

Original Research Article

Learning behaviors and preferences for lecture versus team-based learning among preclinical students in a Caribbean medical school

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ABSTRACT

Background: Medical students exhibit diverse learning behaviors that influence their engagement with instructional formats. This study investigated how preclinical students' learning styles influence preferences for lectures versus team-based learning (TBL) and their impact on academic performance.

Methods: All preclinical students at Trinity Medical Sciences University were invited to participate voluntarily. Learning behaviors avoidant, participant, competitive, collaborative, dependent, and independent were classified using the Grasha-Riechmann questionnaire, while instructional preferences were assessed through a 14-item survey. GPA data were collected, and analyses performed using various statistics tests, and thematic analysis.

Results: A total of 108 students participated (mean age 24.9 years; 42.5% male, 57.5% female). dependent (27.8%) and independent (21.3%) were the most common learning behaviors, while competitive style was absent. Collaborative learners demonstrated a strong preference for TBL over lectures ($p < 0.001$, $d = 1.816$). Avoidant learners moderately favored TBL, whereas Independent and Participant learners showed comparable preferences, and Dependent learners displayed parity across formats. GPA differences across groups were not statistically significant, though small mixed-style cohorts (e.g., collaborative+dependent) had higher averages. Gender analysis revealed males more often exhibited independent and avoidant styles, while females favored dependent and participant behaviors, with mixed profiles more prevalent among female learners. Qualitative themes highlighted nuanced preferences: collaborative students valued frequent TBL, dependent learners preferred lecture-led curricula, and participant learners favored balanced approaches.

Conclusions: This study underscores that students' instructional preferences vary by learning behavior and gender. Tailoring teaching strategies to these profiles can foster adaptive, inclusive curricula that enhance engagement, efficiency, and academic outcomes.

Keywords: Learning behaviors, Lecture, Medical education, TBL

INTRODUCTION

Students exhibit diverse needs in terms of their learning behaviors, objectives, available time, place of learning-classroom or distant and various other factors.¹ Nowadays, they are increasingly reluctant to embrace teaching and learning opportunities that do not match their unique

learning behavior.² Based on the different ways individuals approach the classroom environment, Grasha and Riechmann (1974) identified six distinct types of learners: avoidant, participant, competitive, collaborative, dependent, and independent.³ With the rapid evolution of new learning technologies, adaptive learning both at the level of curriculum or a course and at the individual unit

of instruction level has become the necessity in medical universities. Within a curriculum, a variety of learning opportunities can be offered, allowing students to select options that best meet their specific needs. For instance, a student might choose to attend a live lecture, listen to a podcast version of the lecture, participate in team-based collaborative learning with peers, or work independently through an online program that better aligns with their learning behavior. Ultimately, the extent and diversity of learning choices available depend on the time and resources at hand.⁴

Instead of embracing adaptive learning strategies, a teacher might choose to address the needs of the entire class as a single group. While this approach may seem simpler and easier, it carries significant drawbacks, as illustrated by the following example. An analysis of formative quiz results revealed that one-third of the class answered questions incorrectly on a specific topic covered during a TBL session. In response, a decision was made to conduct an additional TBL session on that same topic prior to the summative examination. However, this remedy might not resolve the issues of students who struggled particularly dependent learners even though it inadvertently penalized the two-thirds of students who had already mastered the material and did not require further repetition.

Alternatively, a teacher-centered method such as a lecture where learning objectives are clearly defined and detailed explanations are provided might have been more appropriate for dependent learners, whereas employing a reverse strategy could benefit collaborative learners. A deeper exploration of this scenario might consider how adaptive learning can be fine-tuned to different learner profiles, ensuring that each student's unique needs are addressed without disadvantaging others. This invites further discussion on designing classroom strategies that balance collective instruction with individualized support. Modern curricula emphasize teaching-learning systems that deliver precise feedback, swift responses, ample practice opportunities, and enriched cognitive engagement.⁵ However, these systems are truly effective only when the sessions are tailored to align with students' learning behaviors. Designing lessons that resonate with the way students best absorb and process information can only ensure meaningful learning outcomes.

Learning behavior influences how students engage with clinical reasoning, teamwork, and feedback.^{6,7} While individualistic (adaptive) approach of education is advocated in modern education, it becomes important for the educator to know the predominant learning behaviour of the learners so that he can use the teaching learning strategies those could be most effective to their learners. At the same time, avoiding the methods that could be least effective to the individual learners can help to save the time and effort of the educators. This study aims to provide a comprehensive understanding of how different learning behaviors influence the preferences of medical students for

conventional lecture-based teaching methods and team-based learning approaches. By uncovering these dynamics, the research aims to equip educators with valuable insights to develop more inclusive and tailored teaching methods to better suit the individual preferences and strengths of each student. These strategies will aspire to optimize learning experiences and outcomes for the vast majority of students, fostering an engaging and effective academic environment for all.

Through this research project, authors aim to classify the different learning behaviors exhibited by preclinical TMSU students, determine how specific learning behavior correlates with the preference for either conventional lectures or team-based learning, explore student perceptions and preferences for conventional lectures versus team-based learning approaches, evaluate the impact of student learning behaviors on overall academic performance.

METHODS

This study employed a cross-sectional, observational, mixed-methods (quantitative as well as qualitative thematic analysis) design using validated and self-developed questionnaires to assess learning styles and instructional preferences among 108 preclinical medical students, with academic performance data incorporated for correlation analysis.

Participants

All preclinical medical students in Terms 1 through 4 at Trinity Medical Sciences University (TMSU) were invited to participate in the study. The study was conducted during Summer and Fall semesters (May to December) in academic year 2025. Participation was voluntary, informed consent was obtained and data collection was conducted toward the end of the academic term to ensure that students had sufficient exposure to both conventional lectures and team-based learning (TBL) sessions. The study was approved by the Institutional Review Board of the university (IRB #052025-001).

Instruments

Grasha-Riechmann student learning styles questionnaire

To classify students' learning behaviors, the validated Grasha-Riechmann student learning styles questionnaire was employed.⁸ This instrument consists of 60 items, with 10 items each assessing six distinct learning behaviors: independent, avoidant, collaborative, dependent, and Participant. Responses were recorded on a five-point likert scale ranging from strongly disagree to strongly agree. Internal consistency of the instrument in this study was confirmed with a Cronbach's alpha of 0.875, indicating high reliability. Based on the aggregated scores, each participant's predominant learning behavior was identified. In addition, the second most common and least

favorable learning behaviors of the participants were noted for comparative analysis.

Self-developed questionnaire on instructional preferences

A second instrument, a 14-item self-developed questionnaire, was designed to explore students' perceptions and preferences regarding conventional lectures versus TBL approaches. The questionnaire included 10 items favoring lectures and 10 items favoring TBL sessions, each rated on the same five-point Likert scale (strongly disagree=1, strongly agree=5). The reliability of this instrument was established with a Cronbach's alpha of 0.771, reflecting acceptable internal consistency. At the conclusion of the questionnaire, students were invited to provide open-ended comments regarding their perspectives on lectures, TBL, or a mixed approach for effective classroom learning.

Procedure

Both questionnaires were administered in person during scheduled classroom sessions toward the end of the academic term. Prior to completing the instruments, students were asked to provide basic demographic information including name, age, sex, and academic term. Although identifiers were collected for administrative purposes, strict confidentiality was maintained throughout the study, and all data were anonymized during analysis to protect participants' privacy.

In addition to questionnaire responses, the grade point average (GPA) of each participant was obtained from the examination department following the final term examinations. This allowed for further exploration of potential correlations between students' academic performance and their predominant learning behaviors.

Data Analysis

The combined dataset comprising demographic information, questionnaire responses, and GPA scores was then prepared for statistical analysis. Data were analyzed using SPSS version 27.

Descriptive statistics were computed to summarize demographic characteristics and overall response patterns. Comparative analyses were conducted using paired sample t-tests, while associations between variables were examined using Pearson correlation tests. Statistical significance was set at $\alpha=0.05$ for all analyses. Effect sizes were calculated using Cohen's *d*, interpreted according to conventional thresholds: approximately 0.2 (small), 0.5 (medium), and ≥ 0.8 (large). For qualitative data, thematic analysis was applied to the open-ended responses. Themes were generated to capture students' perspectives on lectures, TBL, or mixed approaches, and these were further examined in relation to the predominant learning behaviors identified through the Grasha-Riechmann questionnaire.

RESULTS

A total of 108 medical students from Term 1 to 4 responded to all questionnaire and their responses were considered for analysis. The average age of the participants was 24.9 ± 4.2 years.

Participants were categorized according to their predominant learning behaviors in the classroom. The most common behavior was dependent followed by independent, participant, and collaborative. Less frequent behaviors included Avoidant and various combinations of traits (Table 2). However, predominantly competitive learning behavior was found among none of the participants. Notably, 13% of participants exhibited mixed learning behaviors.

Secondary learning behavior of these students are presented in the Table 3. The analysis of independent learners revealed 30.4% of this student group also exhibited dependent tendencies, suggesting that even self-directed learners may seek structured support. Additionally, 17.3% of this student group showed avoidant, collaborative, or participant traits again as secondary behaviors, indicating a diverse mix of autonomy, disengagement, and active involvement. For avoidant learners, 40% showed dependent tendencies as secondary, while another 40% showed a shift toward dependent plus collaborative while 20% toward mix of independent plus dependent styles, hinting at potential behavioral ambivalence or transitional learning states.

Students with a collaborative primary style most frequently paired it with dependent behavior (47.1%), followed by participant (29.5%), suggesting that collaboration often coexists with reliance on structured guidance and active engagement. A small proportion (5.8%) also exhibited avoidant or independent plus dependent traits, reflecting occasional disengagement or dual reliance. Among dependent learners, 46.7% leaned toward participant behavior as secondary, reinforcing a pattern of structured engagement. Notably, 26.7% also showed avoidant tendencies, which may reflect stress-related withdrawal or passive coping mechanisms. Smaller percentages exhibited independent (20%) or hybrid styles, such as collaborative plus participant.

For participant learners, 55% also demonstrated dependent behavior, suggesting that active engagement is often scaffolded by structured support. Other secondary behaviors included independent (15%), independent plus dependent (15%), and avoidant (5%), indicating a blend of autonomy, reliance, and occasional disengagement. Competitive learning behavior was not even noted as second most common learning behavior among any groups. The analysis of least common learning behaviors among medical students reveals distinct avoidance patterns tied to each predominant learning style (Table 4). Among independent learners, a striking 91.4% identified competitive behavior as their least common trait,

underscoring a strong aversion to rivalry and suggesting a preference for autonomy over comparison. Similarly, collaborative learners unanimously (100%) reported competitive behavior as least common, reinforcing the notion that cooperative learners tend to reject competitive dynamics. Avoidant learners also showed low alignment with competitive traits (80%), though 20% indicated Collaborative behavior as least common, hinting at discomfort with group-based learning.

Dependent learners most frequently distanced themselves from competitive behavior (73.4%), followed by avoidant tendencies (23.3%), suggesting that while they rely on structured support, they are neither disengaged nor driven by competition. A small fraction (3.3%) also reported hybrid behaviors like competitive and collaborative as least common. Among participant learners, 50% identified competitive behavior as least common, and 45% distanced themselves from avoidant traits, indicating that active engagement is often accompanied by a rejection of both rivalry and disengagement. Only 5% of participant learners reported avoidant plus competitive as least common, reinforcing the rarity of dual disengagement and competition among engaged students.

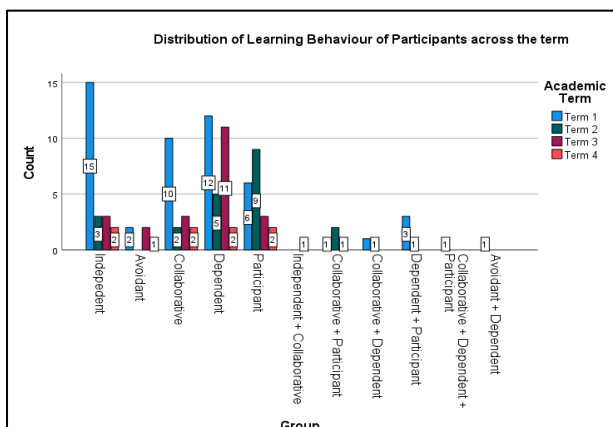


Figure 1: Distribution of learning behaviors across four academic terms.

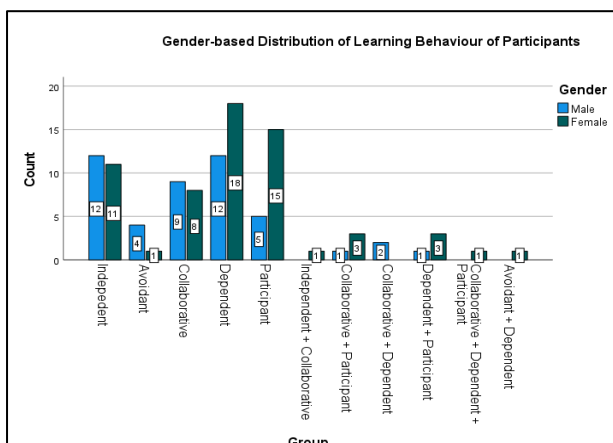


Figure 2: Gender-based distribution of learning behaviors.

Figure 1 reveals the distribution of predominant learning behaviors across four academic terms. In term 1, which comprised nearly half of the sample, students predominantly exhibited independent (28.8%) and dependent (23.1%) learning behaviors, suggesting a strong reliance on both self-direction and structured support at the start of medical school. Term 2 showed a notable shift, with participant learners peaking at 39.1%, indicating heightened engagement and active involvement during this phase. By term 3, dependent behavior resurged sharply to 45.8%, possibly reflecting increased academic demands or complexity that prompted students to seek more guidance. Term 4, representing the smallest cohort, displayed no dominant learning style, with low percentages across all categories, suggesting either greater variability or reduced data capture in later stages. However, Pearson Chi-Square ($p=0.505$) suggests no strong evidence of an overall association between academic terms and learning behavior categories.

The gender-based distribution of learning behaviors among medical students reveals distinct patterns (Figure 2). Among male students (42.6% of the total sample), the most common learning styles were independent (26.1%) and dependent (26.1%), followed by collaborative (19.6%). Female students (57.4%) showed a stronger preference for dependent learning (29.0%) and participant behavior (24.2%), with collaborative styles also present (12.9%). Mixed learning profiles such as combinations of collaborative, dependent, and Participant were more prevalent among females (12.9%) than males (6.5%), suggesting greater behavioral complexity in female learners. Avoidant behavior was notably more common in males (8.7%) than females (1.6%). However, Pearson Chi-Square ($p=0.223$) suggests no strong evidence of an overall association between gender and learning behavior categories.

The Table 5 presents the mean GPA across the various learning groups. Results from the post hoc Tukey analysis indicated that there were no statistically significant differences in GPA among the independent, avoidant, collaborative, dependent, and participant groups. Notably, the highest mean GPA (3.5) was observed among students of mixed learning behavior classified as collaborative plus independent or dependent learners. However, the sample sizes within these groups were very small, suggesting that these findings warrant further investigation in future studies. The comparison of mean scores for statements favoring team-based learning (TBL) versus traditional lectures across different learning behaviors reveals important insights into pedagogical alignment in medical education (Table 6). Collaborative learners showed the most pronounced preference for TBL, with a mean score of 28.7 compared to 17.7 for lectures. This difference was statistically significant ($p<0.001$) and had a very large effect size (Cohen's $d=1.816$), indicating that TBL strongly resonates with students who thrive in group-oriented, interactive environments. Avoidant learners also showed higher mean scores for TBL (25.0 vs. 18.2),

though the difference was not statistically significant ($p=0.414$), suggesting a moderate effect ($d=0.407$) that may reflect increased engagement in structured team settings. Independent learners favored TBL slightly more (22.6 vs. 19.8), but the difference was not statistically significant ($p=0.197$), with a small effect size ($d=0.277$), indicating that while TBL may support autonomy, it does not dramatically outperform lectures for this group. Participant learners showed minimal difference between TBL and lecture scores (25.6 vs. 24.2), with a small effect

size ($d=0.134$), suggesting both formats may be equally acceptable for actively engaged students. Interestingly,

Dependent learners had nearly identical scores for TBL and lectures (23.1 vs. 23.6), with no significant difference ($p=0.813$) and a negligible effect size ($d=-0.044$), indicating that structured support is equally perceived across both modalities. Themes generated from open comments made by the different group of learners are presented in Table 7.

Table 1: Demographic profile of the participants.

Characteristics	Value
Total number of participants	108
Male	46
Female	62
Mean age ($\pm$ SD)	24.9 $\pm$ 4.2 years
Age range	22–46 years

Table 2: Types of learning behavior among TMSU students.

Learning behaviors	Percentage of participants
Dependent	27.8
Independent	21.3
Participant	18.5
Collaborative	15.7
Avoidant	4.6
Competitive	0
Collaborative+participant	3.7
Dependent+participant	3.7
Collaborative+dependent	1.9
Independent+collaborative	0.9
Collaborative+dependent+participant	0.9
Avoidant+dependent	0.9

Table 3: Secondary learning behaviors of participants to each predominant learning style.

Predominant Learning behaviour	Secondary learning behaviours											
	Independent	Avoidant	Collaborative	Dependent	Competitive	Participant	Dependent and participant	Dependent and collaborative	Avoidant+dependent	Independent+participant	Collaborative+participant	Independent+dependent
Independent		17.3%)	17.3%	30.4%	0%	17.3%	4.3%	4.3%	4.3%		4.3%	
Avoidant				40%	0%			40%				20%
Collaborative	11.8%			47.1%	0%	29.5%			5.8%			5.8%
Dependent	20%		26.7%		0%	46.7%				3.3%	3.3%	
Participant	15%		5%	55%	0%			10%				15%

Table 4: The least common learning behaviors among participants to each predominant learning style.

Predominant learning behaviour	Least common learning behaviours						Competitive and Collaborative	Avoidant + Competitive
	Independent	Avoidant	Collaborative	Dependent	Competitive	Participant		
Independent	-	4.3%	4.3%	0%	91.4%	0%		
Avoidant	0%	-	20%	0%	80%	0%		
Collaborative	0%	0%	-	0%	100%	0%		
Dependent	0%	23.3%	0%	-	73.4%	0%	3.3%	
Competitive	0%	0%	0%	0%	-	0%		
Participant	0%	45%	0%	0%	50%	0%		5%

Note: Values in the table indicate percentage of participants.

Table 5: Average GPA of different learning groups.

Learning groups	Number of participants	Average GPA	Standard deviation
Collaborative+independent	1	3.50	0.00
Collaborative+dependent	2	3.50	0.70
Collaborative+participant	4	3.12	0.75
Participant	20	3.00	0.74
Independent	23	2.91	0.92
Collaborative	17	2.86	0.81
Dependent+participant	4	2.62	1.10
Dependent	30	2.61	0.61
Avoidant	5	2.40	0.42
Collaborative+dependent+participant	1	2.00	0.00
Avoidant+dependent	1	1.50	0.00

Table 6: The comparison of mean scores for statements favoring TBL versus lectures across different predominant learning behaviors.

Learning behaviour	TBL (Mean of sum of scores)	Lecture (Mean of sum of scores)	P value	Cohen's d
Independent	22.6±4.8	19.8±6.6	0.197	0.277
Avoidant	25.0±9.1	18.2±7.1	0.414	0.407
Collaborative	28.7±3.8	17.7±5.5	<0.001	1.816
Dependent	23.1±6.7	23.6±7.6	0.813	-0.044
Participant	25.6±6.4	24.2±6.8	0.556	0.134

Table 7: Themes from student perspectives on TBL and lecture: insights across predominant learning behaviors.

Learning behaviour	Themes
Independent	Independent learners favor a lecture-first model that delivers clear, structured content, combined with targeted TBL used sparingly to apply and integrate material. Students want TBL to be predictable, well-prepared, and optional for those who prefer independent study, with emphasis on practice questions and exam preparation. Representative sentiments: Material should be given and then discussed as a team...encourages thinking rather than zoning out. 1–2 TBL sessions per week in addition to lectures.
Avoidant	Avoidant learners favor a lecture-centered approach that preserves independent study time, supplemented by a small, predictable amount of TBL used primarily for clarification and targeted application. They prefer TBL to be limited, well-organized,

Continued.

Learning behaviour	Themes
	and sequenced after lectures so it supports rather than disrupts their independent learning routines. Representative sentiments: I prefer independent learning with a group discussion, follow with a TBL session.
Collaborative	Collaborative learners prefer an integrated, application-focused balance where lectures build foundations and frequent, well-organized TBL sessions drive continuous engagement, deeper understanding, and exam readiness. Representative sentiments: TBL that covers a few lectures and runs every few days forces you to stay on top of material so you don't cram for exams. For harder subjects, discussion helps apply concepts better. About 1 TBL per week. TBL after understanding lecture material satisfies both ideas. TBL before exams and NBME.
Dependent	Dependent learners prefer a lecture-led curriculum that delivers clear, organized content, paired with predictable, well-timed TBL used primarily to review, apply, and consolidate material. They value a mixed approach where TBL is scheduled after content delivery (chapter, topic, or module) so team activities reinforce rather than replace independent study. Representative sentiments: TBL at the end of each chapter would be beneficial. They should not be done randomly. 1 TBL per module summarizing all class content...otherwise I prefer mostly traditional class format. TBL 20%–40% and lecture 60%–80%.
Participant	Participant learners value a balanced, predictable mix of lectures and team-based learning where lectures build foundations and TBL sessions are scheduled to consolidate, apply, and test understanding. They prefer TBL that is purposeful, aligned to recent lectures, and timed to support exam preparation without overwhelming independent study routines. Representative sentiments: One TBL per week related to lectures covered that week helps me review and avoid cramming. Both approaches are needed. I benefit from lectures for core content and TBL to apply and test my understanding. For subjects like physiology or difficult topics, discussion and TBL help apply concepts better than lecture alone.

DISCUSSION

This study classified the diverse learning behaviors exhibited by preclinical students and examined their correlation with preferences for conventional lectures, TBL, or mixed approaches. Recognizing learning behaviors enables educators to design more responsive, flexible learning environments that accommodate evolving student needs and promote adaptive learning strategies. Authors also explored how these behaviors and preferences may influence academic performance.

The most common learning behavior identified was dependent, followed by independent, participant, and collaborative. Less frequent behaviors included avoidant and blended combinations of traits, while no students demonstrated a predominantly competitive style. These findings suggest that while most learners align with a single dominant style, a meaningful subset demonstrates blended approaches, indicating flexibility or transitional learning preferences. Comparable studies in medical education show independent learning styles was the most dominant followed by collaborative, participant and dependent among medical students in a Turkish University which were significantly associated with different types of

intrinsic and extrinsic motivation.⁹ The difference in findings may be due to variation in education system in higher secondary school, types of motivation, class size, learning environment and culture in the university. When students are expected to follow the designated path to achieve high score during high school years, they depend heavily on instructor and provided resources which restrict the development of their autonomy skills. The predominance of dependent learning in the cohort suggests that preclinical students relying heavily on structured guidance and faculty direction. While this can support foundational knowledge acquisition, it may limit the development of self-directed learning skills essential for clinical reasoning and lifelong practice.

A notable pattern was the consistent presence of dependent behavior as a secondary trait across most groups, regardless of whether students were primarily independent, avoidant, collaborative, or participant. Among dependent learners themselves, the second most common tendency was Participant behavior, highlighting the fluidity and multidimensionality of student learning. After review of 25 studies Gouvea et al also found that dependent tendencies often coexist with collaborative and participatory styles, especially in surgical training contexts which reflects the learners rely on expert guidance despite

developing autonomy.¹⁰ The frequent pairing of dependent and participant styles suggests that structured environments may encourage active engagement. Similarly, the overlap between independent and dependent tendencies underscores the need for curricula that balance autonomy with guidance. As the distribution of learners' behaviour may be quite different across the batches, the effectiveness of an instructional strategy used for one batch of students in the class may not remain same for the other batches. Educators should focus on predominant learning behaviour of students in the class. Some approach favouring the second most learning behaviour could also be beneficial at times but should negate the behaviour which is the least favourable of the learner.

Across groups, there was a consistent aversion to Competitive learning, especially among Independent, Collaborative, and Dependent learners. This indicates that medical students may thrive more in cooperative and supportive environments than in competitive ones. Interestingly, while the study found no evidence of a competitive style, Gayef et al reported measurable though modest levels of competitiveness across different years of study.¹¹ This discrepancy may reflect institutional culture, assessment strategies, or peer dynamics. The avoidance of avoidant traits by participant and dependent learners further emphasizes the value of engagement and structure in medical education. Identifying these least-preferred behaviors allows educators to minimize reliance on competitive frameworks or disengaging formats, instead fostering inclusive, collaborative, and structured learning experiences aligned with students' intrinsic preferences.

Learning behavior across the terms illustrate dynamic shifts in learning behaviors across medical training, with phases of independence, participatory, and dependence, but without statistically significant association to academic term. A similar study conducted among 170 final year medical students from Gazi University found that they had collaborative and competitive learning styles.¹² Another study showed the 1st year medical students had more dependent, collaborative, and participatory learning styles compared to the 4th year students.⁹ This underscores the complexity of student adaptation and the need for flexible faculty support strategies. Moreover, if dependent behaviors persist will raise questions about whether current teaching strategies sufficiently encourage self-regulation and reflective practice.

The findings suggest that while both genders share a foundation in Dependent learning, female students tend to engage more actively and collaboratively, whereas males lean toward independence and avoidance. While some other studies also had the similar findings related to gender variation and one study showed dominant styles of male students being cooperative, competitive and dependent while female students were competitive, cooperative and dependent.^{9,12,13} These findings have implications for curriculum design and faculty support: fostering collaborative and participatory environments may better

align with female learning preferences, while structured autonomy and targeted engagement strategies may benefit male learners. Recognizing these gendered tendencies can help educators tailor interventions that promote inclusive and effective learning experiences. The study found no significant GPA differences among primary learning styles, a finding that aligns with prior research suggesting that while learning styles may influence engagement and study habits, they do not consistently predict academic outcomes across diverse student population.^{14,15} This outcome, however, stands in contrast to the findings of AL-Roomy (2023) who reported the positive relationship between GPA and independent learning style while negative relationship with the collaborative learning style.¹⁶ Asci et al found collaborative learners were moderately successful in Pharmacology course but were less likely to get very high (≥ 80) grade.¹⁷ Kathiah et al reported no significant differences in academic performance across learning styles among second-year medical students. Their correlation analysis revealed weak positive associations of independent, dependent, and participatory styles with performance, while the avoidant style showed a weak negative correlation.¹⁸

Interestingly, data highlighted those students exhibiting mixed learning behaviors, particularly those classified as Collaborative plus Dependent or Independent, achieved the highest mean GPA of 3.5. This echoes that students with flexible or hybrid learning styles often adapt more effectively to varied academic demands, potentially enhancing performance. However, it is critical to note that these mixed-style groups in our study had very small sample sizes ($n=1-2$), limiting the generalizability of this observation and underscoring the need for further research with larger cohorts. Thus, our findings reinforce the notion that no single learning style guarantees superior academic performance, but they also open avenues for exploring how hybrid learning behaviors might support academic achievement.

Preferences for instructional formats further highlight the importance of aligning teaching strategies with learning behaviors. The results demonstrate that collaborative learners strongly favored TBL, which is consistent with previous studies reporting that TBL enhances engagement, teamwork, and application of knowledge compared to traditional lectures.^{19,20} The moderate preference for TBL among avoidant learners is particularly interesting, as prior systematic reviews suggest that structured small-group formats can reduce disengagement and encourage participation among students who might otherwise remain passive.²¹ Independent and participant learners in our study demonstrated comparable preferences for lectures and TBL, echoing findings that these groups often value both autonomy and interactive opportunities, depending on task design.²² Similarly, dependent learners showed parity across formats, which aligns with evidence that learners who rely on structured guidance can adapt equally well to lectures or TBL when clear scaffolding and facilitator support are provided.²³

Student comments reinforced these themes. Independent learners favored a lecture-first model with TBL as a targeted, optional supplement focused on exam preparation. Collaborative learners advocated for frequent, integrated TBL to sustain engagement and deepen understanding. Dependent learners valued predictable TBL scheduled after lectures to consolidate material, while Participant learners preferred a balanced mix of lectures and TBL, emphasizing alignment with recent lectures and exam preparation. Zhang et al. also reported that nursing students favored a balanced mix of lectures and TBL, aligning closely with our Participant learners who emphasized integration with exam preparation.²¹

Overall, these findings advocate for a blended instructional approach in medical education leveraging lectures to provide clarity and structure, while strategically integrating TBL to maximize collaborative engagement, reinforce understanding, and accommodate diverse learning behaviors. Such flexibility ensures that instructional strategies remain responsive to cohort differences, gendered tendencies, and evolving student needs, ultimately supporting adaptive and effective learning in preclinical medical education.

Limitations

The relatively small sample size limits the generalizability of these findings beyond the studied cohort. To strengthen external validity, future research should replicate this work across multiple medical schools in preclinical settings. Broader investigations would allow for a more comprehensive understanding of student learning behaviors and their correlation with instructional strategies and academic performance.

CONCLUSION

The study identified dependent learning behavior as the most prevalent among preclinical TMSU students, followed by independent, participant, and collaborative styles, with no evidence of predominantly competitive behavior. Across all groups, lectures consistently emerged as the primary foundation for learning, while preferences for TBL varied according to behavioral orientation. Collaborative and participant learners favored a frequent, integrated, and engagement-driven role for TBL, whereas Independent and Avoidant learners preferred TBL to remain minimal, predictable, and supportive of their self-directed routines. Dependent learners valued structured TBL sessions scheduled after lectures, using them primarily for reinforcement and consolidation.

These findings underscore the importance of educators tailoring instructional strategies to the predominant learning behaviors within each cohort, while also incorporating elements that support secondary preferences. Approaches that align with the least favorable behaviors should be minimized to avoid disengagement. Importantly, the distribution of learning behaviors may

differ across batches, meaning that strategies effective for one group may not yield the same outcomes for another. This highlights the need for a flexible curriculum design that balances the clarity and structure of lectures with adaptable TBL scheduling, ensuring diverse learner needs are met without compromising exam preparation or independent study.

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