ORIGINAL ARTICLE

Assessing of adult learning by learning style inventory

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Abstract

Background: Understanding how adult learners engage with educational experiences is essential for optimizing teaching–learning strategies in Competency-Based Medical Education (CBME). Kolb's Learning Style Inventory (KLSI) provides a structured framework for assessing adult learning preferences and their relationship with educational practices. *Aim and Objectives:* To assess adult learning among undergraduate medical students using KLSI, examine phase-wise variations in learning styles, and explore their association with preferred teaching–learning methods. *Methods:* A descriptive cross-sectional study was conducted among 312 MBBS students from different academic phases at a Government Medical College in India. Learning styles were assessed using KLSI (v3.1/4.0), and preferences for teaching–learning methods were obtained through a structured questionnaire. Descriptive statistics were used to summarize data, while associations between categorical variables were assessed using the Chi-square test, with $p < 0.05$ considered statistically significant. *Results:* Distinct phase-wise variations in learning styles were observed. Diverging learners predominated in Phase I (49.5%), Assimilating learners in Phase II (44.21%), Converging learners in Phase III Part I (37.3%), and Accommodating learners in Phase III Part II (28.8%). Overall, Converging (21.15%) and Diverging (20.83%) styles were most common. Mixed learning styles were identified in 13.46% of students, while 14.74% demonstrated extended KLSI 4.0 categories, with balanced learners representing the largest subgroup (11.86%). Significant associations were observed between learning styles and preferred teaching–learning methods ($p < 0.05$). *Conclusion:* Adult learning preferences among medical students evolve across different phases of training and are significantly associated with preferred teaching approaches. The findings support the adoption of learner-centered, multimodal, and adaptive educational strategies within CBME. Recognition of mixed and balanced learner profiles further highlights the need for flexible instructional designs that accommodate diverse learning preferences in medical education.

Keywords: Adult Learning, Kolb's Learning Style Inventory, Medical Education, Competency-Based Medical Education, Learning Styles, Teaching–Learning Methods

Introduction

Adult learning is a dynamic, self-directed, and experience-driven process through which learners actively construct knowledge, develop professional competencies, and adapt to evolving educational and workplace demands. In medical education, undergraduate students represent adult learners who bring diverse prior experiences, motivations, and learning preferences to the educational environment. Understanding how adult learners acquire, process, and apply knowledge is therefore fundamental to designing effective teaching–learning strategies and achieving desired educational outcomes. In India, medical education is undergoing a major transformation with the implementation of Competency-Based Medical Education (CBME) [1], which emphasizes student-centered, outcome-oriented, and

flexible learning. This paradigm shift challenges traditional teacher-centered approaches and necessitates educational frameworks capable of accommodating diverse learner needs and preferences [1,2]. Contemporary medical education literature further emphasizes that curriculum design and instructional practices should be informed by established learning theories to enhance learner engagement and competency development among adult learners [3].

Among the various theories of adult learning, Kolb's Experiential Learning Theory [4, 5] provides one of the most widely accepted frameworks for understanding how individuals learn from experience. The theory conceptualizes learning as a continuous cycle involving concrete experience, reflective observation, abstract conceptualization, and active experimentation. Based on the interaction of these dimensions, learners are categorized into four predominant learning styles: Diverging, Assimilating, Converging, and Accommodating [6, 7]. These styles have been associated with important educational outcomes, including clinical reasoning, reflective practice, decision-making, problem-solving, and simulation-based learning [8, 9].

The assessment of adult learning through learning style inventories has gained increasing importance in health professions education because it provides insight into how learners engage with educational experiences and respond to different pedagogical approaches. Indian studies have demonstrated preferences for hands-on, experiential, and problem -solving approaches among medical students [10,11]. Similar observations have been reported internationally, where learning style preferences have been shown to influence academic engagement, instructional satisfaction, and educational outcomes among medical students [12-14]. These findings underscore the importance of understanding learner diversity when designing educational interventions in health professions education.

However, educational practices often remain insufficiently aligned with these learner characteristics. Although several studies have described learning style distributions among medical students, the translation of such findings into curriculum design, teaching innovation, and learner support remains limited. Furthermore, calls for integrating learning style assessment into educational planning have largely remained descriptive, with relatively little emphasis on validation, contextual relevance, and practical application [15].

The CBME framework introduced by the National Medical Commission [1] closely reflects the principles of adult learning and Kolb's experiential cycle [4,5] by promoting self-directed learning, formative assessment, reflective practice, early clinical exposure, and competency attainment [1,16]. Despite this theoretical alignment, the systematic use of Kolb's Learning Style Inventory (KLSI) [4,5] for educational planning, mentorship, and curriculum development remains uncommon within Indian medical colleges, even as awareness of learner diversity continues to grow [3].

Recent evidence from Indian medical education further supports the importance of learner-centered educational approaches within the CBME framework. Gugapriya *et al*. (2024) reported that successful implementation of CBME requires educational strategies that accommodate learner diversity, active participation, and competency attainment [17]. Similarly, Shenoy *et al*. (2025) demonstrated substantial readiness for self-directed learning among undergraduate medical students, emphasizing the need for educational approaches that recognize differences in learner characteristics and

learning preferences [18]. These observations reinforce the relevance of assessing adult learning styles in contemporary medical education and support the integration of learner-centered instructional strategies within undergraduate training.

Additional concerns relate to the clarity, reliability, and cultural applicability of learning style assessment tools within the Indian educational context. Most available evidence is derived from Western populations, and there remains limited exploration of newer developments such as KLSI 4.0, [6,7] mixed learning styles, and emerging learner profiles. These gaps are particularly important in light of contemporary educational priorities emphasizing flexibility, equity, inclusiveness, learner autonomy, and personalized learning pathways [19,3].

Against this background, the present study was undertaken to assess adult learning among undergraduate medical students using KLSI as a structured framework for understanding learner preferences. By mapping the distribution of learning styles across different phases of the MBBS curriculum, examining their relationship with preferred teaching–learning methods, and exploring the emergence of mixed and extended learning styles, the study sought to generate evidence that can inform learner-centered educational practices within CBME. In doing so, it aimed to contribute to curriculum refinement, faculty development, learner empowerment, and the advancement of culturally responsive health professions education in India.

The present study aimed to assess adult learning among undergraduate medical students by examining learning style preferences using KLSI. Specifically, the study sought to: (1) identify the distribution of learning styles across different phases of the MBBS curriculum; (2) compare dominant learning styles among preclinical, paraclinical, and clinical cohorts; (3) examine the relationship between learning styles and preferred teaching–learning methods; and (4) explore the occurrence of mixed and extended learning style categories described in KLSI 4.0.

The study was guided by the following research questions: What are the predominant learning styles among undergraduate medical students? How do these learning preferences vary across different phases of medical training? To what extent are learning styles associated with students' preferred teaching–learning methods? Based on these questions, it was hypothesized that significant differences would exist in the distribution of learning styles across academic phases and that students' learning styles would be significantly associated with their preferred teaching–learning approaches.

Methods

This study adopted a descriptive, cross-sectional, and correlational design to examine the distribution of Kolb's learning styles among undergraduate medical students and their relationship with preferred teaching–learning methods. The design allowed both a snapshot of current preferences and comparisons across academic phases, supporting the identification of developmental trends and educational implications. A quantitative approach was chosen as learning style assessment is multidimensional and overlaps with student engagement and teaching practices. The research was conducted at Late Shri Lakhiram Agrawal Memorial Government Medical College, Raigarh, Chhattisgarh, which follows the National Medical Commission curriculum. Participants included MBBS students from Phase I (preclinical), Phase II (paraclinical), and Phase III Part I & II (clinical).

Stratified sampling ensured proportional representation from each phase. Inclusion criteria were enrolment in the MBBS program and willingness to provide informed consent, while exclusion criteria included absence during the study period or incomplete responses. Based on a 90% confidence level, 5% precision, and allowance for 10% non-response, the sample size was calculated as 300, though a total of 312 students participated for the study. Two instruments were used. The primary tool was KLSI (v3.1/4.0), which classifies learners into Diverging, Assimilating, Converging, or Accommodating styles based on four domains: Concrete Experience, Reflective Observation, Abstract Conceptualization, and Active Experimentation. Responses were recorded on a five-point Likert scale. A supplementary questionnaire captured preferences for teaching–learning methods such as lectures, small group discussions, demonstrations, problem-based learning, skill labs, tutorials, and self-study, with ratings of usefulness also on a five-point scale. Both instruments were pretested with 30 students to ensure clarity, reliability, and feasibility. Internal consistency was confirmed (Cronbach's $\alpha \geq 0.70$), and feedback indicated practicality and ease of completion.

Data collection took place over two months (July 15 – September 15, 2025). Students were briefed on the study's purpose, assured of confidentiality, and informed consent was obtained electronically. Surveys were administered in paper format. Data were anonymized, securely stored, and analysed using Microsoft Excel (2024 version).

Descriptive statistics including frequencies, percentages, means, and standard deviations were used to summarize participant characteristics, learning style distributions, and preferred teaching–learning methods. Student's t-test was used where appropriate for comparison of continuous variables, while associations between categorical variables such as MBBS phase, learning style categories, and preferred teaching–learning methods were assessed using the Chi-square test of independence. Statistical significance was established at $p < 0.05$.

Ethical approval was granted by the Institutional Ethics Committee (Ref. No: S.No/Med/Ethics Commi/2025/44, dated 19 March 2025). Permission to use KLSI was obtained from Korn Ferry (10 July 2025), and official booklets were procured. Participants were free to withdraw at any time without consequence, and confidentiality was strictly maintained.

Results

A total of 324 MBBS students were eligible, of whom 312 participated, giving a response rate of 96.3%. The sample included 165 females (52.88%) and 147 males (47.12%), with proportional representation across all phases of the MBBS program. The gender distribution is shown in Table 1.

Distribution of learning styles (KLSI 3.0) (Table 2)

Analysis of KLSI (version 3.0) revealed distinct preferences across phases (Table 2).

Phase I (preclinical): The majority (49.5%) showed a Diverging style, favouring observation and idea generation.

Phase II (paraclinical): Most students (44.21%) preferred the Assimilating style, emphasizing logical reasoning and abstract concepts.

Phase III Part I (clinical): The dominant style was Converging (37.3%), reflecting problem-solving and practical application.

Phase III Part II (clinical): The largest group (28.8%) were Accommodators, preferring hands-on, trial-and-error learning.

Across all participants, 21.15% were Convergers, 20.83% Divergers, 18.59% Assimilators, and 11.22% Accommodators. The differences across phases were statistically significant ($p < 0.05$).

Mixed and Extended Learning Styles (KLSI 4.0)

Beyond the four core styles, 13.46% of students displayed mixed styles, combining elements of two or more approaches (Table 3). Examples included Accommodative-Divergent and Divergent-Convergent blends.

KLSI version 4.0 introduced additional categories. Among these, Balanced learners were most common (11.86%), increasing steadily from Phase I to Phase III Part II. Smaller proportions were classified as Reflecting, Thinking, or Acting styles, while no students fell into the Experiencing category. Chi-square analysis demonstrated a statistically significant association between academic phase and learning style distribution ($\chi^2 = 48.62$, $p < 0.05$). Similarly, significant associations were observed between learning styles and preferred teaching–learning methods ($\chi^2 = 56.84$, $p < 0.05$), supporting the hypothesis that adult learning preferences vary across stages of medical training and influence pedagogical preferences (Table 3).

Correlation with Preferred Teaching–Learning Methods

Students' preferred learning styles were significantly associated with their favoured teaching methods (Tables 4 & 5).

Phase I: Divergers leaned toward interactive lectures and lab work, while Convergers preferred Problem-Based Learning (PBL).

Phase II: Assimilators favoured demonstrations and clinics, while Convergers and Accommodators showed interest in PBL.

Phase III Part I: Convergers strongly preferred PBL and interactive lectures, while Divergers leaned toward seminars and tutorials.

Phase III Part II: Accommodators favoured PBL and demonstrations, while Balanced learners preferred interactive lectures.

Overall (all phases): Interactive lectures (67 students) and PBL (54 students) were the most widely chosen methods, followed by lab work/clinics (54 students). The associations between learning styles and teaching preferences were statistically significant ($p < 0.05$).

Key findings

Diverging style dominated in Phase I (49.5%); Assimilating style was most common in Phase II (44.21%); Converging style prevailed in Phase III Part I (37.3%); Accommodating style was most frequent in Phase III Part II (28.8%); Overall, Convergers (21.15%) and Divergers (20.83%) were the largest groups; 13.46% of students showed mixed learning styles; 14.74% adopted new styles from KLSI 4.0, with balanced learners (11.86%) being the largest subgroup. The results of preferred KLSI correlated with preferred teaching method can be given as under (Table 4):

Table 1: Gender wise distribution of MBBS students

Gender	MBBS Phase 1	MBBS Phase 2	MBBS Phase 3 Part I	MBBS Phase 3 Part II	Total
Female	46 (27.88%)	56 (33.94%)	36 21.82%)	27 (16.36%)	165
Male	53 (36.05%)	39 (26.53%)	23 (15.64%)	32 (21.77%)	147
Total	99 (31.73%)	95 (30.45%)	59 (18.91%)	59 (18.91%)	312

Table 2: Learning style of MBBS students

Learning Style		MBBS Phase 1	MBBS Phase 2	MBBS Phase 3 Part I	MBBS Phase 3 Part II	Total n (%)	*p*
KLSI 3.0	Accommodating	2 (2.01%)	14 (14.74%)	2 (3.39%)	17 (28.81%)	35 (11.22%)	< 0.05
	Assimilating	6 (6.1%)	42 (44.21%)	5 (8.47%)	5 (8.47%)	58 (18.59%)	
	Converging	27 (27.3%)	14 (14.74%)	22 (37.3%)	3 (5.08%)	66 (21.15%)	
	Diverging	49 (49.5%)	2 (2.11%)	8 (13.56%)	6 (10.17%)	65 (20.83%)	
Mixed learning style	Accommodative assimilative	1 (1.01%)	2 (2.11%)	2 (3.39%)	1 (1.69%)	6 (1.92%)	
	Accommodative convergent	3 (3.03%)	0	1 (1.69%)	3 (5.08%)	7 (2.24%)	
	Accommodative Divergent	2 (2.01%)	2 (2.11%)	3 (5.08%)	2 (3.39%)	9 (2.88%)	
	Divergent assimilative	2 (2.01%)	4 (4.21%)	0	1 (1.69%)	7 (2.24%)	
	Assimilative convergent	0	2 (2.11%)	1 (1.69%)	3 (5.08%)	6 (1.92%)	
	Divergent Convergent	0	3 (3.16%)	2 (3.39%)	2 (3.39%)	7 (2.24%)	
Additional learning style as per KLSI 4.0	Experiencing	0	0	0	0	0	
	Reflecting	1 (1.01%)	1 (1.05%)	1 (1.69%)	0	3 (1%)	
	Thinking	1 (1.01%)	2 (2.11%)	0	0	3 (1%)	
	Acting	2 (2.01%)	0	1 (1.69%)	0	3 (1%)	
	Balanced	3 (3.03%)	7 (7.37%)	11 (18.64%)	16 (27.12%)	37 (11.86%)	
	Total	99	95	59	59	312	-

KLSI – Kolb's Learning Style Inventory

Table 3: Chi-square analysis of learning styles across MBBS phases and teaching preferences

Variable Examined	χ^2	Degrees of Freedom	*p*
Learning Style Distribution vs MBBS Phase	48.62	9	<0.05*
KLSI 4.0 Extended Styles vs MBBS Phase	21.37	12	<0.05*
Learning Style vs Preferred Teaching Method	56.84	21	<0.05*

**- Significant association*
KLSI – Kolb's Learning Style Inventory

Table 4: KLSI correlated to preferred teaching method for various phase MBBS students

Phase 1 Students (n=99)												
Preferred Method	**Kolb's learning style**											***p***
	Acco	**Div**	**Conv**	**Assi**	**MLS**	**Exp**	**Refl**	**Thin**	**Act**	**Bal**	**Total**	<0.05
Interactive lecture	1	13	7	1	1	-	1	-	-	1	25	
PBL	-	4	6	-	1	-	-	1	-	-	12	
SGD	-	5	4	1	1	-	-	-	-	1	12	
Demonstration	-	2	6	1	1	-	-	-	-	1	11	
Self-study	-	6	1	1	1	-	-	-	-	-	9	
Lab work /Clinics	1	9	1	1	1	-	-	-	2	-	15	
Didactic lecture	-	6	1	1	1	-	-	-	-	-	9	
Seminar tutorials	-	4	1	-	1	-	-	-	-	-	6	

Continued...

Phase 2 Students (n=95)												
Preferred Method	**Kolb's learning style**											***p***
	Acco	**Div**	**Conv**	**Assi**	**MLS**	**Exp**	**Refl**	**Thin**	**Act**	**Bal**	**Total**	<0.05
Interactive lecture	3	-	3	8	2	-	-	-	-	2	18	
PBL	3	1	3	5	2	-	-	1	-	1	16	
SGD	2	-	2	1	1	-	-	1	-	1	8	
Demonstration	3	-	1	6	1	-	-	-	-	1	12	
Self-study	1	1	1	6	1	-	-	-	-	1	11	
Lab work /Clinics	2	-	2	10	3	-	1	-	-	1	19	
Didactic lecture	-	-	1	4	1	-	-	-	-	-	6	
Seminar tutorials	-	-	1	2	2	-	-	-	-	-	5	
Phase 3 Part I Students (n=59)												
Preferred Method	**Kolb's learning style**											***p***
	Acco	**Div**	**Conv**	**Assi**	**MLS**	**Exp**	**Refl**	**Thin**	**Act**	**Bal**	**Total**	<0.05
Interactive lecture	1	1	6	1	3	-	1	-	-	1	14	
PBL	-	2	7	-	1	-	-	-	1	2	13	
SGD	-	1	3	1	1	-	-	-	-	2	8	
Demonstration	-	1	2	-	1	-	-	-	-	1	5	
Self-study	-	-	1	-	1	-	-	-	-	1	3	
Lab work /Clinics	1	1	1	3	1	-	-	-	-	1	8	
Didactic lecture	-	1	1	-	1	-	-	-	-	1	4	
Seminar tutorials	-	1	1	-	-	-	-	-	-	2	4	

Continued...

Phase 3 Part II Students (n=59)												
Preferred Method	**Kolb's learning style**											***p***
	Acco	**Div**	**Conv**	**Assi**	**MLS**	**Exp**	**Refl**	**Thin**	**Act**	**Bal**	**Total**	**<0.05**
Interactive lecture	3	2	1	1	1	-	-	-	-	2	10	
PBL	6	1	-	1	2	-	-	-	-	3	13	
SGD	2	-	1	1	2	-	-	-	-	2	8	
Demonstration	3	1	-	-	2	-	-	-	-	2	8	
Self-study	1	-	-	-	1		-	-	-	2	4	
Lab work /Clinics	2	2	1	2	2	-	-	-	-	3	12	
Didactic lecture	-	-	-	-	1	-	-	-	-	1	2	
Seminar tutorials	-	-	-	-	1	-	-	-	-	1	2	

Accommodator (Acco), Diverger (Div), Converger (Conv), Assimilator (Assi), Experiencing (Exp), Reflecting (Refl), Thinking (Thin), Acting (Act) & Balanced (Bal) & Mixed learning style (MLS)
KLSI – Kolb's Learning Style Inventory; PBL – Problem based learning; SGD – Small group discussion

Table 5: KLSI correlated to preferred teaching method for all MBBS students (n=312)

Preferred Method	**Kolb's learning style**											***p***
	Acco	**Div**	**Conv**	**Assi**	**MLS**	**Exp**	**Refl**	**Thin**	**Act**	**Bal**	**Total**	<0.05
Interactive lecture	8	16	17	11	7	-	2	-	-	6	67	
PBL	9	8	16	6	6	-	-	2	1	6	54	
SGD	4	6	10	4	5	-	-	1	-	6	36	
Demonstration	6	4	9	7	5	-	-	-	-	5	36	
Self-study	2	7	3	7	4		-	-	-	4	27	
Lab work /Clinics	6	12	5	16	7	-	1	-	2	5	54	
Didactic lecture	-	7	3	5	4	-	-	-	-	2	21	
Seminar tutorials	-	5	3	2	4	-	-	-	-	3	17	

Accommodator (Acco), Diverger (Div), Converger (Conv), Assimilator (Assi), Experiencing (Exp), Reflecting (Refl), Thinking (Thin), Acting (Act) & Balanced (Bal), Mixed Learning Style (MLS)
KLSI – Kolb's Learning Style Inventory; PBL – Problem based learning; SGD – Small group discussion

Discussion

Pedagogical implications, and correlation with study objectives

The present study assessed adult learning among undergraduate medical students using KLSI and demonstrated significant variations in learning style preferences across different phases of the MBBS curriculum. The findings support the concept that adult learning is dynamic, developmental, and strongly influenced by educational context. Consistent with Kolb's Experiential Learning Theory [4,7], students appeared to progress from reflective and observational modes of learning in the early phases of training toward increasingly analytical, problem-solving, and experiential approaches during clinical exposure. This progression highlights the evolving nature of adult learning and reinforces the importance of aligning educational strategies with learners' developmental needs.

A notable finding was the predominance of the Diverging learning style among Phase I students (49.5%). Diverging learners rely heavily on concrete experiences and reflective observation, characteristics that are particularly relevant during the transition from school-based education to the demanding environment of medical training. Study by Teli *et al.* (2021) among undergraduate medical students have demonstrated considerable variation in learning preferences, highlighting the need for learner-centered instructional approaches [11]. We may state that, previous studies have consistently demonstrated substantial heterogeneity in learning preferences among medical students and have emphasized that instructional approaches should be tailored to accommodate diverse learner profiles. These findings support the present study, which likewise highlights the importance of aligning teaching strategies with learner characteristics [15], suggesting that novice learners initially prefer observation, reflection, and conceptual understanding before engaging in active clinical decision-making. The relatively high proportion of Diverging learners observed in the present study may reflect the emphasis on foundational sciences, guided learning, and adaptation to a new educational environment during the first phase of the MBBS curriculum.

In Phase II, Assimilating learners emerged as the dominant group (44.21%). Assimilators prefer abstract conceptualization, logical organization of information, and theoretical understanding. This finding is consistent with observations by Muniyapillai *et al.* (2023), who reported a greater tendency toward analytical and conceptual learning during the paraclinical phase [9]. The shift from Diverging to Assimilating preferences may be explained by increasing exposure to subjects such as pathology, pharmacology, and microbiology, where understanding mechanisms and integrating theoretical concepts become central to learning. Thus, the transition appears to reflect curricular demands rather than merely individual preference.

The predominance of Converging learners in Phase III Part I (37.3%) and Accommodating learners in Phase III Part II (28.8%) provides further evidence of developmental progression in adult learning. Converging learners are characterized by practical application, decision-making, and problem-solving abilities, whereas Accommodating learners prefer active experimentation, adaptability, and hands-on engagement. Similar trends have been reported by Wilkinson *et al.* (2014) and Vemuri & Rao (2024) who observed increasing preference for experiential and application-oriented learning among students engaged in clinical training [8,10]. By Phase

III Part II, accommodating learners were the predominant group, reflecting greater adaptability, active experimentation, and hands-on engagement that characterize advanced clinical training. Similar observations have been reported by Mousavi *et al.* (2024) who found that Accommodating and Converging learning styles were associated with higher levels of clinical competency, supporting the importance of experiential learning in clinical education [16]. The greater representation of Accommodating learners during advanced clinical exposure may reflect the demands of bedside learning, patient interaction, procedural skills, and real-time decision-making. These findings suggest that clinical environments naturally encourage movement toward more action-oriented learning styles.

While the overall pattern of findings is broadly consistent with previous studies, certain differences were observed. The proportion of mixed learning styles (13.46%) and balanced learners (11.86%) appears higher than that reported in several earlier investigations. One possible explanation is the inclusion of KLSI version 4.0, which recognizes greater flexibility and complexity in learner profiles. Additionally, the CBME framework promotes multiple modes of learning, including self-directed learning, early clinical exposure, reflective practice, and skills-based training, all of which may contribute to the development of more adaptive and integrated learning orientations. Differences in institutional culture, teaching methods, assessment practices, and learner demographics may also account for variability between studies.

The present findings are also supported by evidence from the broader medical education literature. Bitran *et al*. (2003) reported considerable heterogeneity in learning styles among medical students and emphasized the importance of accommodating diverse learner preferences within medical curricula [12]. Similarly, Gurpinar *et al*. (2010) demonstrated that congruence between learning styles and instructional methods may positively influence learner satisfaction and engagement, while Almigbal (2015) observed associations between learning preferences and academic performance among medical students [13,14]. These observations are consistent with the present study, which identified significant associations between learning styles and preferred teaching–learning methods. Collectively, these findings reinforce the educational value of understanding learner diversity and support the incorporation of learner-centered approaches within undergraduate medical education.

An important contribution of the present study is the demonstration of a significant relationship between learning styles and preferred teaching–learning methods. Divergers showed greater preference for interactive lectures, group discussions, and laboratory-based activities; Assimilators favoured demonstrations and structured theoretical instruction; convergers preferred problem-based learning and application-oriented activities; whereas Accommodators were more inclined toward experiential methods such as clinical demonstrations and practical exposure. These findings are consistent with previous educational research indicating that learners engage more effectively when instructional methods align with their preferred approaches to knowledge acquisition and application [9]. The observed associations further support the educational relevance of learning style assessment as a component of learner-centered curriculum planning.

From the perspective of adult learning theory, the findings reinforce the principle that learning preferences are neither static nor mutually exclusive. The emergence of mixed learning styles and

balanced learners supports the growing view that adult learners adapt their learning strategies in response to changing academic and clinical demands [5, 20]. Rather than representing fixed categories, learning styles may be viewed as flexible orientations that evolve throughout professional education. This interpretation aligns closely with contemporary perspectives on self-directed learning, reflective practice, and lifelong learning within health professions education.

The findings also carry important implications for CBME, which emphasizes learner-centeredness, flexibility, self-directed learning, and competency attainment, all of which are closely aligned with adult learning principles [1, 2, 19]. These findings are consistent with recent reports from Indian medical education literature. Gugapriya *et al*. (2024) highlighted the importance of adaptable and learner-centered educational strategies for effective implementation of CBME, while Shenoy *et al*. (2025) reported high levels of readiness for self-directed learning among medical undergraduates [17,18]. Together with the present findings, these studies suggest that recognizing learner diversity and providing flexible educational opportunities may enhance student engagement, promote self-directed learning, and facilitate competency acquisition. The observed diversity of learning styles suggests that no single instructional method can effectively address the needs of all learners. Instead, educational strategies should incorporate a balanced combination of interactive lectures, problem-based learning, small-group discussions, demonstrations, simulation-based activities, clinical exposure, and reflective exercises. Such multimodal approaches are likely to enhance learner engagement, facilitate competency acquisition, and support individualized learning pathways.

The present findings directly address the study objectives and research questions. The mapping of learning style distributions across different phases of the MBBS curriculum fulfilled the primary objective of assessing adult learning among undergraduate medical students. The observed phase-wise differences in learning style preferences support the study hypothesis that learning style distributions vary across academic cohorts. Furthermore, the progressive transition from diverging and assimilating orientations in the earlier phases toward converging and accommodating orientations in the clinical phases suggests that learning preferences evolve with curricular progression and increasing clinical exposure. The significant association between learning styles and preferred teaching–learning methods further supports the study hypothesis that pedagogical preferences are closely linked to learner characteristics. Collectively, these findings answer the research questions posed at the outset of the study and provide empirical support for the application of Kolb's experiential learning framework within undergraduate medical education. The results further reinforce the need for learner-centered, flexible, and competency-oriented educational strategies within the CBME framework.

Educational Implications

The present findings have important implications for the effective implementation of CBME. While the National Medical Commission has already advocated learner-centered and multimodal teaching strategies, the observed phase-wise variation in learning preferences indicates that educational interventions should also be responsive to learners' developmental needs. Beyond the routine adoption of mixed teaching methods, curriculum planners and faculty may consider incorporating persona-

lized learning pathways, structured academic mentoring, reflective portfolios, adaptive formative feedback, simulation-based learning, technology-enhanced instruction, and periodic assessment of learner preferences. Such learner-responsive strategies may facilitate greater student engagement, strengthen self-directed learning, promote reflective practice, and enhance competency attainment. Recognizing that learning preferences evolve throughout medical training underscores the importance of maintaining flexibility in instructional design and faculty development to support diverse learner profiles within undergraduate medical education.

Conclusion

The present study demonstrates that learning preferences among undergraduate medical students vary significantly across different phases of the MBBS curriculum, supporting the dynamic nature of adult learning within the CBME framework. Early-phase students predominantly exhibited reflective learning preferences, whereas senior students demonstrated greater inclination towards application-oriented and experiential learning. The significant association between learning styles and preferred teaching–learning methods highlights the importance of recognizing learner diversity when planning educational strategies. These findings suggest that aligning instructional approaches with learners' evolving preferences may enhance student engagement, self-directed learning, and competency attainment. Future multicentric longitudinal studies are warranted to evaluate changes in learning preferences over time and their relationship with academic performance, clinical competence, and professional development.

Limitations and Recommendations

This study has certain limitations. Being conducted at a single institution, the findings may not be generalizable to all medical colleges. The cross-sectional design reflects learning preferences at a single point in time and does not capture their evolution throughout medical training. In addition, the use of self-reported responses may have introduced response bias, and the relatively small number of Mixed and Balanced learners limited subgroup analyses.

Despite these limitations, the findings support the adoption of learner-centered and phase-appropriate teaching strategies within the CBME framework. Faculty may enhance learning by integrating multimodal instructional approaches, reflective practice, structured mentoring, and periodic assessment of learner preferences. Future multicentric longitudinal studies involving larger and more diverse student populations are recommended to evaluate changes in learning styles over time and their relationship with academic performance, clinical competence, and professional development.

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