

Research Article

Learning Styles and Study Strategies Among Pre-Clerkship Caribbean Medical Students: A Cross-Sectional Study

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Abstract: Learning styles include active-reflective, visual-verbal, sensing-intuitive, and sequential-global, based on the Index of Learning Styles (ILS). Understanding learning style preferences and study behaviors among medical students may provide insights into how learners engage with educational materials and self-directed learning strategies. To describe learning style preferences among pre-clerkship medical students and examine associations between these preferences and self-reported study strategies. A cross-sectional study distributed a questionnaire to basic-sciences students at Saint James School of Medicine, measuring learning styles via the validated ILS. Students self-reported usage frequency of five review strategies: Anki, USMLE questions, mnemonics, concept mapping, and re-reading. Chi-square analyses were used to explore associations between learning style preferences and study strategy use. All statistical analyses were done using IBM SPSS V.31. Of 124 participants, 56.5% preferred active learning, followed by visual learning (79.8%), sensing learning (81.6%), and sequential learning (54%). USMLE-style questions and reading/summarizing were used frequently and extensively (49% and 48% of participants, respectively), whereas concept mapping was rarely used in students' study and revision (69.4%). Weak but statistically significant associations were observed between sensing preferences and mnemonic use ($p=0.043$), and between sequential preferences and moderate Anki use ($p=0.037$). There was a slight tendency for sensing learners to favor mnemonics, while sequential learners favored structured instruments like Anki. These findings suggest limited associations between certain learning style preferences and self-reported study strategies. Further research incorporating academic performance outcomes is needed before educational recommendations can be made.

Keywords: learning preferences; study strategies; self-directed learning; pre-clerkship medical students; spaced repetition

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1. Introduction

The quality of medical education is essential, as it directly influences the competence, adaptability, and lifelong learning abilities of future physicians (Mullan, 2003; Hawk & Shah, 2007). There is growing interest in learner-centered approaches to education, as traditional “one-size-fits-all” methods may not adequately address the diverse learning preferences and educational needs of medical students (Hawk & Shah, 2007). Understanding differences in how students approach learning may help educators better understand learner behaviors and support student engagement and academic development (du Plooy et al., 2024).

Several educational theories have contributed to understanding how individuals learn and process information. For instance, Kolb's experiential learning theory conceptualizes learning as a dynamic process involving four stages: concrete experience, reflective observation, abstract conceptualization, and active experimentation (Kolb, 2015). The theory proposes that learners may demonstrate preferences for different approaches to acquiring and processing knowledge. Constructivist theory further suggests that learners actively build understanding through interactions between new information, prior knowledge, and the learning environment (Wiyono et al., 2025). Cognitive learning theories focus on internal mental processes involved in learning, including attention, perception, encoding, and retrieval of information (Wiyono et al., 2025; Krahenbuhl, 2016). Related theories, such as dual coding theory emphasize the processing of visual and verbal information (Clark & Paivio, 1991),

while information processing theory examines how learners organize, sequence, and integrate new knowledge (Gordon & Woods, 2021). Collectively, these theories provide a framework for understanding variation in learning preferences and educational experiences.

The Index of Learning Styles (ILS), developed by Richard Felder, Linda Silverman, and Barbara Solomon, is a widely used instrument for assessing learning preferences across four dimensions: active versus reflective, sensing versus intuitive, visual versus verbal, and sequential versus global (Soloman & Felder, 1999). These dimensions describe different ways in which learners may prefer to receive, process, and organize information. The active-reflective dimension reflects preferences for learning through engagement and application versus reflection and introspection. The sensing-intuitive dimension describes preferences for concrete facts versus conceptual or abstract information. The visual-verbal dimension addresses preferences for visual or language-based representations of information, while the sequential-global dimension relates to stepwise versus holistic approaches to understanding knowledge.

Study strategies represent an important component of self-directed learning and academic success in medical education. Medical students commonly employ repetition-based methods (e.g., Anki and Quizlet), elaborative techniques such as self-explanation and summarization, practice testing, group discussion, and visual learning tools such as diagrams and concept maps. The effectiveness of these strategies varies, with retrieval practice and spaced repetition generally demonstrating stronger evidence for learning outcomes than passive strategies such as rereading or highlighting when used alone (Dunlosky et al., 2013; Ferguson et al., 2002; Briscoe et al., 2009; Mehta et al., 2023; Kortz et al., 2022). Exploring the relationship between learning preferences and study strategies may provide insight into how students approach learning and organize their independent study activities.

While learning preferences and study strategies have been examined in educational research, relatively little is known about these factors among Caribbean medical students, who often represent diverse educational, cultural, and geographic backgrounds. Understanding how students in this setting describe their learning preferences and utilize study strategies may provide context-specific insights into self-directed learning within medical education. Therefore, this study aimed to describe learning preferences using the ILS and examine associations between these preferences and the study strategies used by basic sciences students at Saint James School of Medicine (SJSJ), a Caribbean medical school.

2. Materials and Methods

2.1. Population and Sampling

The study population comprised 320 students enrolled in the Basic Sciences Program at SJSJ during the Summer 2025 academic semester. Sample size estimation was performed using a confidence level of 95%, a margin of error of 5%, and a population size of 320 students. The minimum required sample size was calculated to be 118 participants. A total of 124 students completed the questionnaire, exceeding the minimum sample size requirement.

Eligibility was limited to first- and second-year students enrolled in the Basic Sciences Program at SJSJ. Clinical sciences students were excluded because of differences in educational environment and curriculum structure. Participation was voluntary, and all responses were collected anonymously to maintain confidentiality.

2.2. Questionnaire Development

The primary instrument was the ILS, consisting of 44 forced-choice items distributed across four dimensions: active versus reflective, sensing versus intuitive, visual versus verbal, and sequential versus global. The questionnaire also collected demographic information, including gender, academic level, previous education, healthcare experience, and average weekly study hours.

A third section assessed students' study strategies. Participants rated five study approaches on a 5-point Likert scale ranging from "never" to "extensively": (a) practice testing (e.g., multiple-choice and USMLE-style questions), (b) spaced repetition (e.g., Anki and Quizlet), (c) mnemonics (e.g., SketchyMed, Picmonic, or self-generated mnemonics), (d) concept mapping, and (e) reading and summarization. The purpose of this section was to evaluate the use of commonly employed study strategies in medical education and examine

their associations with learning preferences.

The ILS questionnaire has established validity and reliability as reported by its developers (Zywno, 2003). The structure and wording of the original ILS items were not modified. The study-strategy section was developed by the investigators to reflect commonly used, evidence-informed study strategies in medical education and was reviewed for clarity, relevance, and wording prior to distribution.

2.3. Questionnaire Dissemination and Data Collection

The final questionnaire was distributed electronically through Google Forms to all eligible students enrolled in the Basic Sciences Program at SJSU. Data collection was conducted over a three-month period from March 2025 to June 2025, allowing sufficient time for participation and follow-up reminders.

The survey included an informed consent statement describing the purpose of the study, the voluntary nature of participation, and measures taken to ensure anonymity and confidentiality. Of the 320 eligible students, 124 completed the questionnaire, corresponding to a response rate of 38.8%.

2.4. Data Analysis

Following data collection, responses were transferred into IBM SPSS Version 31 for statistical analysis. Descriptive statistics were used to summarize demographic characteristics, learning preferences, and study strategies. Each ILS item was numerically coded, and scores were calculated for the four learning preference dimensions. Responses to study-strategy items were recorded on a 5-point Likert scale ranging from 1 (“never”) to 5 (“extensively”).

Associations between demographic variables, learning preferences, and study strategies were examined using chi-square (χ^2) tests of independence. Categorical variables were summarized using frequencies and percentages. Given the exploratory nature of the study, statistical significance was defined as a two-tailed p-value ≤ 0.05 .

3. Results

3.1. Participants' Demographics

A total of 124 students completed the questionnaire. Participants included 57 males (46.0%) and 67 females (54.0%). Age distribution was as follows: ≤ 25 years (32.2%), 26–35 years (37.9%), and > 35 years (29.8%). More participants were in their first year (54.8%) than in the second year (45.2%). Approximately 62.9% of respondents held a bachelor's degree as their highest educational qualification.

Regarding healthcare experience, 21.8% of participants reported no prior healthcare experience, 45.9% reported ≤ 5 years of experience, 17.6% reported 6–10 years, and 14.5% reported more than 10 years. Average weekly study hours varied, with 38.7% studying ≤ 20 hours per week, 30.6% studying 21–30 hours per week, and 30.6% studying more than 30 hours per week. Additional demographic characteristics are presented in table 1.

Table 1. Demographic characteristics of participants.

Characteristic	n (%)
Total participants	124 (100.0%)
Gender	
Male	57 (46.0%)
Female	67 (54.0%)
Age	
≤ 25 years	40 (32.2%)
26–35 years	47 (37.9%)
> 35 years	37 (29.8%)
Current MD basic sciences level	
First-year	68 (54.8%)
Second-year	56 (45.2%)
Highest educational attainment	
Pre-medicine courses	12 (9.7%)
Bachelor's degree	78 (62.9%)

Master's degree	24 (19.4%)
Ph.D. / Professional doctorate	8 (6.5%)
Other	2 (1.6%)
Previous healthcare experience	
None	27 (21.8%)
≤5 years	57 (45.9%)
6–10 years	22 (17.6%)
>10 years	18 (14.5%)
Average study hours per week	
≤20 hours	48 (38.7%)
21–30 hours	38 (30.6%)
>30 hours	38 (30.6%)

3.2. Study & Review Strategies and Habits

Participants demonstrated variability in their use of study strategies, as summarized in table 2. Overall, USMLE step 1-style questions and reading and summarization were among the most utilized study strategies, whereas concept mapping was the least frequently used.

Table 2. Study strategy utilization among basic sciences medical students (n=124).

Study strategy	Never n (%)	Rarely n (%)	Moderately n (%)	Frequently n (%)	Extensively n (%)
Anki	22 (17.7%)	48 (38.7%)	31 (25.0%)	15 (12.1%)	8 (6.5%)
USMLE step 1-style questions	9 (7.3%)	10 (8.1%)	45 (36.3%)	42 (33.9%)	18 (14.5%)
Concept mapping	62 (50.0%)	23 (18.5%)	26 (21.0%)	12 (9.7%)	1 (0.8%)
Mnemonics	17 (13.7%)	29 (23.4%)	37 (29.8%)	31 (25.0%)	10 (8.1%)
Reading and summarization	4 (3.2%)	19 (15.3%)	42 (33.9%)	37 (29.8%)	22 (17.7%)

USMLE step 1-style questions were widely used, with only 9 participants (7.3%) reporting that they never used them and 10 (8.1%) reporting rare use. Most participants reported moderate (36.3%), frequent (33.9%), or extensive (14.5%) use. In contrast, Anki was used less frequently, with 17.7% of participants reporting that they never used it and 38.7% reporting rare use. Moderate, frequent, and extensive use of Anki was reported by 25.0%, 12.1%, and 6.5% of participants, respectively.

Concept mapping was the least utilized study strategy, with 50.0% of participants reporting that they never used it and 0.8% reporting extensive use. Mnemonics demonstrated a more balanced pattern of use, with 13.7% of participants reporting that they never used them and 8.1% reporting extensive use.

Reading and summarization was commonly employed, with only 3.2% of participants reporting that they never used this strategy and 15.3% reporting rare use. Approximately one-third of participants reported moderate use (33.9%), while 29.8% and 17.7% reported frequent and extensive use, respectively.

The use of study strategies was further examined across participant characteristics. Overall, no statistically significant differences were observed in study-strategy utilization based on gender, age group, highest educational attainment, or previous healthcare experience ($p > 0.05$). However, use of USMLE Step 1-style questions differed significantly by academic level. Second-year students reported more frequent and extensive use of practice questions compared with first-year students, who more commonly reported moderate use ($p = 0.013$). In addition, students who reported more frequent use of USMLE Step 1-style questions tended to report higher weekly study hours than those who used practice questions less frequently ($p = 0.045$). Similarly, students who reported frequent use of reading and summarization tended to report higher weekly study hours than those who reported rare or no use of this strategy ($p = 0.050$).

3.3. Learning Styles

The ILS classifies learning preferences across four dimensions: active-reflective, visual-

verbal, sensing-intuitive, and sequential-global. Overall, participants demonstrated a tendency toward active, visual, sensing, and sequential learning preferences.

In the active-reflective dimension, 70 students (56.5%) were classified as active learners, whereas 54 (43.5%) were classified as reflective learners. In the visual-verbal dimension, 99 participants (79.8%) demonstrated a preference for visual learning, compared with 25 (20.2%) who preferred verbal learning. For the sensing-intuitive dimension, 101 students (81.5%) were classified as sensing learners and 23 (18.5%) as Intuitive learners. In the sequential-global dimension, 67 participants (54.0%) demonstrated a preference for sequential learning, while 56 (45.2%) preferred Global learning.

A chi-square test of independence was conducted to examine associations between demographic characteristics and learning-style preferences. Among the demographic variables examined, current academic level was significantly associated with the active-reflective dimension, $\chi^2(1, N = 124) = 10.739, p = 0.031$. Further analysis using a z-test for proportions demonstrated a greater preference for active learning among first-year students compared with second-year students (70% versus 40%), $z = 2.50, p = 0.012$.

A significant association was also observed between gender and the visual-verbal dimension, $\chi^2(1, N = 124) = 6.084, p = 0.014$. Female participants were more likely to demonstrate a Visual learning preference than male participants (54% versus 46%), $z = 2.67, p = 0.050$.

In addition, highest educational attainment was significantly associated with the sequential-global dimension, $\chi^2(4, N = 124) = 10.638, p = 0.031$. Participants holding a master's degree demonstrated a greater preference for global learning compared with non-graduates, $z = 2.19, p = 0.028$.

No other statistically significant associations were identified between demographic variables and the four ILS learning-style dimensions.

3.4. Association between Learning Styles and Study Strategies

A chi-square test of independence was conducted to examine associations between learning-style preferences and study strategies. A significant association was observed between the sensing-intuitive dimension and the use of mnemonics, $\chi^2(1, N = 124) = 4.754, p = 0.043$. Among participants who reported frequent or extensive use of mnemonics, 84.6% were classified as Sensing learners, compared with 15.4% who were classified as intuitive learners.

A significant association was also identified between the sequential-global dimension and Anki use, $\chi^2(2, N = 124) = 6.621, p = 0.037$. Specifically, 61.3% of sequential learners reported moderate use of Anki, compared with 38.7% of Global learners. However, no significant differences were observed between Sequential and Global learners with respect to low or high levels of Anki use.

No statistically significant associations were identified between study strategies and the active-reflective or visual-verbal learning-style dimensions. Additional details regarding the associations between learning-style preferences and study strategies are presented in table 3.

Table 3. Associations between learning style dimensions and study strategies.

Learning style dimension	Study strategy	Chi-square (χ^2)	p-value	Notes
Active-reflective	Anki	0.491	0.782	–
	USMLE step 1-style questions	1.930	0.381	–
	Concept mapping	0.199	0.905	–
	Mnemonics	3.509	0.173	–
	Reading and summarization	0.499	0.778	–
Visual-verbal	Anki	0.419	0.811	–
	USMLE step 1-style questions	0.011	0.994	–
	Concept mapping	0.235	0.881	–
	Mnemonics	1.500	0.472	–
	Reading and summarization	1.223	0.543	–

Sensing-intuitive	Anki	1.634	0.422	–
	USMLE step 1-style questions	0.956	0.585	–
	Concept mapping	0.377	0.828	–
	Mnemonics	4.754	0.043*	84.6% of sensing learners reported frequent or extensive use of mnemonics compared with 15.4% of intuitive learners.
	Reading and summarization	3.523	0.172	–
Sequential-global	Anki	6.621	0.037*	61.3% of sequential learners reported moderate use of Anki compared with 38.7% of global learners.
	USMLE step 1-style questions	2.466	0.177	–
	Concept mapping	3.011	0.222	–
	Mnemonics	2.510	0.285	–
	Reading and summarization	0.230	0.892	–

Note: $p < 0.05$. Chi-square (χ^2) tests of independence were used to examine associations between learning-style dimensions and study strategies.

Based on the results obtained, it is possible to conclude that there were certain links between the learning style preferences and the selected demographic characteristics or study strategies, but those were not very strong. Most of the students exhibited a preference for visual, sensing, active, and sequential learning. Also, the USMLE step 1-type practice questions and reading/summarizing were found to be the most popular study strategies. It should be noted that increased use of the mentioned study strategies correlated with higher weekly study hours, as well as with greater use of practice questions by second-year compared to first-year students. At the same time, the small number of significant connections between the learning style preferences and study strategies suggests that the students might use various approaches to studying regardless of their preferences.

4. Discussion

This study examined associations between learning preferences, as measured by the ILS, and study strategies among pre-clerkship students at a Caribbean medical school. The findings contribute to the limited literature on learning preferences and study behaviors among Caribbean medical students and provide context-specific insights into self-directed learning within an international medical education setting. To our knowledge, relatively few studies have explored learning preferences and study strategies simultaneously within this population.

Overall, participants demonstrated preferences for active, visual, sensing, and sequential learning. The most utilized study strategies were USMLE step 1-style practice questions and reading and summarization, whereas concept mapping was the least frequently used. These findings are broadly consistent with previous studies reporting widespread use of practice questions and reading-based study methods among medical students (Sheehy et al., 2024; Zalman et al., 2024).

Although Anki and other spaced-repetition tools have been associated with improved learning outcomes and academic performance in medical education (Gilbert et al., 2023), utilization among participants was generally moderate. This finding may reflect the mixed perceptions surrounding spaced-repetition tools, as recent studies have reported both educational benefits and potential limitations depending on patterns of use, learner engagement, and integration with other study strategies (Niroula & Niroula, 2020; Goldman et al., 2024). Mnemonics were also used moderately despite evidence supporting their effectiveness for improving recall and retention of information (Meenu et al., 2022). Concept mapping was the least frequently utilized strategy despite growing evidence suggesting

benefits for critical thinking, knowledge integration, and academic performance (Baliga et al., 2021; Fonseca et al., 2024; Srikantaiah et al., 2025). The reasons underlying the limited use of concept mapping were not explored in the present study and warrant further investigation through qualitative research.

The predominance of Visual learning preferences observed in this study is consistent with findings reported among medical students in several international settings, including Ireland, Saudi Arabia, Central Asia, and Romania (Hernández-Torrano et al., 2017; Alfahid et al., 2022; Rahim et al., 2019; Buşan, 2014). Although a study from Turkey reported a lower prevalence of visual learning preferences, methodological differences in the classification of learning styles may partly explain this discrepancy (Baykan & Naçar, 2007). Similarly, the distribution of Active and Reflective learning preferences observed in our study was broadly comparable to findings reported in previous medical education studies utilizing the ILS framework (Rahim et al., 2019).

Most participants in the present study were classified as sensing learners. This finding may reflect the emphasis placed on factual knowledge, clinical recall, and structured learning within pre-clerkship medical curricula. Sensing learners typically prefer concrete information, practical applications, and stepwise approaches to learning, characteristics that align with the demands of foundational medical sciences education (Samarakoon et al., 2013). In contrast, disciplines that emphasize abstract reasoning and theoretical problem-solving, such as mathematics and engineering, may demonstrate greater representation of intuitive learning preferences (Coto Jiménez, 2019).

Within the sequential-global dimension, our findings demonstrated a relatively balanced distribution between sequential and global learners. Previous studies conducted in the United States, Turkey, and South Asia have generally reported a stronger preference for sequential learning among medical students (Baykan & Naçar, 2007; Charkins et al., 1985; Wehrwein et al., 2007). The more balanced distribution observed in the current study may reflect the diverse educational and cultural backgrounds of Caribbean medical students, many of whom enter medical school with prior university education or international academic experience. It may also reflect increasing emphasis on integrated and clinically contextualized curricula that encourage broader conceptual understanding alongside sequential knowledge acquisition.

Two statistically significant associations were identified between learning preferences and study strategies. First, the sensing-intuitive dimension was associated with mnemonic use, with sensing learners more likely to report frequent or extensive use of mnemonics. This finding is conceptually consistent with the preference of Sensing learners for factual, practical, and detail-oriented information (Samarakoon et al., 2013). Mnemonics serve as effective memory aids for discrete information such as anatomy, pharmacology, and biochemistry, making them particularly attractive to learners who favor structured factual recall (Meenu et al., 2022).

Second, the sequential-global dimension was associated with moderate Anki use, with Sequential learners reporting greater utilization than global learners. Given the structured, incremental, and repetitive nature of flashcard-based learning systems, this association is theoretically plausible. Previous research has similarly suggested that sequential learners often favor organized and systematic learning environments (Wehrwein et al., 2007). However, it is important to note that this association was observed only for moderate Anki use and was not evident across all levels of utilization.

No statistically significant associations were identified between study strategies and either the active-reflective or visual-verbal dimensions. This finding may suggest that study strategy selection is influenced less by learning preferences and more by external factors such as curriculum structure, assessment demands, peer recommendations, and the perceived effectiveness of specific study tools. Consistent with previous reports, students may adopt study methods primarily because they are viewed as useful and practical rather than because they align with a particular learning preference (Lujan & DiCarlo, 2006).

This study has several strengths. It provides data from an underrepresented population within medical education research and contributes novel information regarding learning preferences and study strategies among Caribbean medical students. In addition, the final sample exceeded the minimum calculated sample size required for the study. The use of the ILS, a widely utilized and validated instrument in STEM and health professions education,

further strengthens the methodological rigor of the investigation (Zywno, 2003).

Several limitations should also be acknowledged. First, the study relied on self-reported questionnaire data and is therefore subject to reporting bias. Although anonymity was maintained to encourage honest responses, self-report bias cannot be entirely excluded. Second, the study was conducted at a single institution, which may limit the generalizability of the findings to other Caribbean or international medical schools with different student populations, curricula, or educational environments. Third, the cross-sectional design precludes conclusions regarding causality between learning preferences and study strategies. Fourth, multiple statistical comparisons were performed, increasing the possibility of type I error. Consequently, statistically significant findings should be interpreted cautiously and confirmed in future studies. Finally, the study did not include measures of academic performance, examination outcomes, or learning effectiveness. Therefore, no conclusions can be drawn regarding whether specific learning preferences or study strategies were associated with superior academic achievement.

Future research should explore these relationships across multiple Caribbean medical schools and incorporate objective measures of academic performance. Qualitative approaches, including interviews and focus groups, may also provide deeper insight into the factors influencing students' selection of study strategies and their perceptions of learning preferences. Such work may help clarify whether learning preferences have practical implications for academic support and educational design within medical education.

5. Conclusions

This study was the first study to address the relationship between learning styles and learning strategies among pre-clerkship medical students. Students in pre-clerkship of Saint James School of Medicine in the Caribbean had significant preferences for Active, Visual, Sensing, and Sequential learning styles, implying that the majority of participants preferred experience, visual perception, concrete knowledge, and step-by-step learning. In terms of the examined learning techniques, USMLE step 1 practice questions and reading and summarizing were most often used by the participants, while concept mapping was least often used. The participants in the second year reported using USMLE Step 1 practice questions more frequently than those in the first year, and an increased number of hours spent studying each week correlated with increased frequency of USMLE step 1 practice questions and reading and summarizing. Furthermore, there were significant associations between the preferences of the participants in terms of the style of learning and demographic variables, namely academic level, gender, and highest education level attained. More specifically, first-year participants preferred active learning, females preferred visual learning, and participants who had obtained a master's degree preferred global learning.

These findings contribute to the limited literature examining learning preferences and study strategies among Caribbean medical students and provide context-specific insights into self-directed learning within medical education. While certain learning preferences were associated with particular study strategies, broader influences such as curriculum structure, assessment demands, and perceived effectiveness of study methods may also play important roles in shaping students' learning behaviors. Such results confirm the idea that study habits of medical students are rather determined by curriculum requirements than by their learning styles. Additionally, the study provides baseline data that can be useful for designing programs aimed at learners' assistance and multicenter studies devoted to the study habits – learning styles-academic success relationship. Further multicenter studies incorporating academic performance outcomes are needed to better understand the educational significance of these relationships.

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