a scale for English curriculum of Yildiz Technical University, Tang (2023) uses CIPP to develop Teaching Quality Evaluation System of Intelligent Education System, Chinta et al. (2016) developed a framework to evaluate HEIs through CIPP, etc.

Another framework, that is proposed by David Jonasson in 1999, is a Constructivist Learning Environment (**CLE**) **framework** to create learning environment that aligns with constructivist principles and focuses on active learning of learners by allowing them to create their own understanding and knowledge by experiencing and interacting with a supporting learning environment (Jonassen & Rohrer-Murphy 1999). By the concept of constructivist, we mean that learners will develop (build or construct) their own understanding rather than simple grasping other understanding passively (Mugambi, 2018). There are six key components of CLE framework. First is **Problem** that should encourage learners to get engaged deeply with the subject matter or content (Hong & Lee, 2022). Second is **cognitive tools** or resources that support learners to process the information to solve the problem and developing a construct or concept in mind (Hong & Lee, 2022). Third is **conversation & collaboration tools** that support interaction with peers, faculty or others, fostering an environment to learn like discussion forums (Hong & Lee, 2022). Next is **Scaffolding or Coacing**, which means giving support to learners as required (Qu & Chaijaroen, 2025). For example, giving hints to solve problem at initial stage but later stopping when they start becoming proficient. coaching means faculty will be the facilitators or coach for the learners (Hong & Lee, 2022; Qu & Chaijaroen, 2025). The last is **Information resources** and contents i.e. digital libraries, databases, etc. (Qu & Chaijaroen, 2025).

Another framework that is looked in is **Biggs' 3P Model (Presage-Process-Product)** that is developed by John Biggs (Han, 2014) that is widely used in analyzing and improving educational experiences. It is constituted on three components: presage, process and product mainly oriented towards 'before learning', 'during learning' and 'after learning' respectively. The model is dynamic in nature as each stage influences the next. The '**Presage**' component is composed of two sub class, i.e., 'Student' element includes factors like **background factors** (Factors pertaining to student demographic characteristics (e.g., campus location and gender)), **cognitive factors** and **non-cognitive factors** (Han, 2014). The second part of **Presage** is 'instructor factors', which includes elements like course level (Factors related to the context), instructor/institutional effects (factors that explain the broader contextual factors) and pedagogical training (Factors pertaining to instructors' preparedness and knowledge about teaching) (Han, 2014). The second component of the 3P Model is '**Process**', which encompasses delivery methods, instructional activities/course design, and assessment & feedback. The last element of the 3P Model is '**Product**'. 'Product' includes cognitive outcomes and non-cognitive outcomes. The Biggs' 3P model, hence, provide a guideline for analyzing the relational impact of factors of any any concept (like course or program) at presage, process and product level. Therefore, researchers are not going to consider dimensions of this framework while creating an inventory of dimensions to be considered.

The **SAMR Model (Substitution, Augmentation, Modification, Redefinition)** is a framework designed by Ruben Puentedura (2006) to help educators integrate technology into their teaching practices effectively. The SAMR model categorizes four levels of technology use in education. The first category is of '**Substitution**', where technology acts as direct substitute for some traditional tool without changing the process. Second is '**Augmentation**', which acts' act as a substitute with some process improvement. Third is '**Modification**', which means through technology, significant process redesign happens and fourth is '**Redesign**' under which technology enables creation of new task that previous not possible (Hamilton et al., 2016). The model faces some shortcomings. For example, it lags academic rigour and emphasizes product over process (Kelsch & Wang, 2021). The model also does not consider teachers' expertise with technology or educational context that may influence its application (Blundell et al., 2022).

The other theory that is under discussion is the **Ecology of Learning Model**, inspired by Bronfenbrenner's Ecological Systems Theory, which provides a comprehensive framework for understanding the multifaceted influences on learning environments (Navarro & Tudge, 2025). Bronfenbrenner's theory, initially developed in the 1970s, emphasizes the importance of multiple environmental systems and their interactions in human development (An & Blanchard, 2020). This model also, like others, has key components. These key components with educational environment are:

(1) **Microsystem** (includes direct environment like family, school, peers) (Huang et al., 2025); (2) **Mesosystem** (includes interaction between Microsystem like parent-teacher collaboration, school-community partnerships, Participation in extracurricular activities, etc.); (3) **Exosystem** that includes broader social systems that indirectly affect an individual such as community resources and early education policies, parent workplace policies, school board decisions, etc.) ; (4) **Macrosystem** dimension encompasses the larger cultural and societal influences for example Cultural beliefs, societal values, and education policies; and the (5) is **Chronosystem** is the dimension that involves the influence of time and changes over the life course, for example pandemic inclines education towards online learning (Iruka et al., 2020).

Mostly studies are done for regular or traditional mode of the study. But some studies cover online learning also. For say, **Community of Inquiry (CoI)** Framework developed by Garrison, Anderson, & Archer (Garrison et al, 1999) is a widely recognized model for understanding and facilitating effective online learning environments. The framework is built on three interdependent elements: social presence cognitive presence and teaching presence. The first dimension or element of this framework is ‘**Social Presence**’, which means the ability of participants to identify with the community, communicate purposefully, and develop interpersonal relationships (Rapchak, 2017). The second dimension is ‘**Cognitive Presence**’ which means the extent up to which learners can construct and confirm meaning through sustained reflection and discourse (Rapchak, 2017). The third dimension is ‘**Teaching Presence**’, which is the design, facilitation and direction of cognitive and social processes to achieve meaningful learning outcomes (Arbaugh et al., 2008).

Established Scales for Educational Learning

Validated instruments and scales for assessing learning environments in HEIs are instruments can be considered as an entity that measure students' perceptions about various aspects of learning like academic, social and physical factors influencing their learning experience.

The Classroom Environment Scale (CES)

The Classroom Environment Scale (CES) is a widely used instrument designed to assess various dimensions of the classroom environment. The scale has nine dimensions (Fisher & Fraser, 1983). The first is ‘**Involvement**’, which indicates the level of involvement of the student in class activities; the second is ‘**Affiliation**’, which indicates the level of positive interaction among learners; ‘**Teacher Support**’ includes how teachers support students and encourage them; ‘**Task Orientation**’ is emphasis and encouragement to students on completing assignments and staying focused; ‘**Competition**’ means emphasis on outperforming classmates; ‘**Order and Organization**’ includes structure, planning and clarity in class operations; ‘**Rule Clarity**’ that covers how clear and consistent classroom rules are; ‘**Teacher Control**’, which represents the teacher’s strictness and discipline approach; ‘**Innovation**’, which means openness to new ideas and flexible teaching methods.

Learning Environment Inventory (LEI)

As per Fraser (1982) Learning Environment Inventory (LEI), developed by Herbert J. Walberg and Gary Anderson, in 1969, measures students’ perceptions of the social climate in high school classrooms. It consists of fifteen scales: **Cohesiveness** reflects the extent of student friendship and support to each other; **Friction** measures the level of conflict and tension among students; **Cliqueness** indicates the degree to which students form exclusive groups; **Satisfaction** captures students’ enjoyment of class activities; **Apathy** reflects lack of interest and participation; **Speed** assesses the pace of classroom activities; **Difficulty** relates to the perceived challenge of the work; **Competitiveness** measures emphasis on outperforming peers; **Diversity** covers tolerance and acceptance of individual differences; **Formality** examines adherence to formal classroom procedures; **Material Environment** assesses adequacy and quality of physical resources; **Goal Direction** reflects clarity and commitment to class objectives;

Disorganization indicates the extent of confusion or lack of order; *Favoritism* assesses perceptions of unequal treatment; and *Democracy* measures the extent of shared decision-making in the classroom.

CUCEI

The College and University Classroom Environment Inventory (CUCEI), developed by Fraser & Treagust (1986), is designed to measure students' perceptions of the social and instructional climate in higher education classrooms. It comprises seven dimensions: *Personalization* reflects the degree of individual attention and concern shown by the instructor; *Involvement* indicates the extent of students' active participation in class activities; *Student Cohesiveness* measures the degree of friendship and support among students; *Satisfaction* captures students' enjoyment and positive feelings toward the course; *Task Orientation* reflects the emphasis on completing activities and staying focused on academic goals; *Innovation* measures the openness to trying new ideas, methods, or activities in teaching; and *Individualization* indicates the extent to which students can make decisions and tailor learning to their own needs and preferences.

Science Laboratory Environment Inventory (SLEI)

The Science Laboratory Environment Inventory (SLEI), developed by Fraser, Giddings and McRobbie is designed to assess students' perceptions of the learning environment specifically within science laboratory classes (Fraser & Lee, 2009). It consists of five dimensions: *Student Cohesiveness* reflects the extent to which students know, support, and help each other in the lab; *Open-Endedness* measures the degree to which laboratory activities allow for student-designed investigations and creativity; *Integration* assesses how well laboratory activities are linked with theory taught in class; *Rule Clarity* indicates the clarity and consistency of laboratory rules and procedures; and *Material Environment* evaluates the adequacy and quality of laboratory equipment and materials.

What Is Happening In this Class? (WIHIC)

The What Is Happening In This Class? (WIHIC) questionnaire, developed by Fraser, Fisher, & McRobbie (1996), is designed to capture students' perceptions of the classroom learning environment across a broad range of contexts. It includes seven dimensions: *Student Cohesiveness* reflects the degree of friendship, help, and support among students; *Teacher Support* measures how much the teacher assists, trusts, and shows concern for students; *Involvement* indicates the extent of students' active participation and interest in class activities; *Investigation* assesses the emphasis on inquiry, problem-solving, and use of evidence; *Task Orientation* measures the importance placed on staying focused and completing assignments; *Cooperation* reflects the level of collaboration and teamwork among students; and *Equity* indicates the fairness of treatment and equal opportunities provided to all students.

Distance Education Learning Environments Survey (DELES)

The Distance Education Learning Environments Survey (DELES), developed by Walker & Fraser (2005), is designed to evaluate students' perceptions of the online and distance learning environment. It contains six dimensions: *Instructor Support* assesses the degree of help, guidance, and encouragement provided by the instructor; *Student Interaction and Collaboration* measures the extent of communication and teamwork among students in the virtual environment; *Personal Relevance* reflects how much the course content relates to students' personal goals and real-life experiences; *Authentic Learning* evaluates the extent to which tasks mirror real-world situations and applications; *Active Learning* indicates the degree to which students are actively engaged in meaningful learning activities; and *Student Autonomy* measures the level of independence and control students have over their learning process.

Technology-Rich Outcomes-Focused Learning Environment Inventory (TROFLEI)

The Technology-Rich Outcomes-Focused Learning Environment Inventory (TROFLEI), developed by Aldridge, Fraser, & Huang (1999), is used to measure students' perceptions of classroom environments that integrate technology and focus on learning outcomes. It includes ten dimensions: *Student Cohesiveness* assesses the degree of mutual support and friendships among students; *Teacher Support* reflects the encouragement and help provided by the teacher; *Involvement* measures students' active participation in class activities; *Investigation* gauges the emphasis on inquiry-based learning; *Task Orientation* assesses clarity and focus in completing assignments; *Cooperation* measures collaboration among students; *Equity* evaluates fairness and equal treatment; *Differentiation* reflects tailoring of instruction to meet diverse needs; *Computer Usage* assesses the extent of technology integration in learning; and *Outcome Orientation* measures the focus on achieving specific learning goals and results.

Constructivist Learning Environment Survey (CLES)

The Constructivist Learning Environment Survey (CLES), developed by Taylor, Fraser, & Fisher (1997), is designed to assess the extent to which classroom environments reflect constructivist principles of teaching and learning. It consists of five dimensions: *Personal Relevance* examines how learning is connected to students' real-life experiences; *Uncertainty of Science* explores the understanding that scientific knowledge is subject to change and interpretation; *Critical Voice* measures the degree to which students feel comfortable questioning and expressing critical opinions about teaching and learning; *Shared Control* assesses the extent to which students have influence over learning activities, assessment, and decision-making; and *Student Negotiation* evaluates opportunities for students to discuss, share, and negotiate ideas with peers and teachers.

Research methodology

The present study moves in different phases. The **first phase** is to comprehensively explore various theories and scales related to learning environment is developed and are present in literature and this is achieved in literature review. The **second phase** of the study is to explore various dimensions for the learning environment. These dimensions are taken from the theories and scales explored in the first phase. In this phase, efforts are made to define each of the dimensions. This is done through searching the meaning of dimension

In the **second phase** itself, various listed dimensions will be assigned to various groups based on repetition of dimensions, similarity and or near in meaning or conceptual proximity, to reduce the number of dimensions for the list of final dimensions. This step is done by the researchers. The method used is **Nominal Group Technique (NGT)** and **five** research experts are part of it. In NGT, the study follows four steps. In the first step, all participants jaunt down their points separately. Then each one shares idea with others. After that, all discuss together about the idea. In the last step, through rating, they come on common conclusion. The method is given by Delbecq & Van de Ven (1971). After each iteration, evaluation is done by each expert on Likert scale of one to five. Everytime, the evaluation or feedback will be taken for each point under discussion.

In the **Third Phase** of the study, the list is then provided to **ten education experts** who have more than fifteen years of experience working in HEIs. All experts remain anonymous to each other. In the list, various dimensions with definitions, respectively, will be given. These definitions for dimensions will be from the theory itself. In the next column of the list, proposed groups (tentative clusters) with respective definitions are provided. In this phase, the Delphi Method is employed to validate and refine these proposed groups through structured expert consultation.

-By giving the list to **ten validating** educational experts, clusters are going to be finalized. In this case, experts verify the allotment of each dimension to one of the groups (clusters) based on definitions. Also, open-ended suggestions are asked to improvise the definitions of proposed groups and either dimension allotment is needed to be change. About the definition of each group definition and allotment of dimensions in groups, feedback is taken on Likert scale. The stopping criterion is getting more or equal

to four, the average of Likert scale measures given by educational experts. Here also, feedback is taken on Likert scale for each group definition and for each allotment.

Through the iterative approach of Delphi method, both, definitions of groups (which later become latent constructs for the proposed scale) and which dimensions of literature should be in which group, are finalised. By iterative process, we mean that individual experts will be given dimensions with group name and group definition and suggestions will be taken and it will be repeated (after implementing previous recommendations) until no suggestions are given by any of experts. That last iteration will be a face validation for the groups and dimension allotment to various groups and definitions. At the end of the third phase, the study has finalised groups or clusters with respective definitions. In the analysis section of the study, table 3 is given in which the output of phase three, i.e., the final grouping is shown.

By utilizing this dual-method approach, the study effectively mitigates the inherent risks of subjectivity in qualitative analysis (Singh & Hurley, 2017). Furthermore, the NGT-Delphi sequence systematically refines raw conceptual data into a validated framework, as the iterative Delphi rounds allow for the objective assessment of expert consensus through structured feedback loops (Bozkurt & Bozkaya, 2015; Saar et al., 2022). This hybridization of consensus techniques ensures that the resulting framework achieves both theoretical sufficiency and practical applicability contexts (Foth et al., 2016; Sims & Cilliers, 2023) and as well as reduces biasness (Paz-Pascual et al., 2029)) within higher education.

In the **fourth phase**, questions or items for each cluster, which are now considered latent variables, are developed. This is done by analysing items of questionnaires present where scales are developed related to environmental learning. Items are either taken as they are, or with adaptation, or by creating new items fitting with the definition of the respective constructs.

In the **fifth phase**, the finalised questionnaire will be distributed among respondents from three selected universities representing different geographical regions of India. These universities will include both online and offline learners, enabling the study to capture responses from learners with diverse modes of education. The inclusion of universities from different regions (North, South and East) and learning modes will help ensure geographical diversity and obtain a broader representation of respondents for the study.

In the **sixth phase**, quantitative analysis will be done that includes exploratory data analysis and confirmatory data analysis to justify reliability and validity of the instrument for psychometric aspect. In total, one thousand learners from universities, questionnaire is sent which is constituted from table 3. Five hundred offline students and five hundred online learners are targeted. Out of them, data are prepared from four hundred and thirty-nine learners from offline learners and four hundred and forty-five from online learners. In total, eight hundred and eighty-four responses are eligible for analysis after pre-processing. First, the Exploratory Factor Analysis (EFA) is done. Parallel analysis is done to finalize the number of factors in EFA, which is the best method in organisational and psychological results (Hayton, Allen & Scarpello, 2004). EFA is done through using the 'psych' package in R language. For Confirmatory Factor Analysis (CFA), IBM SPSS Amos is used.

Analysis

The first phase is done through literature review of papers having theories and scales that are learning environment oriented. Following theories and scales are identified that are learning environment oriented: CIPP Model (Context–Input–Process–Product), Constructivist Learning Environment (CLE) framework, Biggs' 3P Model (Presage–Process–Product), SAMR Model (Substitution, Augmentation, Modification, Redefinition), Ecology of Learning Model, Community of Inquiry (CoI) framework, Classroom Environment Scale (CES), Learning Environment Inventory (LEI), College and University Classroom Environment Inventory (CUCEI), Science Laboratory Environment Inventory (SLEI), What

Is Happening In this Class (WIHIC), Distance Education Learning Environments Survey (DELES), Technology-Rich Outcomes-Focused Learning Environment Inventory (TROFLEI), Constructivist Learning Environment Survey (CLES).

Phase 2

The second phase starts with identifying ninety-seven dimensions from selected scales and theories of phase one. The definitions of all dimensions are taken from the respective research papers. Based on definitions, all dimensions that portray same concept or highly similar concepts are taken as single dimension synthesized draft definition. With this, the number of dimensions are reduced to sixty four.

After this, based on commonality in definition content, dimensions are assigned to groups by the researcher. The number of groups come out to be twenty. Groups are made keeping in mind that there should be some similarity in definitions but specific enough to be different from other groups. Now, based on the definition of dimensions in each group, tentative definition of groups is drafted from the definitions of dimensions belonging to the group. the result of draft is the definition of dimensions as well as the groups as an input data for NGT.

In NGT, three iteration happens until consensus is reached for all definitions of dimensions and groups. Each research expert rates the (possibly revised) definition after each iteration on clarity, accuracy and distinctiveness on a Likert scale of one two five. The average cut-off after third iteration comes out to be more than four on Likert scale which is more than the decided threshold of eighty percent (proposed by the researchers).

In the second phase, Table 1 data is finalized. Through NGT, data comes out with **thirteen** groups consensually with the groups' tentative definitions and with sixty-four dimension definitions. All the thirteen cluster definitions are given in table 1. Some points that are noted in advance is that the dimension 'Task Orientation' is appearing in two places. This is because of how they are defined in their respective scales. Some definitions are made broad so that expert revision can be checked.

Table 1: First Level Grouping

S.no.	Dimensions of learning environment	definitions of dimensions	Cluster Number first level	Clustering (first iteration)	Cluster Definitions after first analysis
1	Apathy	lack of interest and participation by learners (LEI)	1	Affective Environment	The degree to which students' emotional and attitudinal experiences in the classroom are favourable or unfavourable, as evidenced by enjoyment/satisfaction, readiness to engage and ease in articulating critical perspectives or challenging pedagogical practices.
2	Critical Voice	measures the degree to which students feel comfortable questioning and expressing critical opinions about teaching and learning (CLES)	1	Affective Environment	
3	Satisfaction	captures students' enjoyment of class activities (LEI) Extent of enjoyment of classes (CUCEI)	1	Affective Environment	
4	Competition	emphasis on outperforming classmates (CES)	2	Competitive Orientation	The degree to which the classroom emphasizes outperforming others and encourages comparison-based achievement.
5	Competitiveness	measures emphasis on outperforming peers (LEI)	2	Competitive Orientation	
6	Difficulty	Degree or extend to which students find difficulty with the work of the class (LEI)	3	Classroom Organization & Structure	How well the class is organized and predictable, including clear rules, orderly routines, appropriate pace, goal clarity, and well-structured tasks.
7	Disorganization	indicates the extent of confusion or lack of order (LEI)	3	Classroom Organization & Structure	
8	Order and Organization	includes structure, planning and clarity in class operations (CES)	3	Classroom Organization & Structure	

9	Rule Clarity	that covers how clear and consistent classroom rules are (CES)	3	Classroom Organization & Structure	
10	Speed	assesses the pace of classroom activities by students (LEI)	3	Classroom Organization & Structure	
11	Formality	examines adherence to formal classroom procedures. Hence, the degree to which learners' actions are in direction with rules (LEI)	3	Classroom Organization & Structure	
12	Goal Direction	reflects clarity and commitment to class objectives by the students. how clear students are about goal clarity in the class (LEI)	3	Classroom Organization & Structure	
13	Task Orientation	Extent to which class activities are clear and well organized (CUCI)	3	Classroom Organization & Structure	
14	Cognitive Presence	the extent up to which learners can construct and confirm meaning through sustained reflection and discourse (COI)	4	Cognitive & Epistemic Engagement	The extent to which learners develop understanding through reflection and discussion and recognize that knowledge can change and be interpreted.
15	Uncertainty of Science	explores the understanding that scientific knowledge is subject to change and interpretation (CLES)	4	Cognitive & Epistemic Engagement	
16	Differentiation	It reflects tailoring of instruction to meet diverse needs. Hence, The extent to which teachers cater for students differently on the basis of ability, rates of learning and interests. (TROFLEI)"	5	Equity, Diversity & Fairness	The degree to which instruction is equitable and respectful of differences, including fair treatment, absence of favouritism and appropriate personalization/differentiation.
17	Diversity	covers tolerance and acceptance of individual differences (LEI)	5	Equity, Diversity & Fairness	

18	Equity	The extent to which the teacher treats students equally, including distributing praise, questions, and opportunities to be included in discussion (WIHIC) The extent to which students are treated equally by the teacher. (TROFLEI) The extend to which students are treated equally by the teacher. (OLES)	5	Equity, Diversity & Fairness	
19	Favoritism	assesses perceptions of unequal treatment by faculty for the students (LEI)	5	Equity, Diversity & Fairness	
20	Individualization	Extent to which students are allowed to make decisions and are treated differentially according to ability, interest of rate of working (CUCFI)	5	Equity, Diversity & Fairness	
21	Personalization	"Emphasis on opportunities for individual students to interact with the instructor and on concern for students' personal welfare (CUCFI)"	5	Equity, Diversity & Fairness	
22	Chronosystem	is the dimension that involves the influence of time and changes over the life course, for example pandemic inclines education towards online learning (EOL Model)	6	Institutional & Systemic Context	The broader system shaping learning, including institutional objectives, resources and outcomes, and influences from family, community, culture, policy, and changes over time.
23	Context	is to evaluate over all objectives of the institute (CIPP)	6	Institutional & Systemic Context	

24	Exosystem	that includes broader social systems that indirectly affect an individual such as community resources and early education policies, parent workplace policies, school board decisions, etc.) (Ecology of Learning Model)	6	Institutional & Systemic Context	
25	Input	It is assessing the resources allotted to achieve the overall objectives of program, for example, assessing faculty, facilities and financial support of the institute (CIPP)	6	Institutional & Systemic Context	
26	Macrosystem	dimension encompasses the larger cultural and societal influences for example Cultural beliefs, societal values, and education policies (Ecology of Learning Model)	6	Institutional & Systemic Context	
27	Microsystem	includes direct environment like family, school, peers (Ecology of Learning Model)	6	Institutional & Systemic Context	
28	Mesosystem	includes interaction between Microsystem like parent-teacher collaboration, school-community partnerships, Participation in extracurricular activities, etc. (Ecology of Learning Model)	6	Institutional & Systemic Context	
29	Product	includes outcome and effectiveness of the program(CIPP)	6	Institutional & Systemic Context	
30	Scaffolding	Scaffolding, which means giving support to learners as required (CLE Framework) by facilitator	7	Instructional Support & Teaching Role	How effectively the teacher facilitates learning through scaffolding, coaching, supportive relationships, appropriate control,

31	Coaching	coaching that means faculty will be the facilitators or coach for the learners. coaching that means faculty will be the facilitators or coach for the learners (CLE Framework)	7	Instructional Support & Teaching Role	and purposeful design and direction of learning activities.
32	Teacher Control	which represents the teacher's strictness and discipline approach (CES)	7	Instructional Support & Teaching Role	
33	Teacher Support	"The extent to which the teacher helps, befriends, and is interested in students. (WIHIC) how teachers support students and encourage students (CES) The extent to which the teacher helps, befriends, trusts and is interested in students. (TROFLEI) the extend to which the teacher helps, befriends, trusts and is interested in students. (OLES)"	7	Instructional Support & Teaching Role	
34	Teaching Presence	which is the design, facilitation and direction of cognitive and social processes to achieve meaningful learning outcomes (COI)	7	Instructional Support & Teaching Role	
35	Active Learning	the degree to which students are actively engaged in meaningful learning activities (DELES)	8	Learner Engagement & Participation	The extent to which students actively engage and take responsibility for learning through involvement, autonomy, shared control, negotiation, and being treated as responsible learners.

36	Involvement	"Extent to which students participate actively and attentively in class discussions and activities (CUCFI) The extent to which students have attentive interest, participate in discussions, and enjoy the Class (WIHIC) which indicates the level of involvement of the student in class activities (CES) The extent to which students have attentive interest, participate in discussions, do additional work and enjoy the class. (TROFLEI)"	8	Learner Engagement & Participation	
37	Shared Control	assesses the extent to which students have influence over learning activities, assessment, and decision-making(CLES)	8	Learner Engagement & Participation	
38	Student Autonomy	"measures the level of independence and control students have over their learning process.(DELES) the extend to which ... students have opportunities to initiate ideas and make their own learning decisions, and the locus of control is student oriented. (OLES)"	8	Learner Engagement & Participation	
39	Student Negotiation	evaluates opportunities for students to discuss, share, and negotiate ideas with peers and teachers.(CLES)	8	Learner Engagement & Participation	
40	Young Adult Ethos	"The extent to which teachers give students responsibility and treat them as young adults. (TROFLEI)"	8	Learner Engagement & Participation	

41	Authentic Learning	"evaluates the extent to which tasks mirror real-world situations and applications(DELES) the extend to which students have the opportunity to solve real world problems that are authentic. (OLES)"	9	Learning Relevance & Authenticity	The extent to which learning connects to real-world situations and to students' personal goals and experiences, making learning meaningful.
42	Personal Relevance	"examines how learning is connected to students' real-life experiences(CLES) reflects how much the course content relates to students' personal goals and real-life experiences (DELES) the extend to which there is a connection between students' out of school experiences. (OLES)"	9	Learning Relevance & Authenticity	
48	Task Orientation	The extent to which it is important for students to complete activities planned and to stay on the subject matter (WIHIC) emphasis and encouragement to students on completing assignments and staying focused (CES) measures the focus on achieving specific learning goals and results. The extent to which it is important to complete activities planned and to stay on the subject matter. (TROFLEI)	10	Pedagogical Design & Practices	The quality of learning task design and implementation, including problem-centred learning, use of cognitive and collaborative tools, innovation, inquiry/investigation, task focus, learning processes, and reflective online participation.
43	Problem	Problem that should encourage learners to get engages deeply with the subject matter or content (CLE Framework)	10	Pedagogical Design & Practices	

44	Cognitive Tools	cognitive tools or resources that support learners to process the information to solve the problem and developing a construct or concept in mind (CLE Framework)	10	Pedagogical Design & Practices	
46	Innovation	"Extent to which the instructor plans new, unusual class activities, teaching techniques and assignments (CUCET) openness to new ideas and flexible teaching methods (CES)"	10	Pedagogical Design & Practices	
47	Investigation	"The extent to which there is emphasis on skills and inquiry and their use in problem Solving and investigation (WIHC) The extent to which skills and processes of inquiry and their use in problem solving and investigation are emphasised (TROFLEI)"	10	Pedagogical Design & Practices	
49	Process	focusses on evaluating how well resources are being utilized or implemented and could be assess through teaching pedagogy, student engagement, etc(CIPP)	10	Pedagogical Design & Practices	
50	Asynchronicity	the extent to which the asynchronous nature of the discussion forum promotes reflective thinking and the posting of messages at times convenient to the students. (OLES)	10	Pedagogical Design & Practices	
45	Collaborative tools	collaborative tools that support interaction with peers, faculty or others, fostering an environment to learn like discussion forums (CLE Framework)	10	Pedagogical Design & Practices	

51	Affiliation	indicates the level of positive interaction among learners (CES)	11	Peer Relationships & Social Climate	The quality of peer relationships and interaction, including belonging, cooperation, cohesiveness, collaboration, social presence, and low levels of friction or cliques.
52	Cliqueness	indicates the degree to which students form exclusive groups (LEI)	11	Peer Relationships & Social Climate	
53	Cooperation	"The extent to which students cooperate with each other during activities (WIHIC) The extent to which students cooperate rather than compete with one another on learning tasks (TROFLEI)"	11	Peer Relationships & Social Climate	
54	Friction	measures the level of conflict and tension among students (LEI)	11	Peer Relationships & Social Climate	
55	Social Presence	which means the ability of participants to identify with the community, communicate purposefully, and develop interpersonal relationships (COI)	11	Peer Relationships & Social Climate	
56	Student Cohesiveness	"extend to which students know, help and are friendly with each other (LEI) Extent to which students know, help and are friendly towards each other (CUCEI) The extent to which students are friendly and supportive to each other (WIHIC) The extent to which students know, help and are supportive of one another (TROFLEI)"	11	Peer Relationships & Social Climate	

57	Student Interaction and Collaboration	"measures the extent of communication and teamwork among students in the virtual environment (DELES) the extent to which students have opportunities to interact with one another, exchange information and engage in collaboration (OLES)"	11	Peer Relationships & Social Climate	
58	Computer Usage	"assesses the extent of technology integration in learning (TROFLEI) the extend to which students use their computers as a tool to communicate with others and to access information (OLES)"	12	Resources & Infrastructure	The availability and adequacy of learning resources and infrastructure, including physical facilities, learning materials, and access to computers/technology for learning.
59	Material Environment	assesses adequacy and quality of physical resources available to the students (LEI)	12	Resources & Infrastructure	
60	Learning Resouces	Learning resources and contents i.e. digital libraries, databases, etc.	12	Resources & Infrastructure	
61	substitutujion of technology	where technology acts as direct substitute for some traditional tool without changing the process (SAMR)	13	Technology Integration	The level at which technology changes learning activities—from simple substitution to improvement, redesign of processes, and enabling new tasks that were previously not possible.
62	augmentation of technology	Augmentation' act as a substitute with some process improvement (SAMR)	13	Technology Integration	
63	modification of technology	which means through technology, significant process redesigns happen (SAMR)	13	Technology Integration	
64	redesign of technology	under which technology enables creation of new task that previous not possible (SAMR)	13	Technology Integration	

Phase 3

In the third phase of the study, the output of the second phase (Table 1) is given to ten educational experts working in Higher Education Institutions under Delphi method. In this, three iterations happened. In the first and second iterations, suggestions comes that are implemented by the researchers. In the third iteration, no suggestion comes and the average of likert scale measurement comes more that four (more that eighty percent agreement). The table 2 is the final output of the third phase.

The experts provided inputs and recommendations for that is imbibed for dimensions, their allotment of groups and definitions. For example, forty-eighth item in table 1 is shifted to different cluster in table 2. In the same way, some groups are joined. For example, cluster two and cluster three present in table 1 is joined together to be single cluster number two in table 2. Following is the table 2 which is output of the third phase having nine clusters and the Figure 1 denotes the final nine clusters to capture learning environment feedback from learners.

Table 2: Output of third Phase

S.no.	Dimensions of learning environment	definitions of dimensions	New Cluster Number	Clustering after Phase III	definitions of Dimensions
1	Apathy	lack of interest and participation by learners (LEI)	1	Affective Environment	The degree to which students' emotional and attitudinal experiences in the classroom are favourable or unfavourable, as evidenced by enjoyment/satisfaction, readiness to engage, and ease in articulating critical perspectives or challenging pedagogical practices.
2	Critical Voice	measures the degree to which students feel comfortable questioning and expressing critical opinions about teaching and learning(CLES)	1	Affective Environment	
3	Satisfaction	"captures students' enjoyment of class activities (LEI) Extent of enjoyment of classes (CUCET)"	1	Affective Environment	

4	Competition	emphasis on outperforming classmates(CES)	2	Classroom Regulation, Pace & Performance Climate	It defines how well the classroom is run by clear rules and structured routines, which keeps things in order and makes sure everyone knows what they need to do and when. It also sets expectations for staying on task and finishing planned work, controls the pace and perceived difficulty of learning activities, and emphasises positively competing with peers.
5	Competitiveness	measures emphasis on outperforming peers (LEI)	2	Classroom Regulation, Pace & Performance Climate	
6	Difficulty	Degree or extend to which students find difficulty with the work of the class (LEI)	2	Classroom Regulation, Pace & Performance Climate	
7	Disorganization	indicates the extent of confusion or lack of order (LEI)	2	Classroom Regulation, Pace & Performance Climate	

8	Order and Organization	includes structure, planning and clarity in class operations(CES)	2	Classroom Regulation, Pace & Performance Climate	
9	Rule Clarity	that covers how clear and consistent classroom rules are(CES)	2	Classroom Regulation, Pace & Performance Climate	
10	Speed	assesses the pace of classroom activities by students (LEI)	2	Classroom Regulation, Pace & Performance Climate	
11	Formality	examines adherence to formal classroom procedures. Hence, the degree to which students' actions are in direction with rules (LEI)	2	Classroom Regulation, Pace & Performance Climate	

12	Goal Direction	reflects clarity and commitment to class objectives by the students. how clear students are about goal clarity in the class (LEI)	2	Classroom Regulation, Pace & Performance Climate	
13	Task Orientation	Extent to which class activities are clear and well organized (CUCEI)	2	Classroom Regulation, Pace & Performance Climate	
48	Task Orientation	"The extent to which it is important for students to complete activities planned and to stay on the subject matter (WIHIC) emphasis and encouragement to students on completing assignments and staying focused (CES) measures the focus on achieving specific learning goals and results. The extent to which it is important to complete activities planned and to stay on the subject matter. (TROFLEI)"	2	Classroom Regulation, Pace & Performance Climate	
14	Cognitive Presence	which means the extent up to which learners can construct and confirm meaning through sustained reflection and discourse (COI)	3	Cognitive & Epistemic Engagement	

15	Uncertainty of Science	explores the understanding that scientific knowledge is subject to change and interpretation(CLES)	3	Cognitive & Epistemic Engagement	The extent to which learning promotes deep conceptual understanding through reflection and dialogue, is experienced as authentic and applicable to real-life situations, and is viewed through an epistemic lens where knowledge may be uncertain and changeable.
41	Authentic Learning	"evaluates the extent to which tasks mirror real-world situations and applications(DELES) the extend to which students have the opportunity to solve real world problems that are authentic. (OLES)"	3	Meaning-Making & Authentic Cognitive Engagement	
42	Personal Relevance	"examines how learning is connected to students' real-life experiences(CLES) reflects how much the course content relates to students' personal goals and real-life experiences (DELES) the extend to which there is a connection between students' out of school experiences. (OLES)"	3	Meaning-Making & Authentic Cognitive Engagement	
16	Differentiation	"reflects tailoring of instruction to meet diverse needs. Hence, The extent to which teachers cater for students differently on the basis of ability, rates of learning and interests.(TROFLEI)"	4	Equity, Diversity & Fairness	
17	Diversity	covers tolerance and acceptance of individual differences (LEI)	4	Equity, Diversity & Fairness	

18	Equity	"The extent to which the teacher treats students equally, including distributing praise, questions, and opportunities to be included in discussion (WIHIC) The extent to which students are treated equally by the teacher. (TROFLEI) the extend to which students are treated equally by the teacher. (OLES)"	4	Equity, Diversity & Fairness	The degree to which the learning environment is perceived as inclusive and equitable, as evidenced by equitable treatment (lack of favouritism), acknowledgement of different perspectives, and instructional adaptability to different abilities, interests, and learning paces, including provisions for personalised interaction and guidance.
19	Favoritism	assesses perceptions of unequal treatment by faculty for the students (LEI)	4	Equity, Diversity & Fairness	
20	Individualization	Extent to which students are allowed to make decisions and are treated differentially according to ability, interest of rate of working (CUC EI)	4	Equity, Diversity & Fairness	
21	Personalization	"Emphasis on opportunities for individual students to interact with the instructor and on concern for students' personal welfare (CUC EI)"	4	Equity, Diversity & Fairness	
22	Chronosystem	is the dimension that involves the influence of time and changes over the life course, for example pandemic inclines education towards online learning (EOL Model)	5	Institutional & Systemic Context	

23	Context	is to evaluate over all objectives of the institute (CIPP)	5	Institutional & Systemic Context	The extent to which the learning environment is shaped by the wider institutional and societal setting i.e., through programme goals, organizational support, and external contextual influences over time; that together defined, how teaching and learning are experienced and what outcomes become feasible.
24	Exosystem	that includes broader social systems that indirectly affect an individual such as community resources and early education policies, parent workplace policies, school board decisions, etc.) (Ecology of Learning Model)	5	Institutional & Systemic Context	
25	Input	is assessing the resources allotted to achieve the overall objectives of program, for example, assessing faculty, facilities and financial support of the institute (CIPP)	5	Institutional & Systemic Context	
26	Macrosystem	dimension encompasses the larger cultural and societal influences for example Cultural beliefs, societal values, and education policies (Ecology of Learning Model)	5	Institutional & Systemic Context	
27	Microsystem	includes direct environment like family, school, peers (Ecology of Learning Model)	5	Institutional & Systemic Context	
28	Mesosystem	includes interaction between Microsystem like parent-teacher collaboration, school-community partnerships, Participation in extracurricular activities, etc. (Ecology of Learning Model)	5	Institutional & Systemic Context	

29	Product	includes outcome and effectiveness of the program(CIPP)	5	Institutional & Systemic Context	
30	Scaffolding	Scaffolding, which means giving support to learners as required (CLE Framework) by facilitator	6	Teaching Design, Facilitation & Instructional Scaffolding	
31	Coaching	coaching that means faculty will be the facilitators or coach for the learners. coaching that means faculty will be the facilitators or coach for the learners (CLE Framework)	6	Teaching Design, Facilitation & Instructional Scaffolding	
32	Teacher Control	which represents the teacher's strictness and discipline approach (CES)	6	Teaching Design, Facilitation & Instructional Scaffolding	

33	Teacher Support	"The extent to which the teacher helps, befriends, and is interested in students. (WIHIC) how teachers support students and encourage students (CES) The extent to which the teacher helps, befriends, trusts and is interested in students. (TROFLEI) the extend to which the teacher helps, befriends, trusts and is interested in students. (OLES)"	6	Teaching Design, Facilitation & Instructional Scaffolding	The extent to which teaching is deliberately designed and facilitated to support learning i.e. through planning and directing learning processes, providing guidance and support, managing control/discipline when needed, and selecting/structuring pedagogical practices such as inquiry, innovation, problem-centered tasks, learning tools (cognitive/collaborative), and asynchronous arrangements that promote reflective engagement.
34	Teaching Presence	which is the design, facilitation and direction of cognitive and social processes to achieve meaningful learning outcomes (COI)	6	Teaching Design, Facilitation & Instructional Scaffolding	
43	Problem	Problem that should encourage learners to get engages deeply with the subject matter or content (CLE Framework)	6	Teaching Design, Facilitation & Instructional Scaffolding	

44	Cognitive Tools	cognitive tools or resources that support learners to process the information to solve the problem and developing a construct or concept in mind (CLE Framework)	6	Teaching Design, Facilitation & Instructional Scaffolding	
46	Innovation	"Extent to which the instructor plans new, unusual class activities, teaching techniques and assignments (CUCEI) openness to new ideas and flexible teaching methods (CES)"	6	Teaching Design, Facilitation & Instructional Scaffolding	
47	Investigation	"The extent to which there is emphasis on skills and inquiry and their use in problem Solving and investigation (WIHIC) The extent to which skills and processes of inquiry and their use in problem solving and investigation are emphasised (TROFLEI)"	6	Teaching Design, Facilitation & Instructional Scaffolding	
49	Process	focusses on evaluating how well resources are being utilized or implemented and could be assess through teaching pedagogy, student engagement, etc(CIPP)	6	Teaching Design, Facilitation & Instructional Scaffolding	

50	Asynchronicity	the extent to which the asynchronous nature of the discussion forum promotes reflective thinking and the posting of messages at times convenient to the students.(OLES)	6	Teaching Design, Facilitation & Instructional Scaffolding	
35	Active Learning	the degree to which students are actively engaged in meaningful learning activities (DELES)	7	Learner Agency & Participation	The extent to which students actively participate and invest attentive effort in learning activities, exercise autonomy and responsibility, and influence learning decisions (shared control), including negotiating and discussing ideas with peers and teachers - capturing learner-centered involvement and voice in the learning process.
36	Involvement	"Extent to which students participate actively and attentively in class discussions and activities (CUCEI) The extent to which students have attentive interest, participate in discussions, and enjoy the Class (WIHIC) which indicates the level of involvement of the student in class activities (CES) The extent to which students have attentive interest, participate in discussions, do additional work and enjoy the class. (TROFLEI)"	7	Learner Agency & Participation	
37	Shared Control	assesses the extent to which students have influence over learning activities, assessment, and decision-making(CLES)	7	Learner Agency & Participation	

38	Student Autonomy	"measures the level of independence and control students have over their learning process.(DELES) the extend to which ... students have opportunities to initiate ideas and make their own learning decisions, and the locus of control is student oriented. (OLES)"	7	Learner Agency & Participation	
39	Student Negotiation	evaluates opportunities for students to discuss, share, and negotiate ideas with peers and teachers.(CLES)	7	Learner Agency & Participation	
40	Young Adult Ethos	"The extent to which teachers give students responsibility and treat them as young adults. (TROFLEI)"	7	Learner Agency & Participation	
51	Affiliation	indicates the level of positive interaction among learners (CES)	8	Peer Relationships & Social Climate	The extent to which students encounter a supportive, cohesive, and collaborative peer community defined by positive affiliation, cooperation, interaction, and social presence. Lower degree of it means the presence of negative peer dynamics such as cliques and friction.
52	Cliqueness	indicates the degree to which students form exclusive groups (LEI)	8	Peer Relationships & Social Climate	

53	Cooperation	"The extent to which students cooperate with each other during activities (WIHIC) The extent to which students cooperate rather than compete with one another on learning tasks (TROFLEI)"	8	Peer Relationships & Social Climate	
54	Friction	measures the level of conflict and tension among students (LEI)	8	Peer Relationships & Social Climate	
55	Social Presence	which means the ability of participants to identify with the community, communicate purposefully, and develop interpersonal relationships (COI)	8	Peer Relationships & Social Climate	
56	Student Cohesiveness	"extend to which students know , help and are friendly with each other (LEI) Extent to which students know, help and are friendly towards each other (CUCEI) The extent to which students are friendly and supportive to each other (WIHIC) The extent to which students know, help and are supportive of one another (TROFLEI)"	8	Peer Relationships & Social Climate	

57	Student Interaction and Collaboration	"measures the extent of communication and teamwork among students in the virtual environment(DELES) the extend to which students have opportunities to interact with one another, exchange information and engage in collaboration (OLES)"	8	Peer Relationships & Social Climate	
45	Collaborative tools	collaborative tools that support interaction with peers, faculty or others, fostering an environment to learn like discussion forums (CLE Framework)	9	Resources, Infrastructure & Technology Integration	The degree to which sufficient learning resources, such as physical and digital infrastructure, are accessible and utilised, encompassing students' computer usage for communication and information retrieval, as well as the extent of technology integration into educational activities, ranging from basic substitution to innovative redesign that facilitates previously unattainable tasks.
58	Computer Usage	"assesses the extent of technology integration in learning(TROFLEI) the extend to which students use their computers as a tool to communicate with others and to access information (OLES)"	9	Resources, Infrastructure & Technology Integration	
59	Material Environment	assesses adequacy and quality of physical resources available to the students (LEI)	9	Resources, Infrastructure & Technology Integration	

60	Learning Resources	Learning resources and contents i.e. digital libraries, databases, etc.	9	Resources, Infrastructure & Technology Integration	
61	substitution of technology	where technology acts as direct substitute for some traditional tool without changing the process(SAMR)	9	Resources, Infrastructure & Technology Integration	
62	augmentation of technology	Augmentation' act as a substitute with some process improvement (SAMR)	9	Resources, Infrastructure & Technology Integration	
63	modification of technology	which means through technology, significant process redesign happens (SAMR)	9	Resources, Infrastructure & Technology Integration	

64	redesign of technology	under which technology enables creation of new task that previous not possible (SAMR)	9	Resources, Infrastructure & Technology Integration	
----	------------------------	---	---	--	--

The table 1 has thirteen clusters whereas expert-validated table 2 has nine clusters. Experts merged related clusters, renaming some clusters with revision of their definitions. ‘Affective Environment’ cluster remained unchanged with dimensions i.e. ‘Apathy’, ‘Critical Voice’, and ‘Satisfaction’, and its group definition also remains essentially the same. It oriented around learners’ enjoyment, comfort, engagement how comfortable students feel when sharing critical feedback or respectfully questioning the teacher’s methods or lessons. Through literature also, these three dimensional relationships could be explored like apathy and satisfaction (Sashittal et al., 2012), critical voice and satisfaction (Hooper and Murphey, 2023) and between apathy and critical value (Sashittal et al., 2021)

One of the major revisions done by the experts is to club two separate cluster from phase 2, ‘Competitive Orientation’ and ‘Classroom Organization & Structure’ into a single cluster ‘Classroom Regulation, Pace & Performance Climate’. The merger of ‘Competitive Orientation’ and ‘Classroom Organization & Structure’ appears conceptually justified because the underlying definitions share a common focus on how the classroom is run and how performance is expected within it. Hence, this cluster or latent construct directs towards the working atmosphere of the class. Through literature, relationships could be justified between competition and competitiveness (Petrík & Vašašová, 2022), difficulty, goal direction and speed (Yang, Liu & Hunt, 2022), disorganization, order and rule clarity (Yang, Liu & Hunt, 2022), order and organization with rule clarity and task orientation, speed, difficulty and competition (Petrík & Vašašová, 2022), formality, rule clarity and order (Yang, Liu & Hunt, 2022), goal direction and task orientation (Yang, Liu & Hunt, 2022), etc.

Another important change is in the cognitive area. In the first table, Cognitive & Epistemic Engagement included only Cognitive Presence and Uncertainty of Science, while Authentic Learning and Personal Relevance were in a separate cluster called Learning Relevance & Authenticity. In the final table, the experts brought these together under Cluster three, keeping Cognitive Presence and Uncertainty of Science, and adding Authentic Learning and Personal Relevance. The merger appears justified the four dimensions that collectively describe how knowledge is accepted by learners. Cognitive Presence and Uncertainty of Science capture the reflective and epistemic side of learning, whereas Authentic Learning and Personal Relevance capture the applied and meaningful side. Hence, the latent construct shows how knowledge is constructed, interpreted by students and made meaningful by learners. In literature also, the interconnection of dimensions could be seen. For example, between authentic learning and cognitive presence (Finch & Jefferson, 2013), authentic learning and personal relevance (Subramaniam, 2020), Uncertainty of Science and Authentic Learning (Manz, 2018), Cognitive Presence and Personal Relevance (McCrudden et al., 2010), Uncertainty of Science and Cognitive Engagement (Aridor et al., 2023) to name few.

The cluster Equity, Diversity & Fairness remains, but its group definition is expanded and sharpened. In Table 1, it focused on equitable treatment, absence of favouritism, and personalization/differentiation. In the final version, the experts reframed it more clearly as an inclusive and equitable learning environment, explicitly mentioning acknowledgement of different perspectives, instructional adaptability, and personalized interaction and guidance. The dimensions themselves remain the same: Differentiation, Diversity, Equity, Favouritism, Individualization, and Personalization. Their relationships among them through literature could be seen among ‘Differentiation’, ‘Individualization’ and ‘Personalization’ (Tomlinson & Jarvis, 2023), ‘Diversity’ and ‘Equity’ (De Leersnyder, Gündemir & Ağirdağ, 2022), ‘Equity’, ‘Diversity’ and ‘Personalization’ (Lartey, Cummings, Richter & Montgomery, 2026), ‘Individualism’, ‘Differentiation’ and ‘Personalization’ (Solnosky & O'Halloran, 2023), ‘Personalization’, ‘Equity’ and ‘Differentiation’ (Mahmoudi-Dehaki & Nasr-Esfahani, 2025), etc. Hence, the cluster captures learners’ perception that includes justice in the classroom, i.e., the extent to which fairness, respect for diversity and adaptive instructional support coexist in the learning environment.

The Institutional & Systemic Context cluster is retained, but its definition is rewritten more clearly. The included dimensions remain the same: Chronosystem, Context, Exosystem, Input, Macrosystem, Microsystem, Mesosystem, and Product. This construct captures the ecosystem surrounding learning (from program to institutional level), namely the institutional, social, cultural, policy-related and temporal conditions that influence how teaching is delivered and how learning outcomes are experienced by learners.

A large merger happened around teaching and pedagogy. In Table 1, there were two separate clusters: Instructional Support & Teaching Role and Pedagogical Design & Practices. In the final table, these have been merged into one broader cluster called Teaching Design, Facilitation & Instructional Scaffolding. This new cluster includes Scaffolding, Coaching, Teacher Control, Teacher Support, Teaching Presence, Problem, Cognitive Tools, Innovation, Investigation, Process, and Asynchronicity. So, the experts no longer separated the teacher’s role from pedagogical design; instead, they treated them as one integrated teaching-support system. This construct captures the extent to which teaching in higher education is perceived as well-planned, facilitative, supportive and pedagogically structured to help students engage in meaningful learning. The dimensions included in the final latent construct are also associated with each other in literature. For say, ‘Scaffolding’ with ‘Coaching’, ‘Cognitive tools’ and ‘Teacher support’ (Puntambekar, 2022), ‘Coaching’ with ‘Scaffolding’ and ‘Problem tasks’ (Singkaew & Chaijaroen, 2020; Samat, Chaijaroen, & Wattanachai, 2019), ‘Teacher Control’, ‘Scaffolding’ and ‘Process’ (Winnips, 2000), ‘Teacher Support’, ‘Scaffolding’ and ‘Teaching Present’ (Jaber Rafidi & Wagner, 2024), ‘Teaching Presence’, ‘Asynchronicity’ and ‘Teacher Support’ (DeCamp et al., 2022), ‘Problem’, ‘Investigation’ and ‘Cognitive Tools’ (Singkaew & Chaijaroen, 2020), ‘Cognitive Tools’, ‘Scaffolding’ and ‘Investigation’ (Kim, & Reeves, 2007), ‘Innovation’, ‘Inquiry’ and ‘Scaffolding’ (Li, 2001), ‘Investigation’, ‘Problem’ and ‘Cognitive Tools’ (Tsai et al., 2018), ‘Process’, ‘Teacher Control’ and ‘Teaching Presence’ (Chatterji, 2010), ‘Asynchronicity’, ‘Teaching Presence’, ‘Scaffolding’ and ‘Cognitive Tools’ (DeCamp et al., 2022).

The former Learner Engagement & Participation cluster has been renamed FLearner Agency & Participation. The included dimensions remain the same: Active Learning, Involvement, Shared Control, Student Autonomy, Student Negotiation, and Young Adult Ethos. In the previous definition, the construct was targeting engagement of learners in the sense of being getting involved, active and share responsibility in the learning process. In the updated by experts’ definition, beyond above mentioned keys, learners influence decisions of learning process like through discussion with peers and instructors. Hence, the definition is now from engagement, also include learners’ influence and ownership of learning.

The Peer Relationships & Social Climate cluster remains same with some changes in definition. The change strengthens the construct by making it more learner-centred and conceptually integrated. The new definition not only focuses on one to one or one to many relationships but also convers the quality of peer environment. the revised definition reframes the construct as the extent to which students encounter a supportive, cohesive, and collaborative peer community.

One of the important structural changes concerns technology and resources. In Table 1, there were two different clusters: Resources & Infrastructure and Technology Integration. In the final table, the experts merged these into one cluster, Resources, Infrastructure & Technology Integration. This means the experts no longer treated technology integration as a stand-alone construct; they treated it as part of the broader resource and infrastructure environment. Also, Collaborative Tools, which was previously under Pedagogical Design & Practices, has now been shifted into this combined technology-resource cluster. The expert revision appears conceptually justified because learning resources, infrastructure and technology integration jointly represent the enabling conditions through which contemporary higher education learning is accessed and experienced. In this sense, technology integration is not independent of infrastructure; rather, it depends upon and functions through the accessibility and utilization of institutional resources. Therefore, the construct is trying to find either learners do have the resources and technology they need and is the technology usage is happening in a meaningful and pragmatic way or not. As two separate constructs are again come into single construct and various dimensions coming together; these dimensions' associations can be verified by literature. For say, 'Collaborative Tools' requires 'Computer Usage' that uses 'Learning Resources' which is affected by 'Material Environment' that can be can map to any SAMR level (Pang et al., 2024; Blundell et al., 2022), 'Computer Usage' enables 'Collaborative Tools' that enables access to 'Learning Resources' that depends on Material Environment that determines SAMR level application (Koul, Fisher and Shaw, 2011), Material Environment supports 'technology infrastructure' for 'Computer Usage', 'Collaborative Tools', 'Learning Resources' and 'SAMR' dimensions (Genn, 2001), 'Learning Resources' require 'Computer Usage' that are used within Collaborative Tools which reinforce SAMR amalgamation (Pang et al., 2024), SAMR Levels Categorize how 'Collaborative Tools', 'Computer Usage', and 'Learning Resources' are used (Blundell et al., 2022)

Phase Four

Below are the items that proposed to be used for empirical research for the future. Items are taken by the researchers, keeping in mind that they could be used in all the category of learners i.e. Online, Offline or Blended. Mostly, items are generated through actual items of dimensions present in final latent construct. The items present in Table 3 are suggestive only that could be used in validating scale in quantitative studies until unless scale get generalized in other universities with similar objectives.

Table 3: Items of latent variables

S.No.	Dimension No.	Latent variables from table 2	Original Question	Modified Question (Neutral for Both)	Status	Postive / Negative question	PAPER
-------	---------------	-------------------------------	-------------------	--------------------------------------	--------	-----------------------------	-------

1	1	Affective Environment	Members of the class don't care what the class does	I feel that members of this class care about our collective progress. (N)	Modified	N	LEI
2	1	Affective Environment	I feel safe questioning the teacher's ideas.	I feel safe questioning or discussing the teacher's ideas.	Modified	P	CLES
3	1	Affective Environment	Student find classes are boring	I find the classes to be engaging and interesting.(N)	Modified	N	CUCEI(Modified)
4	1	Affective Environment	I feel comfortable asking questions.	I feel comfortable asking questions during class.	Modified	P	CLES
5	2	Classroom Regulation, Pace & Performance Climate	Students seldom compete with one another	Students in this course rarely compete with one another.	Modified	P	(LEI)
6	2	Classroom Regulation, Pace & Performance Climate	The Class is well organised and efficient	The class sessions are well-organized and efficient.	Modified	P	(LEI)
7	2	Classroom Regulation, Pace & Performance Climate	Assignments are usually clear 'so everyone knows what to do	Assignments are clearly explained so I know exactly what to do.	Modified	P	CES
8	2	Classroom Regulation, Pace & Performance Climate	Student do not have to hurry to finish their work	I have enough time to complete my work without rushing.	Modified	P	LEI
9	2	Classroom Regulation, Pace & Performance Climate	know how much work I have to do.	I know exactly how much work I am expected to do for this course.	Modified	P	(TROFLEI)

10	3	Meaning-Making & Authentic Cognitive Engagement	Course discussions help me explore new ideas.	Course discussions help me explore new ideas.	Same	P	Modified(COI)
11	3	Meaning-Making & Authentic Cognitive Engagement	I use real facts in class activities.	I use real-world facts and data in class activities.	Modified	P	OLES, DELES
12	3	Meaning-Making & Authentic Cognitive Engagement	I can connect my studies to my activities outside of class	I can connect my studies to my activities outside of class.	Same	P	DELES
13	4	Equity, Diversity & Fairness	I do work that is different from other students' work.	I have the opportunity to do work that is personalized or different from others.	Modified	P	Troflei
14	4	Equity, Diversity & Fairness	The class has students with many different interests.	The class includes students with a wide variety of interests.	Modified	P	LEI
15	4	Equity, Diversity & Fairness	I get the same opportunity to answer questions as other students.	I have the same opportunity to participate and answer questions as others.	Modified	P	(TROFLEI)
16	4	Equity, Diversity & Fairness	The instructor goes out of his/her way to help students	The instructor goes out of their way to help students succeed.	Modified	P	(CUCEI)
17	5	Institutional & Systemic Context	Changes in family situations affect students' academic p...	Changes in my personal/family situation affect my academic performance.	Modified	N	EOL(modified)

18	5	Institutional & Systemic Context	The objectives of the program are clearly defined.	The objectives of the program are clearly defined.	Same	P	CIPP
19	5	Institutional & Systemic Context	School administration provides adequate facilities.	The administration provides adequate facilities and technical support.	Modified	P	Ecology of Learning Model
20	5	Institutional & Systemic Context	Adequate learning materials are available for the program	Adequate learning materials are easily accessible for the program.	Modified	P	CIPP
21	5	Institutional & Systemic Context	My teacher motivates me to participate in class	My teacher motivates me to participate in class.	Same	P	Ecology of Learning Model
22	5	Institutional & Systemic Context	The program improves students' knowledge and skills.	The program improves my knowledge and skills.	Modified	P	CIPP
23	6	Teaching Design, Facilitation & Instructional Scaffolding	The teacher explains complex ideas step by step.	The teacher explains complex ideas step by step.	Same	P	CLE Framework
24	6	Teaching Design, Facilitation & Instructional Scaffolding	Teachers provide examples to explain concepts.	The teacher provides examples to explain concepts.	Same	P	CLE Framework
25	6	Teaching Design, Facilitation & Instructional Scaffolding	The teacher gives me valuable feedback on my assignments	The teacher gives me valuable feedback on my assignments.	Same	P	OLES ,WIHIC
26	6	Teaching Design, Facilitation & Instructional Scaffolding	The teacher encourages participation in discussions..	The teacher encourages participation in discussions.	Same	P	COI

27	6	Teaching Design, Facilitation & Instructional Scaffolding	The teacher guides discussions effectively.	The teacher guides discussions effectively.	Same	P	CLE Framework
28	6	Teaching Design, Facilitation & Instructional Scaffolding	The teacher provides helpful feedback.	The teacher provides helpful feedback on my progress.	Modified	P	TROFLEI
29	6	Teaching Design, Facilitation & Instructional Scaffolding	The teacher organizes learning activities clearly.	The teacher organizes learning activities clearly.	Same	P	OLES
30	7	Learner Agency & Participation	The teacher encourages participation in discussions.	The teacher encourages active participation in discussions (online or in-person).	Modified	P	TROFLEI
31	7	Learner Agency & Participation	Students participate in decisions about learning.	I am able to participate in decisions about my learning process.	Modified	P	CLES
32	7	Learner Agency & Participation	I explain my ideas to classmates.	I explain my ideas to my classmates.	Same	P	CLES, CES
33	7	Learner Agency & Participation	I make decisions about my learning.	I make decisions about my own learning.	Modified	P	(DELES,OLES)
34	8	Peer Relationships & Social Climate	I ask other students to explain their ideas.	I ask other students to explain their ideas.	Same	P	WIHIC, TROFLEI
35	8	Peer Relationships & Social Climate	I feel comfortable interacting with other students	I feel comfortable interacting with other students (in-person or online).	Modified	P	COI
36	8	Peer Relationships & Social Climate	I share information with other students.	I share information and resources with other students.	Modified	P	CUCEI)

37	8	Peer Relationships & Social Climate	I discuss my ideas with other students.	I discuss my ideas with other students.	Same	P	OLES,DELES
38	9	Resources, Infrastructure & Technology Integration	Students work together to solve problems.	I work together with other students to solve problems.	Modified	P	CLE Framework
39	9	Resources, Infrastructure & Technology Integration	The books and equipment students need... are easily available in the classroom.	The books, equipment, and digital tools I need are easily available.	Modified	P	LEI)
40	9	Resources, Infrastructure & Technology Integration	Using the LMS to assign homework	The use of the Learning Management System (LMS) for assignments is effective.	Modified	P	(SAMR)
41	9	Resources, Infrastructure & Technology Integration	Employing gamification apps (e.g., Kahoot & Quizizz)...	Using gamification tools (like Kahoot or Quizizz) helps my learning.	Modified	P	(SAMR)
42	9	Resources, Infrastructure & Technology Integration	Having students synthesise their analytical thoughts using multimedia tools	I find it helpful to use multimedia tools to express my analytical thoughts.	Modified	P	(SAMR)

Phase Five

Preliminary Analyses

For EFA first two hundred datapoints from online and two hundred data points from offline respondents are allotted to data which is going to be used by EFA. Hence four hundred data points are considered for EFA. The suitability of the data for EFA was first assessed using the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy and Bartlett's test of sphericity. The overall KMO value is .789, exceeds the commonly accepted minimum threshold of .60, indicating that

the sample was adequate for factor analysis (Kaiser, 1960). Bartlett's test of sphericity was significant, $\chi^2(861) = 5959.66$, $p < .001$, confirming that the correlation matrix is not an identity matrix and that sufficient inter-item correlations existed to justify factor extraction (Bartlett, 1954).

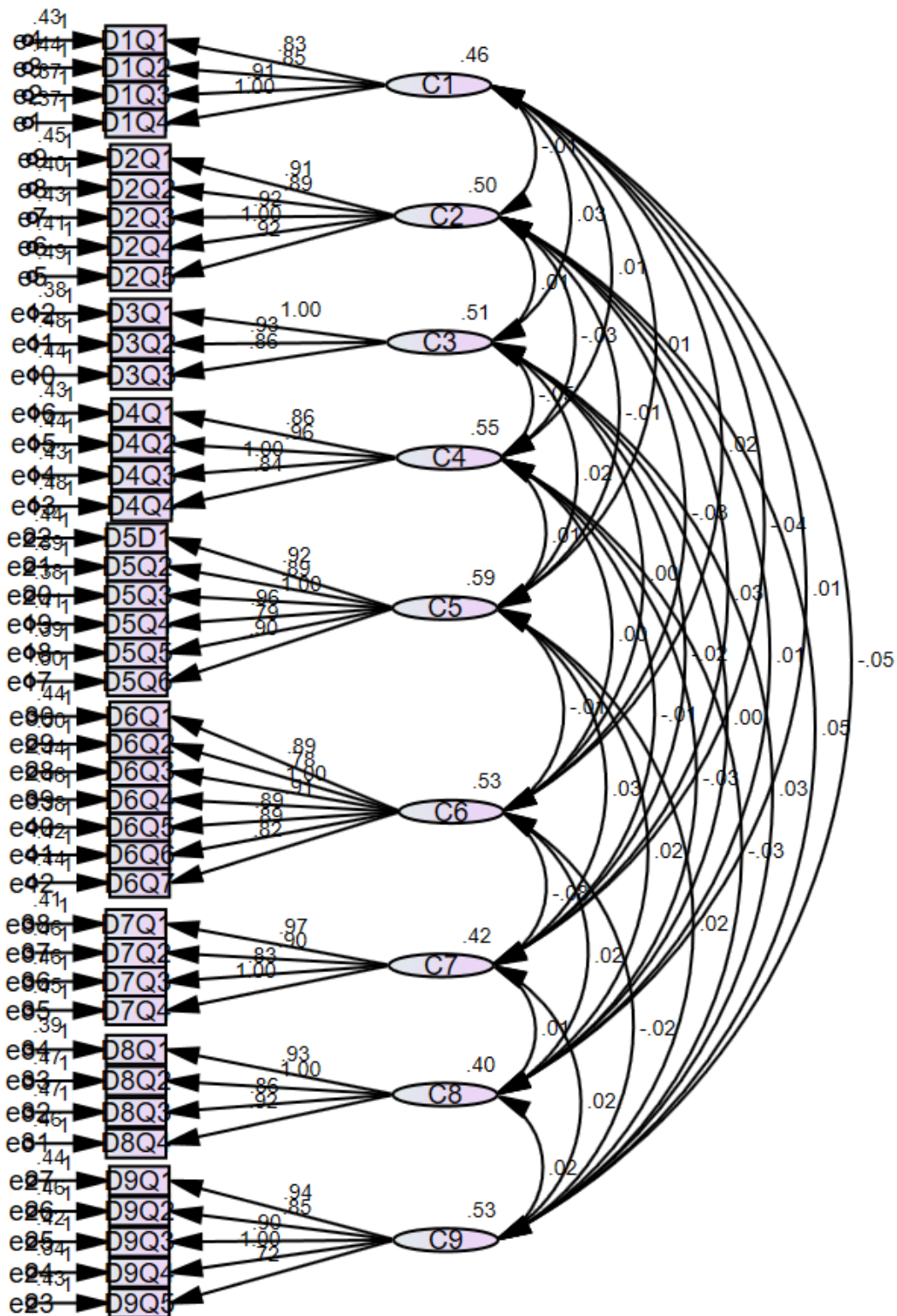
EFA

Although initial inspection of the raw eigenvalues suggested only four factors with eigenvalues greater than one, 'Parallel Analysis', that is regarded as one of the most accurate methods for determining the correct number of factors to retain (Horn, 1965; Zwick & Velicer, 1986) is conducted using 100 random datasets and indicated that nine factors should be retained, as their eigenvalues exceeded those generated by chance (Hayton, Allen, & Scarpello, 2004). Based on this recommendation, a maximum likelihood (ML) extraction with varimax (orthogonal) rotation is performed specifying nine factors, following recommended EFA reporting practices for psychometric scale development (Costello & Osborne, 2005; Fabrigar et al., 1999). The resulting nine-factor solution produced a clean simple structure, with the majority of items loading strongly ($\geq .58$) on a single factor and no substantial cross-loadings above .30, and communalities ranging from .354 to .629, indicating that the extracted factors accounted for a reasonable to substantial proportion of variance in most items (Hair et al., 2019). Collectively, the nine factors accounted for 50.1% of the total cumulative variance, which is consistent with acceptable variance-explained thresholds in applied social science research (Hair et al., 2019; Costello & Osborne, 2005).

CFA

A CFA is conducted using the Maximum Likelihood estimation method to assess the measurement model comprising nine latent constructs (Labelled C1 to C9 as per the sequence of Table 3 column '*Dimension No.*') and 42 observed indicators (Figure 1). Data for the CFA is the rest of the data points not used for EFA. The chi-square statistic was non-significant ($\chi^2 = 797.155$, $df = 783$, $p = .355$), suggesting that the covariance matrix implied by the model did not significantly differ from the sample covariance matrix. Furthermore, the normed chi-square value ($\chi^2/df = 1.018$) was substantially below the recommended threshold of 3.0, indicating a very good model fit. Further, the fit indices satisfied the recommended thresholds, including CFI = .998, TLI = .998, IFI = .998, GFI = .929, AGFI = .918, RMR = .028, and RMSEA = .006, confirming the adequacy of the measurement model. All factor loadings were statistically significant ($p < .05$), with standardized loadings ranging from 0.621 to 0.783. These values exceeded the recommended threshold of 0.50, indicating satisfactory convergent validity and indicator reliability. Additionally, the correlations among the latent constructs were low, ranging from -0.168 to 0.098, supporting discriminant validity. Most construct covariances were statistically non-significant, indicating that the constructs were distinct from one another.

Figure 1: Unstandardized values in CFA



Discussion

The present study is done to address the gap in educational environment evaluation, that is, the absence of factors that are common for assessing educational learning environment common for online, offline and blend of both. Literature tells us several models and framework for the same. But none of them fits the requirement of the study. Therefore, the proposed factors provide step towards developing scale to fulfil present need. In the initial phase, sixty-four dimensions are identified. They were grouped into thirteen groups. These dimensions were first grouped into thirteen clusters and later refined into nine expert-validated clusters as shown in Figure 2. The reduction in clusters shows conceptual integration. It means some clusters appears to be different, but similar on the premise of concept. For example, the merger of “Competitive Orientation” and “Classroom Organization & Structure” into “Classroom Regulation, Pace & Performance Climate” shows that classroom order, task clarity, pace, difficulty and performance expectations are not isolated experiences for learners. Rather, they cooperatively shape how students perceive the academic discipline, structure and performance climate of a course.

The cluster “Equity, Diversity & Fairness” brings together differentiation, diversity, equity, favouritism, individualization and personalization. This reflects the need for inclusive learning environments in higher education. A valid learning environment scale must capture whether students feel fairly treated, personally supported and respected within the learning process.

The study also combines institutional and systemic factors into one construct. The cluster “Institutional & Systemic Context” shows that learner experience is not shaped only by classroom-level factors. It is influenced by programme goals, institutional support, policy expectations, family background, cultural setting and community resources. This is consistent with ecological and systemic approaches to education, where learning is an outcome of interaction between the learner and multiple environmental systems (Li et al., 2025). through this construct, the proposed framework moves beyond narrow course feedback and shows that the quality of learning depends on broader institutional and social arrangements.

The merger of teaching role and pedagogical design into “Teaching Design, Facilitation & Instructional Scaffolding” is another important outcome of the expert validation process. This finding suggests that learners may not experience teaching support and pedagogical design as separate aspects. Instead, they experience them together through the way the instructor plans the course, facilitates interaction, provides support, uses inquiry-based tasks, offers scaffolding and manages the learning process. In online, offline and blended environments, the instructor’s role is not limited to content delivery. The teacher functions as a facilitator, guide, designer and supporter of learning (Wojciechowski & Cellary, 2013; NALLE et al., 2024; Machumu, & Zhu, 2019; Matewere et al., 2022). Therefore, this cluster provides a broader and more contemporary understanding of teaching effectiveness.

The renaming of “Learner Engagement & Participation” as “Learner Agency & Participation” is conceptually valuable. The term agency goes beyond involvement or participation. It indicates that learners are not recipients of instruction but contributors to the learning process (Mairitsch et al., 2023). This includes their autonomy, shared control, negotiation, involvement and responsibility. In the context of higher education, learner agency is essential because students are expected to manage their own learning, participate in discussions, use digital resources as well as make decisions related to their learning journey.

The Peer Relationships & Social Climate cluster reinforces the social nature of learning (Kornienko, 2024; Mohammad Hosseini et al. 2022). Whether learning occurs in a physical classroom, virtual classroom or blended environment, students’ interaction with peers contributes to belongingness, cooperation, confidence and motivation. The inclusion of affiliation, cohesiveness, cooperation, social presence, collaboration, friction and cliqueness within one construct depicts that peer climate includes positive and negative social dynamics. This is important where social presence may not emerge

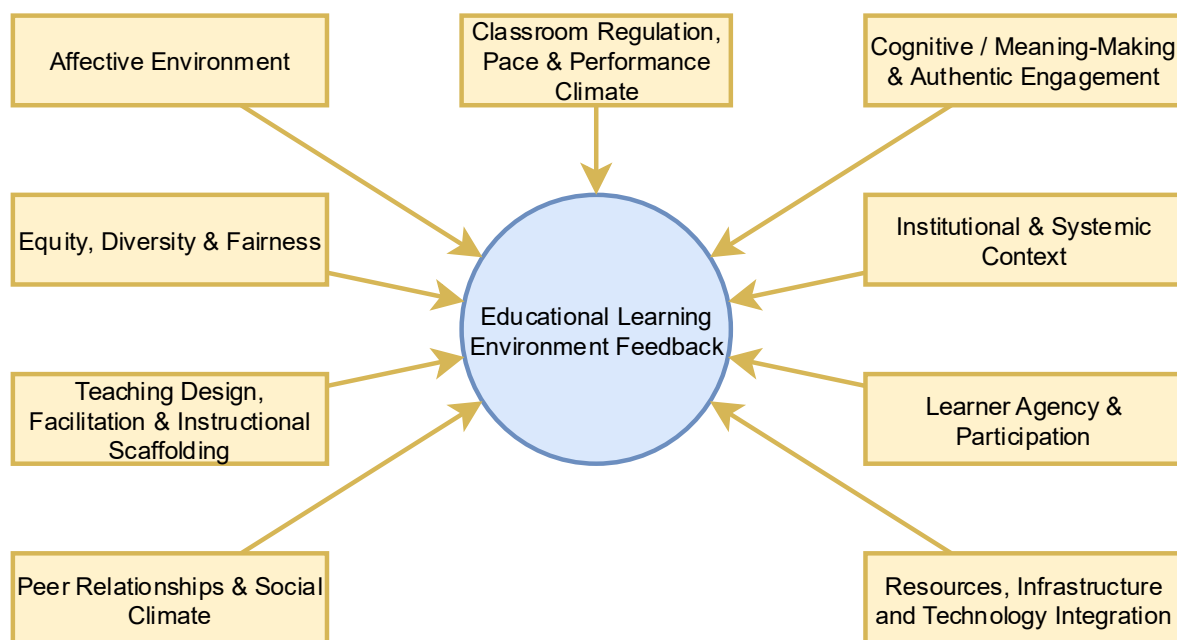
naturally unless intentionally supported through discussion forums, group activities and collaborative tools.

The final cluster, “Resources, Infrastructure & Technology Integration,” reflects the changing nature of higher education. The expert decision to merge resources, infrastructure and technology integration is appropriate because technology use cannot be separated from the availability of resources and infrastructure (Sunnasy et al., 2025). In learning environments, digital platforms, learning resources, computer usage, collaborative tools and technology-enabled redesign of learning activities determine the accessibility and quality of the learning experience. This cluster aligns with the need to evaluate not merely whether technology is present, but whether it is integrated into teaching and learning (Zheng et al., 2025).

All items are also validated by online and offline learners through EFA and CFA.

The findings suggest that the proposed framework provides a foundation for developing a unified learning environment scale. It captures emotional, cognitive, pedagogical, social, technological, institutional and equity-related dimensions of learning. The study contributes to the literature by offering a consolidated conceptual structure that can support comparable feedback across different learning modalities.

Figure 2: Factors of Educational Environment.



Source: Created by researchers

Practical Implications

From educational institutions point of view, the present study is valuable because it balances the conceptual comprehensiveness of dimensions with measurement feasibility. A common difficulty in educational scale development is that a highly comprehensive conceptual model can become too unwieldy for actual administration. On the other hand, an overly brief scale may fail to capture the richness of the learning environment.

The paper also has practical relevance for policy and institutional quality assurance. Because the study is motivated by the equivalence of learning modes and the need for a common evaluative basis, its output may help institutions move toward more comparable student feedback systems across online,

offline, and blended programmes. This is particularly relevant in systems where higher education is expanding rapidly into flexible and technology-enabled modes. A unified framework could allow institutions to compare student perceptions across modalities more fairly, identify strengths and weaknesses in programme delivery, and make more evidence-based improvements in teaching-learning design and support systems.

Another is the final constructs are broad enough to guide targeted institutional interventions. For example, low scores on Affective Environment may indicate the need to improve student comfort, satisfaction and openness in classroom interaction; weak results on Teaching Design, Facilitation & Instructional Scaffolding may point toward faculty development needs; poor perception on Resources, Infrastructure & Technology Integration may indicate the need for better digital tools, access, or support systems. In this way, the framework does not merely measure student opinion but can also help institutions identify where improvement is needed.

Finally, because the study proceeds to item development after expert validation, its output has direct applicability for future instrument construction. This means the paper does not stop at abstract conceptualization; rather, it moves toward a usable student-feedback scale that can later be empirically validated and adopted in practice.

Future Research

The present study provides a conceptual and expert-validated foundation for a unified educational learning environment scale in higher education. However, the proposed framework should be seen as an initial stage in a larger scale-development process as it need to be validated through research in different universities of different locations for being generalized.

While the present study identifies affective, cognitive, institutional, pedagogical, participatory, peer-related and technological dimensions, it remains to be tested whether all constructs contribute equally to the educational experience. Some dimensions may have stronger explanatory value in particular contexts than others.

The central motivation of the paper is the absence of a common learner-feedback instrument that can function across online, offline, and blended learning. Accordingly, future studies should investigate whether the same constructs are understood similarly across these instructional modes and whether comparisons between modalities can be made meaningfully. Without such testing, the promise of a unified cross-modal scale remains conceptual.

At present, the framework organizes dimensions of the learning environment, but it remains to be established how these constructs relate to important educational outcomes. Succeeding studies may therefore examine their relationship with student satisfaction, academic achievement, retention, perceived learning, engagement, sense of belonging, and overall educational quality.

Future studies may critically explore whether additional dimensions emerge over time or whether some current dimensions need to be reconfigured. As educational environments continue to evolve due to digital transformation, artificial intelligence, changing pedagogies and shifts in policy and student expectations, new aspects of the learning environment may gain importance.

References

- Adedoyin, O. B., & Soykan, E. (2023). Covid-19 pandemic and online learning: the challenges and opportunities. *Interactive learning environments*, 31(2), 863-875.
- Al Yakin, A., Fitriana, Y., Elngar, A. A., & Obaid, A. J. (2025). Social Stratification and the Influence of Financial Literacy on Student Social Interaction within AI Technologically Enhanced Learning Environments: An Examination from a Sociological Lens. In *Cutting-Edge Solutions for Advancing Sustainable Development: Exploring Technological Horizons for Sustainability-Part 2* (pp. 73-99). Bentham Science Publishers.

- Al-Barakat, A. A., Al-Hassan, O. M., Al-Ali, R. M., Bataineh, R. F., Aboud, Y. Z., & Ibrahim, N. A. (2025). Shaping young minds: How teachers foster social interaction, psychological security and motivational support in the primary language classroom. *International Journal of Learning, Teaching and Educational Research*, 24(1), Article 18. <https://doi.org/10.26803/ijlter.24.1.18>
- Aldridge, J. M., Fraser, B. J., & Huang, I. T.-C. (1999). Investigating classroom environments in Taiwan and Australia with multiple research methods. *Journal of Educational Research*, 93, 48-62.
- An, J., & Blanchard, S. B. (2020). Bioecological theory. In J. M. Block, L. D. Haegele, S. Kelly, & L. Lieberman (Eds.), *The Routledge handbook of adapted physical education* (1st ed., pp. 14–24). Routledge. <https://doi.org/10.4324/9780429052675-5>
- Arbaugh, J. B., Cleveland-Innes, M., Diaz, S. R., Garrison, D. R., Ice, P., Richardson, J. C., & Swan, K. P. (2008). Developing a community of inquiry instrument: Testing a measure of the community of inquiry framework using a multi-institutional sample. *The internet and higher education*, 11(3-4), 133-136.
- Aridor, K., Dvir, M., Tsybulsky, D., & Ben-Zvi, D. (2023). Living the DReaM: The interrelations between statistical, scientific and nature of science uncertainty articulations through citizen science. *Instructional Science*, 51(5), 729-762.
- Ballouk, R., Mansour, V., Dalziel, B., & Hegazi, I. (2022). The development and validation of a questionnaire to explore medical students' learning in a blended learning environment. *BMC medical education*, 22(1), 4.
- Bartlett, M. S. (1954). A note on the multiplying factors for various χ^2 approximations. *Journal of the Royal Statistical Society. Series B (Methodological)*, 296-298.
- Bervell, B., Umar, I. N., Kumar, J. A., Asante Somuah, B., & Arkorful, V. (2021). Blended learning acceptance scale (BLAS) in distance higher education: toward an initial development and validation. *Sage Open*, 11(3), 21582440211040073.
- Biggs, J., Tang, C., & Kennedy, G. (2022). *Teaching for quality learning at university 5e*. McGraw-hill education (UK).
- Blundell, C. N., Mukherjee, M., & Nykvist, S. (2022). A scoping review of the application of the SAMR model in research. *Computers and Education Open*, 3, 100093.
- Bozkurt, A., & Bozkaya, M. (2015). Evaluation criteria for interactive e-books for open and distance learning. *International Review of Research in Open and Distributed Learning*, 16(5), 58-82.
- Cavanagh, R. F., & Fisher, W. P. (2018, August). The science in human science research: The case for Rasch measurement in learning environment research. In *Journal of Physics: Conference Series* (Vol. 1065, No. 7, p. 072010). IOP Publishing.
- Chang, H.-Y., Wang, C.-Y., Lee, M.-H., Wu, H.-K., Liang, J.-C., Lee, S. W.-Y., Chiou, G.-L., Lo, H.-C., Lin, J.-W., Hsu, C.-Y., Wu, Y.-T., Chen, S., Hwang, F.-K., & Tsai, C.-C. (2015). A review of features of technology-supported learning environments based on participants' perceptions. *Computers in Human Behavior*, 53, 223–237. <https://doi.org/10.1016/j.chb.2015.06.042>
- Chatterji, M. (2010). Evaluation methodology. In P. Peterson, E. Baker, & B. McGaw (Eds.), *International encyclopedia of education* (3rd ed., pp. 735–745). Elsevier. <https://doi.org/10.1016/B978-0-08-044894-7.01608-0>
- Cheers, C., Eng, C. S., & Postle, G. (2012). Experiential space. In M. Keppell, K. Souter, & M. Riddle (Eds.), *Physical and virtual learning spaces in higher education: Concepts for the modern learning environment* (pp. 239–250). IGI Global. <https://doi.org/10.4018/978-1-60960-114-0.ch016>
- Chinta, R., Kebritchi, M., & Ellias, J. (2016). A conceptual framework for evaluating higher education institutions. *International Journal of Educational Management*, 30(6), 989-1002.
- Closs, L., Mahat, M., & Imms, W. (2022). Learning environments' influence on students' learning experience in an Australian Faculty of Business and Economics. *Learning environments research*, 25(1), 271-285.
- Costello, A. B., & Osborne, J. (2005). Best practices in exploratory factor analysis: Four recommendations for getting the most from your analysis. *Practical assessment, research, and evaluation*, 10(1).
- De Leersnyder, J., Gündemir, S., & Ağirdağ, O. (2022). Diversity approaches matter in international classrooms: How a multicultural approach buffers against cultural misunderstandings and encourages inclusion and psychological safety. *Studies in Higher Education*, 47(9), 1903-1920.
- DeCamp, W., Horvitz, B., Garza Mitchell, R. L., Kowalske, M. G., & Singleton, C. (2022). Development of a self-report instrument for measuring online teaching practices and discussion facilitation. *Plos one*, 17(10), e0275880.
- Delbecq, A. L., & Van de Ven, A. H. (1971). A group process model for problem identification and program planning. *The journal of applied behavioral science*, 7(4), 466-492.
- Dixon, M. D. (2015). Measuring student engagement in the online course: The Online Student Engagement Scale (OSE). *Online Learning*, 19(4), 1–15.
- Dizon, A. G. (2023). Historical development of CIPP as a curriculum evaluation model. *History of Education*, 52(1), 109-128.
- Fabrigar, L. R., Wegener, D. T., MacCallum, R. C., & Strahan, E. J. (1999). Evaluating the use of exploratory factor analysis in psychological research. *Psychological methods*, 4(3), 272.
- Faruque, M., Haque, M., Islam, S., Shihab, S. F., & Kamal, Z. M. (2017). Outpatient Educational Environment of Dental-Medical Colleges of Bangladesh Utilizing ACLEEM Questionnaire. *J Global Pharm Tech*, 9, 41-47.
- Feld, T. C. (2010). The development of organizations as an organizational-pedagogic task: Requirements of a learning further education organization. *Zeitschrift für Erziehungswissenschaft*, 13, 83-98.
- Finch, J. L., & Jefferson, R. N. (2013). Designing authentic learning tasks for online library instruction. *The Journal of Academic Librarianship*, 39(2), 181-188.
- Fisher, D. L., & Fraser, B. J. (1983, April). Use of Classroom Environment Scale in investigating effects of psychosocial milieu on science students' outcomes. Paper presented at the Annual Meeting of the National Association for Research in Science Teaching, Dallas, TX.
- Foth, T., Efstathiou, N., Vanderspank-Wright, B., Ufholz, L. A., Dütthorn, N., Zimansky, M., & Humphrey-Murto, S. (2016). The use of Delphi and Nominal Group Technique in nursing education: A review. *International journal of nursing studies*, 60, 112-120.
- Fraser, B. J. (1982). Assessment of Learning Environments: Manual for Learning Environment Inventory (LEI) and My Class Inventory (MCI). Third Version.
- Fraser, B. J., & Lee, S. S. U. (2009). Science laboratory classroom environments in Korean high schools. *Learning Environments Research*, 12(1), 67–84. <https://doi.org/10.1007/s10984-008-9048-1>
- Fraser, B. J., & Treagust, D. F. (1986). Validity and use of an instrument for assessing classroom psychosocial environment in higher education. *Higher Education*, 15(1), 37–57. <https://doi.org/10.1007/BF00138091>
- Fraser, B. J., McRobbie, C. J., & Fisher, D. L. (1996). Development, validation and use of personal and class forms of a new classroom environment instrument. *Proceedings Western Australian Institute for Educational Research Forum*. Retrieved from <http://www.waier.org.au/forums/1996/fraser.html>

- Fraser, B. J., Treagust, D. F., & Dennis, N. C. (1986). Development of an instrument for assessing classroom psychosocial environment at universities and colleges. *Studies in Higher Education*, 11(1), 43–54. <https://doi.org/10.1080/03075078612331378173>
- Gabryś-Barker, D. (2019). Cognitive and affective dimensions of foreign language learning environments: A Polish-Turkish comparative study. *neofilolog*, (52/1), 139-157.
- Garrison, D. R., Anderson, T., & Archer, W. (1999). Critical inquiry in a text-based environment: Computer conferencing in higher education. *The internet and higher education*, 2(2-3), 87-105.
- Genn, J. M. (2001). AMEE Medical Education Guide No. 23 (Part 1): Curriculum, environment, climate, quality and change in medical education—a unifying perspective. *Medical teacher*, 23(4), 337-344.
- Glaser, B. G., & Strauss, A. L. (1967). *Grounded theory: Strategies for qualitative research*. Chicago, IL: Aldine Publishing Company.
- Gruppen, L. D., & Fogarasi, M. C. (2021). Considerations on conducting research on wellness in the context of the learning environment. *Global Advances in Health and Medicine*, 10, 2164956121989708.
- Haag, M., Duan, Y., & Mathews, B. (2007, September). Knowledge development in e-Learning environments: A cross-cultural perspective. In *Proceedings of the 8th European Conference on Knowledge Management (ECKM 2007)*, Barcelona, Spain, 6th (Vol. 1, pp. 391-397).
- Hair, J. F., Black, W. C., Babin, B. J., & Anderson, R. E. (2019). *Multivariate data analysis eight edition*. Cengage Learning EMEA: United Kingdom.
- Hakan, K., & Seval, F. (2011). CIPP evaluation model scale: development, reliability and validity. *Procedia-Social and Behavioral Sciences*, 15, 592-599.
- Hamilton, E. R., Rosenberg, J. M., & Akcaoglu, M. (2016). The substitution augmentation modification redefinition (SAMR) model: A critical review and suggestions for its use. *TechTrends*, 60(5), 433-441.
- Han, J. H. (2014). Closing the missing links and opening the relationships among the factors: A literature review on the use of clicker technology using the 3P model. *Journal of Educational Technology & Society*, 17(4), 150-168.
- Hayton, J. C., Allen, D. G., & Scarpello, V. (2004). Factor retention decisions in exploratory factor analysis: A tutorial on parallel analysis. *Organizational research methods*, 7(2), 191-205.
- Hong, S., & Lee, J. Y. (2022). Evaluation of therapeutic communication education for nursing students based on constructivist learning environments: A systematic review. *Nurse education today*, 119, 105607.
- Hooper, D., & Murphey, T. (2023). *Landscaping and Sustaining Well-Becoming in Learning Partnerships: Concrete Steps to “Communities Full of Leaders”*. In *Leaderful classroom pedagogy through an interdisciplinary lens: Merging theory with practice* (pp. 255-270). Singapore: Springer Nature Singapore.
- Horn, J. L. (1965). A rationale and test for the number of factors in factor analysis. *Psychometrika*, 30(2), 179-185.
- Huang, F., Ge, X., Li, Y., & Tang, Z. (2025). Unveiling unwillingness to communicate among EFL learners in flipped learning: an ecological perspective. *Innovation in Language Learning and Teaching*, 1-15.
- Iqbal, Z., Anees, M., Khan, R., Wadood, A., & Malik, S. (2021). A comparative analysis of the efficacy of three program-evaluation models—A review on their implication in educational programs. *Humanities & Social Sciences Reviews*, 9(3), 326-336.
- Insel, P. M., & Moos, R. H. (1974). Psychological environments: Expanding the scope of human ecology. *American psychologist*, 29(3), 179.
- Iruka, I. U., DeKraai, M., Walther, J., Sheridan, S. M., & Abdel-Monem, T. (2020). Examining how rural ecological contexts influence children's early learning opportunities. *Early Childhood Research Quarterly*, 52, 15-29.
- Jaber Rafidi, T., & Wagner, B. (2024). The impact of emotional scaffolding on online teaching and learning in Palestinian English language classrooms during COVID-19. *Innovation in Language Learning and Teaching*, 18(2), 155-168.
- Jawaid, M., & Aly, S. M. (2014). Learning environment in undergraduate institutes in Pakistan: determining factors and suggestions. *Journal of Postgraduate Medical Institute*, 28(3).
- Jonassen, D. H., & Rohrer-Murphy, L. (1999). Activity theory as a framework for designing constructivist learning environments. *Educational technology research and development*, 47(1), 61-79.
- Kaiser, H. F. (1960). The application of electronic computers to factor analysis. *Educational and psychological measurement*, 20(1), 141-151.
- Kang, H., & Chang, B. (2016). Examining culture's impact on the learning behaviors of international students from Confucius culture studying in western online learning context. *Journal of International Students*, 6(3), 779-797.
- Kelsch, J., & Wang, T. (2021, November). An action research of using SAMR to guide blended learning adoption during COVID-19. In *International Symposium on Emerging Technologies for Education* (pp. 207-218). Cham: Springer International Publishing.
- Kim, B., & Reeves, T. C. (2007). Reframing research on learning with technology: In search of the meaning of cognitive tools. *Instructional science*, 35(3), 207-256.
- Kirkpatrick, D. (1994). *Evaluating Training Programs: The Four Levels*. Berrett-Koehler Publishers.
- Kornienko, O. (2024). Social network analysis. *Encyclopedia of adolescence*, 2, 528-539.
- Koul, R. B., Fisher, D. L., & Shaw, T. (2011). An application of the TROFLEI in secondary-school science classes in New Zealand. *Research in Science & Technological Education*, 29(2), 147-167.
- Lartey, S. A., Cummings, G. G., Richter, S., & Montgomery, C. L. (2026). Equity, diversity and inclusion in nursing educational institutions: A scoping review. *Journal of Advanced Nursing*, 82(2), 1206-1231.
- Latrous, W. O., & Khadraoui, M. (2020). Cultural challenges of E-Learning experiences: an exploratory research. *International Journal of E-Services and Mobile Applications (IJESMA)*, 12(3), 18-37.
- Lee, W. W. S., & Chan, C. K. K. (2018). Relationships among epistemic beliefs, perception of learning environment, study approaches and academic performance: a longitudinal exploration with 3P model. *The Asia-Pacific Education Researcher*, 27(4), 267-276.
- Lewis, J., & Sireci, S. G. (2022). *ITEMS module: digital module 30: validity and educational testing: purposes and uses of educational tests*. Educational measurement: issues and practice, 41(4), 72–75. <https://doi.org/10.1111/emip.12533>
- Li, H., Zhang, J., Khan, W. A., & Lamsali, H. (2025). Teacher responsibility, AI integration, and student well-being: The role of peer collaboration in higher education. *Acta Psychologica*, 260, 105532.
- Li, W. (2001, August). Constructivist learning systems: A new paradigm. In *Proceedings IEEE International Conference on Advanced Learning Technologies* (pp. 433-434). IEEE.
- Machumu, H., & Zhu, C. (2019). Teachers' perceived roles and their constructivist engagement practices in blended learning environment courses in Tanzanian universities. *International Journal of Learning Technology*, 14(2), 102-124.
- Mahmoudi-Dehaki, M., & Nasr-Esfahani, N. (2025). *Enhancing Engagement and equity in personalized learning through adaptive systems. In Personalized Learning Through Adaptive Systems and Intelligent Tutoring* (pp. 219-246). IGI Global Scientific Publishing.

- Mairitsch, A., Sulis, G., Mercer, S., & Bauer, D. (2023). Putting the social into learner agency: Understanding social relationships and affordances. *International Journal of Educational Research*, 120, 102214.
- Matewere, I., Msosa, A., & Mfuni, J. (2022). Exploring perceived barriers to effective utilization of learner-centred teaching methods by tutors at Holy Family College of Nursing and Midwifery, Phalombe, Malawi. *Malawi Medical Journal*, 34(3), 192.
- Manz, E. (2018). Designing for and analyzing productive uncertainty in science investigations. *International Society of the Learning Sciences, Inc.[ISLS]*.
- McCrudden, M. T., Magliano, J. P., & Schraw, G. (2010). Exploring how relevance instructions affect personal reading intentions, reading goals and text processing: A mixed methods study. *Contemporary Educational Psychology*, 35(4), 229-241.
- Mohammad Hosseini, H., Fathi, J., Derakhshesh, A., & Mehraein, S. (2022). A model of classroom social climate, foreign language enjoyment, and student engagement among English as a foreign language learners. *Frontiers in psychology*, 13, 933842.
- Moos, R. H., & Trickett, E. J. (1974). *Classroom Environment Scale Manual*. Palo Alto, CA: Consulting Psychologists Press.
- Mugambi, M. M. (2018). Linking constructivism theory to classroom practice. *International Journal of Humanities Social Sciences and Education*, 5(9), 96-104.
- NALLE, C., SARYANTO, S., & REJOKIRONO, R. (2024). The use of constructivist learning theory in Ki Hadjar Dewantara system through Tut Wuri Handayani in Merdeka curriculum. *INTERNATIONAL JOURNAL OF ENGINEERING, SCIENCE*, 5(1), 28-34.
- Navarro, J. L., & Tudge, J. R. (2025). Understanding and Teaching Bronfenbrenner's Bioecological Theory. Taylor & Francis.
- NEP 2020. National Education Policy 2020. Government of India.
- O'Sullivan, M. L., & Samarawickrema, G. (2008). Changing learning and teaching relationships in the educational technology landscape. *Proceedings ascilite Melbourne*, 711-714.
- Olofsson, A. D., & Lindberg, J. O. (2006). "Whatever happened to the social dimension?" Aspects of learning in a distance-based teacher training programme. *Education and Information Technologies*, 11(1), 7-20. <https://doi.org/10.1007/s10639-005-5716-2>
- Ouyang, S., Zhang, W., Xue, L., Rashid, A. M., Pyng, H. S., & Hassan, A. B. (2025). The Cultural Compass: A Systematic Review on Cultural Dimensions Theory in Educational Settings. *SAGE open*, 15(2), 21582440251342160.
- Ozkan, S., & Koseler, R. (2009). Multi-dimensional students' evaluation of e-learning systems in the higher education context: An empirical investigation. *Computers & Education*, 53(4), 1285-1296.
- Pang, S., Lv, G., Zhang, Y., & Yang, Y. (2024). Enhancing students' science learning using virtual simulation technologies: a systematic review. *Asia Pacific Journal of Education*, 1-21.
- Panigrahi, R., Nihar, K. L., & Singh, N. (2024). Quality Measurement of the Blended Learning Model in Higher Education: Scale Development and Validation. *Higher Learning Research Communications*, 14(1), 86-102.
- Paz-Pascual, C., Artieta-Pinedo, I., & Grandes, G. (2019). Consensus on priorities in maternal education: results of Delphi and nominal group technique approaches. *BMC pregnancy and childbirth*, 19(1), 264.
- Perkilli, P., & Lehtelii, P. L. (2007). Learning environments in mathematics and science. In *How Finns learn mathematics and science* (pp. 69-85). Brill.
- Petrík, Š., & Vašáková, Z. (2022). Relationship Between Interaction Style-Built Teacher Authority and Classroom Climate Dimensions. *The New Educational Review*, 68, 107-118.
- Pokharel, M. P., & Ok Choi, S. (2015). Exploring the relationships between the learning organization and organizational performance. *Management research review*, 38(2), 126-148.
- Precel, K., Eshet-Alkalai, Y., & Alberton, Y. (2009). Pedagogical and Design Aspects of a Blended Learning Course. *The International Review of Research in Open and Distributed Learning*, 10(2). <https://doi.org/10.19173/irrodl.v10i2.618>
- Puentedura, R. (2006). Transformation, technology, and education [Blog post]. Retrieved from <http://hippasus.com/resources/tte/>.
- Puntambekar, S. (2022). Distributed scaffolding: Scaffolding students in classroom environments. *Educational Psychology Review*, 34(1), 451-472.
- Qu, X., & Chaijaroen, S. (2025). Theoretical Retrospectives for Developing a Constructivist Learning Environment Model to Enhance Metacognitive Regulation in Authentic Writing. *Forum for Linguistic Studies*, 7(3), 63-78. <https://doi.org/10.30564/fls.v7i3.8452>
- Ramsden, P. (2003). *Learning to Teach in Higher Education*. Routledge.
- Rapchak, M. E. (2017). Creating a community of inquiry in online library instruction. *Journal of Library & Information Services in Distance Learning*, 11(1-2), 59-67.
- Saar, M., Rodríguez-Triana, M. J., & Santos, L. P. P. (2022). Towards data-informed teaching practice: A model for integrating analytics with teacher inquiry. *Journal of Learning Analytics*, 9(3), 88-103.
- Samat, C., Chaijaroen, S., & Wattanachai, S. (2019, November). The designing of constructivist web-based learning environment to enhance problem solving process and transfer of learning for computer education student. In *International Conference on Innovative Technologies and Learning* (pp. 117-126). Cham: Springer International Publishing.
- Sashittal, H. C., Jassawalla, A. R., & Markulis, P. (2012). Students' perspective into the apathy and social disconnectedness they feel in undergraduate business classrooms. *Decision Sciences Journal of Innovative Education*, 10(3), 413-446.
- Schunk, D. H., & Usher, E. L. (2012). Social cognitive theory and motivation. In R. M. Ryan (Ed.), *The Oxford handbook of human motivation* (pp. 13-27). Oxford University Press. <https://doi.org/10.1093/oxfordhb/9780195399820.013.0002>
- Selwyn, N. (2016). *Education and Technology: Key Issues and Debates*. Bloomsbury Publishing.
- Sims, D. A., & Cilliers, F. J. (2023). Clinician educators' conceptions of assessment in medical education. *Advances in Health Sciences Education*, 28(4), 1053-1077.
- Singh, R. N., & Hurley, D. (2017). The effectiveness of teaching and learning process in online education as perceived by university faculty and instructional technology professionals. *Journal of Teaching and Learning with Technology*, 6(1), 65-75.
- Sharma, P., & Rani, N. (2022). Academic Satisfaction in Blended Environments: A Scale Validation Approach. *Indian Journal of Educational Research*, 10(1), 112-127.
- Singkaew, C., & Chaijaroen, S. (2020, November). Development of constructivist web-based learning environment model to enhance problem-solving and transfer of learning on student in industrial: integration between pedagogy and neuroscience. In *International Conference on Innovative Technologies and Learning* (pp. 399-408). Cham: Springer International Publishing.
- Sitzia, J. (1999). How valid and reliable are patient satisfaction data? An analysis of 195 studies. *International Journal for Quality in Health Care*, 319-328.
- Solnosky, R. L., & O'Halloran, T. G. (2023, June). Classroom Climate Analysis of Flipped Structural Classrooms with Active Learning: A Case Study. In *2023 ASEE Annual Conference & Exposition*.

- Stoten, D. W. (2022). How relevant is cultural dimensions theory? An empirical study of Sri Lankan undergraduate business and management students. *Higher Education for the Future*, 9(2), 132-149.
- Stufflebeam, D. L. (1971). The Relevance of the CIPP Evaluation Model for Educational Accountability. *Journal of Research and Development in Education*, 5(1), 19-25.
- Subramaniam, K. (2020). A place-based education analysis of prospective teachers' prior knowledge of science instruction in informal settings. *International Journal of Educational Research*, 99, 101497.
- Sun, J. (2016). Multi-dimensional alignment between online instruction and course technology: A learner-centered perspective. *Computers & Education*, 101, 102-114. <https://doi.org/10.1016/j.compedu.2016.06.003>
- Sunnasy, A., & van der Heever, M. M. (2025). Technology-mediated education: The lived experiences of nurse educators. *International Journal of Africa Nursing Sciences*, 100885.
- Tang, Y. (2023, August). Construction of Teaching Quality Evaluation System of Intelligent Education System Under OBE+ CIPP Model. In *International Conference on E-Learning, E-Education, and Online Training* (pp. 387-405). Cham: Springer Nature Switzerland.
- Taylor, P. C., Fraser, B. J., & Fisher, D. L. (1997). Monitoring constructivist classroom learning environments. *International journal of educational research*, 27(4), 293-302.
- Taylor, P. C., Fraser, B. J., & White, L. R. (1994). CLES: An instrument for monitoring the development of constructivist learning environments. Paper presented at the annual meeting of the American Educational Research Association, New Orleans, LA.
- Thomas, R., Oviedo-García, M. Á., Sulkowski, N. B., & Deakin, M. K. (2009). Does understanding culture help enhance students' learning experience? *International Journal of Contemporary Hospitality Management*, 21(2), 154-166. <https://doi.org/10.1108/09596110910935651>
- Tomlinson, C. A., & Jarvis, J. M. (2023). Differentiation: Making curriculum work for all students through responsive planning & instruction. In *Systems and models for developing programs for the gifted and talented* (pp. 599-628). Routledge.
- Toosi, M., Modarres, M., Amini, M., & Geranmayeh, M. (2021). Context, Input, Process, and Product Evaluation Model in medical education: A systematic review. *Journal of education and health promotion*, 10(1), 199.
- Tsai, C. Y., Wang, C. C., Chu, H. C., & Chen, Z. W. (2018, July). Effects of Web Issue-Quest Approaches with Different Prompting Strategies on Students' Learning Performance in a Natural Science Course. In *2018 7th International Congress on Advanced Applied Informatics (IIAI-AAI)* (pp. 300-305). IEEE.
- University Grants Commission (UGC). (2020). Guidelines for Online Learning Programs. [India].
- University Grants Commission. (2021, March). UGC credit framework for online learning courses through Study Webs of Active Learning for Young Aspiring Minds Regulations, 2021. https://www.ugc.gov.in/pdfnews/2727945_SWAYAM-Regulations-2021.pdf
- Ustunel, H. H., & Tokel, S. T. (2018). Distributed scaffolding: Synergy in technology-enhanced learning environments. *TechTrends in Knowledge and Learning*, 23(1), 129-160. <https://doi.org/10.1007/s10758-017-9299-y>
- Varlamis, I., & Apostolakis, I. (2010). A framework for the quality assurance of blended e-learning communities. In R. Setchi, I. Jordanov, R. J. Howlett, & L. C. Jain (Eds.), *Knowledge-based and intelligent information and engineering systems (KES 2010) (Lecture Notes in Computer Science, Vol. 6278, pp. 27-36)*. Springer. https://doi.org/10.1007/978-3-642-15393-8_4
- Walberg, H. J., & Anderson, G. J. (1968). Classroom climate and individual learning. *Journal of Educational Psychology*, 59(6), 414-419. <https://doi.org/10.1037/h0026565>
- Walker, S. L., & Fraser, B. J. (2005). Development and validation of an instrument for assessing distance education learning environments in higher education: The Distance Education Learning Environments Survey (DELES). *Learning Environments Research*, 8(3), 289-308. <https://doi.org/10.1007/s10984-005-1568-3>
- Walker, S. L., & Fraser, B. J. (2005). Development and validation of an instrument for assessing distance education learning environments in higher education: The Distance Education Learning Environments Survey (DELES). *Learning environments research*, 8(3), 289-308.
- Wan, Z., & Fang, Y. (2006). The role of information technology in technology-mediated learning: A review of the past for the future.
- Winnips, J. C. (2000). Support of active, self-reliant learning via the WWW by means of cue scaffolding. *International Journal of Continuing Engineering Education and Life Long Learning*, 10(1-4), 296-313.
- Wojciechowski, R., & Cellary, W. (2013). Evaluation of learners' attitude toward learning in ARIES augmented reality environments. *Computers & education*, 68, 570-585.
- Yang, S., Liu, L., & Hunt, N. (2022). Exploring the influence of perceived classroom environment on learner autonomy in a Chinese EFL learning context. *Frontiers in Psychology*, 13, 1063473.
- Zhu, G., Teo, C. L., Scardamalia, M., Badron, M. F., Martin, K., Raman, P., ... & Woodruff, E. (2020). Emotional and cognitive affordances of collaborative learning environments.
- Zheng, L., Chen, S., Zhang, H., Feng, Y., & Gu, X. (2025). Evolving knowledge structures in technology integration: Tracking changes embedded in teaching artifacts. *Teaching and Teacher Education*, 162, 105072.
- Zwick, W. R., & Velicer, W. F. (1986). Comparison of five rules for determining the number of components to retain. *Psychological bulletin*, 99(3), 432.

Statements and Declarations

AI Usage: AI is used (QuiltBot/Grammarly), for proper sentence phrasing and grammar/spelling corrections.

Competing Interests: The authors declare no competing interests.

Funding: There is no Funding support.

Author Contributions: All authors contributed equally to the study design, data collection, analysis, and manuscript

Data Availability: The data collected and analyzed during the current study are not publicly available due to privacy and confidentiality considerations but may be available from the corresponding author on reasonable request, subject to appropriate restrictions.

Ethics Approval: The study involved human participants through a questionnaire-based survey and is conducted in accordance with the ethical principles of the Declaration of Helsinki. Ethical approval is obtained from the Directorate of Research (DoR), Manipal University Jaipur (MUJ), district-Jaipur, India, which administered the 'Ethical Committee' when data was collected, vide reference number DoR/EC/26/20. The study followed the ethical standards prescribed by the approving committee, including voluntary participation, informed consent, confidentiality and anonymity among the respondents.

Consent to Participate: Informed consent was obtained from all individual participants included in the study. Participation was entirely voluntary, and participants were informed about the purpose of the study, their right to withdraw at any stage, and the assurance of confidentiality and anonymity.

Consent for Publication: The consent to publish is not applicable.

Clinical Trial Statement: No clinical trial was conducted in this study.