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St. Paul's Hospital Millennium Medical College

**SCHOOL OF MEDICINE
UNDERGRADUATE STUDY PROGRAM**

**Knowledge, Attitude, and Practice of Active Recall and Spaced
Repetition among Medical Students at St Paul Hospital Millennium
Medical College , Addis Ababa, Ethiopia**

Addis Ababa, Ethiopia

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St. Paul's Hospital Millennium Medical College

School of medicine

Undergraduate Study Program

Knowledge, Attitude and Practice of learning concepts of active recall and spaced repetition among medical students of St Paul Hospital Millennium Medical College , Addis Ababa, Ethiopia, 2025

A Student Research paper to be submitted to St. Paul's Hospital Millennium Medical College, School of Public Health in Partial Fulfillment of the requirements for the Degree of Doctor of Medicine (MD)

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Abbreviations

ART: antiretroviral therapy

ENT: ear nose and throat

ICU: intensive care unit

SPHMMC: Saint Paul's Hospital Millennium Medical College

Abstract

Background: Active recall and spaced repetition are evidence-based learning strategies proven to enhance long-term retention and academic performance in medical education. Despite their efficacy, these techniques remain underutilized globally, particularly in settings where formal instruction on study skills is absent.

Objectives: This study aimed to assess the knowledge, attitudes, and practices of active recall and spaced repetition among undergraduate medical students at St. Paul's Hospital Millennium Medical College, Addis Ababa, Ethiopia.

Methods: A cross-sectional study (September–November 2025) included 261 medical students selected through simple random sampling. Data were collected via a structured, self-administered questionnaire adapted from validated tools and analyzed using SPSS v27. Knowledge, attitude, and practice were categorized using predefined criteria, with results summarized using descriptive statistics (frequencies and percentages)

Results: Participants were predominantly female (59.4%) and aged 21–23 years (50.2%), with 80.1% reporting no prior formal training in study strategies. Knowledge levels were low: only 31.8% demonstrated adequate understanding of active recall and 33.7% of spaced repetition, while over half were classified as not knowledgeable. Although 82.7% theoretically recognized the strategies' effectiveness, only 25.7% held a positive overall attitude, largely due to perceived cognitive effort and time demands. Practice patterns revealed a significant theory–practice gap: 46.4% reported low use of active recall, while 55.9% reported high spaced repetition use—a figure likely inflated by misconceptions, as 76.2% still relied on massed cramming. Chi-square analyses indicated that clinical-year progression and prior formal training were significantly associated with improved KAP scores ($p < 0.001$)

Conclusion: Despite recognizing their value, St. Paul's Hospital Millennium Medical College medical students show limited knowledge and inconsistent use of evidence-based strategies, with moderate underuse of active recall and spaced repetition. This likely stems from lack of formal training and misconceptions about effort and feasibility. The findings highlight the need to integrate structured learning-skills training into the curriculum, adding workshops and peer led sessions to bridge the gap between awareness and effective practice.

Keywords: Students, Medical, Active recall/ Spaced repetition, Evidence based practice, Knowledge, Attitude, Practice.

1. Introduction

1.1 Background of study

Learning is fundamental to medical education, underpinning both clinical competence and lifelong professional development. As medical knowledge continues to expand, the need for efficient and effective learning strategies becomes increasingly critical. Active recall and spaced repetition have attracted considerable attention for over a century. Since the early 20th century, extensive research has consistently shown that these methods improve memory retention and promote deeper understanding of learned material.(1).

Learning is composed of two interlinked but distinct steps: the memorization of factual knowledge and the subsequent application of that knowledge in new or unfamiliar contexts. In evaluating learning outcomes, two key terms are commonly used knowledge retention and knowledge transfer. Knowledge retention refers to the ability to store and recall information, whereas knowledge transfer denotes the capacity to apply acquired knowledge to novel situations, reflecting a deeper and more flexible understanding of the material(1). Importantly, effective transfer depends on a foundation of retained knowledge; failure to transfer can result either from an inability to recall previously learned information, a failure to connect prior knowledge to the present context, or both (2). While application and reasoning are essential to medical problem solving, memorization remains a fundamental first step. It enables the construction of a robust knowledge base necessary for more complex cognitive processes such as analysis and synthesis (3).

Spaced repetition is a learning strategy that involves reviewing information at progressively increasing intervals to improve long-term retention. Effective learning typically requires repeated exposure to material rather than a single encounter. Importantly, research indicates that the timing of these repetitions is critical; even when total study time is equivalent, distributed practice over time yields significantly better performance than massed practice in a single session. (4). Remarkably, even spacing study sessions across a single day can lead to substantial improvements

in retention. In a typical study design on the spacing effect, two groups receive the same amount of practice either massed (closely spaced) or spaced (distributed) with spaced practice consistently leading to superior performance on later assessments. The benefits of spaced repetition have been demonstrated across a wide range of age groups and educational levels, from preschool children to postgraduate learners. It has proven effective in various domains, including anatomy (5), statistics (6), cardiopulmonary resuscitation (CPR) skills (7), and clinical urology education (8). Although it is not possible to recommend a universally optimal spacing schedule, effective strategies usually include sufficient engagement with the material during each session, and spacing the sessions so that information is still familiar but no longer fresh in the mind. This delicate balance appears to support memory consolidation and long-term recall. Furthermore, the positive effects of spacing are not only long-lasting (4), but have also been shown to enhance higher-order thinking skills such as critical evaluation in school-aged children just 30 days after practice (9). For instance, reviewing a course the day after initially studying it while the material is still fresh tends to yield minimal benefits compared to revisiting the same content a week later, when the specific details have faded but the general understanding remains. Despite equal study durations, the latter approach is significantly more effective for long-term retention.

Although it may seem counterintuitive, active recall is a highly effective learning strategy that enhances both memory and understanding. Unlike passive methods such as rereading or highlighting, it requires active retrieval of information from memory. For example, rather than repeatedly reviewing a textbook, a more effective approach is to study it once and then recall the key points. Compared with non-retrieval strategies, such as rereading or note review, retrieval-based methods consistently produce more durable and accessible memories, a finding strongly supported by numerous studies and meta-analyses demonstrating significant improvements in memory retention.(10,11), and similarly strong effects for knowledge transfer (12,13). In a typical study of retrieval practice, participants first learn material and are then assigned either to a restudy condition or a retrieval condition. After a delay, those who practiced retrieval generally outperform their peers in tests of both recall and application. This growing body of evidence highlights that retrieval is not merely a test of learning it is a powerful *means* of learning in itself.

1.2. Statement of problem

Evidence from cognitive psychology highlights active recall and spaced repetition as highly effective strategies for enhancing long-term retention and knowledge transfer. Active recall entails retrieving information from memory without consulting source materials, whereas spaced repetition involves reviewing content at progressively increasing intervals. Despite strong empirical support, many students misunderstand the application of these methods. For instance, studies conducted at the University of California, Los Angeles indicate that although approximately 70% of students report using self-testing, they primarily perceive it as a means of assessing knowledge rather than as a strategy for strengthening memory.(14,15). In addition, students often perceive active recall as more difficult than rereading because it requires greater mental effort, leading them to incorrectly assume that it is less effective (16,17). This misunderstanding can discourage students from using strategies that are actually more beneficial for learning.

Failure to apply evidence-based learning strategies may negatively affect students' academic achievement. Research shows that effortful retrieval significantly improves long-term recall of information compared with passive review methods (5). Similarly, spaced education has been shown to significantly improve composite end-of-year test scores among students (8,18). Studies conducted in real-world classroom settings have also demonstrated that the spacing effect enhances both factual learning and critical thinking skills (9). When students do not use these strategies, they may lose these potential advantages, resulting in poorer long-term retention of knowledge, reduced academic performance, and greater difficulty applying learned information in new situations.

Although extensive research has demonstrated the effectiveness of active recall and spaced repetition in improving learning and long-term retention (1,7,19,20), most of this evidence comes from studies conducted in Western educational settings and general university populations. There is limited research examining the knowledge, attitudes, and practice of these evidence-based learning strategies among medical students in low- and middle-income countries, including Ethiopia.(21,22).

1.3. Rationale and Significance of the Study

In modern medical education, the volume of knowledge students must acquire is rapidly expanding due to continuous advancements in technology, diagnostic tools, imaging techniques, and clinical expectations. While these developments improve healthcare delivery, they also intensify academic pressure, making learning increasingly demanding and stressful. Consequently, the use of efficient, evidence-based strategies such as active recall and spaced repetition has become essential for managing workload, reducing stress, and promoting long-term retention of medical knowledge. Despite these challenges, most higher education institutions, including medical schools, do not provide formal instruction on effective study techniques, leaving students to rely on trial and error. This gap may partly arise from limited faculty training or resistance to adopting new teaching approaches (23), ultimately contributing to inefficient learning, poorer academic performance, and increased stress.

This situation raises critical questions regarding medical students' awareness, attitudes, and use of active recall and spaced repetition as learning strategies. Even when students are familiar with these methods, their adoption may be limited by uncertainty, perceived difficulty, or time constraints within an already demanding curriculum. Attitudes toward these strategies play a key role in determining their consistent use, and without adequate guidance or support, students may not implement them effectively. Furthermore, the lack of local evidence assessing the knowledge, attitude, and practice of these strategies among medical students at SPHMMC, Addis Ababa, Ethiopia, represents a significant gap in understanding. Therefore, this study aims to assess the knowledge, attitude, and practice of active recall and spaced repetition as learning strategies among medical students at SPHMMC. Identifying this gap is essential, as inadequate use of evidence-based learning strategies may represent a missed opportunity to improve learning outcomes, reduce burnout, and enhance long-term retention, ultimately strengthening the training of future healthcare professionals.

2. Literature review

2.1. Theoretical Foundations

Retrieval practice has demonstrated long-term benefits, with studies showing improvements in memory retention that can last anywhere from nine months to as long as eight years (20). Its effectiveness is further enhanced when paired with feedback informing learners whether their recalled responses are correct or incorrect. This combination not only reinforces correct information but also helps fill in knowledge gaps and correct misconceptions (18,24). The utility of retrieval practice spans across a wide array of academic disciplines and educational levels. For example, it has been shown to improve learning outcomes in anatomy (25), biology (26), and neuroscience (27), and psychology courses (28). Moreover, various retrieval formats have proven effective, including multiple-choice questions, short answer questions, cued recall, free recall, and clinical scenario-based assessments. In one study, the use of clinical case questions with feedback significantly enhanced retention of orthodontic procedures (29). Among newer strategies, digital flashcards have emerged as a convenient and efficient way to implement retrieval practice, especially in large-scale or self-directed learning environments (26). This modern adaptation leverages technology to provide immediate feedback and spaced repetition, making it a powerful tool for consolidating memory and enhancing learning over time.

Combining the benefits of retrieval practice with spaced intervals leads to even greater learning gains than using retrieval alone over the same time frame(30). This synergy forms the foundation of a powerful learning technique known as successive relearning. In this approach, learners first engage in a session where they repeatedly attempt to recall information until they reach a predetermined level of mastery such as 100% accuracy while receiving feedback after each attempt to ensure correctness. These retrieval sessions are then repeated over spaced intervals, with each session requiring learners to again retrieve the material to the same performance criterion (31). The repeated and spaced retrieval not only reinforces memory but also enhances the ability to transfer and apply knowledge in new contexts. Evidence consistently shows that long-term learning and retention are optimized when relearning sessions are distributed over time, making successive relearning one of the most potent, yet underutilized, strategies in educational practice.

2.2 Knowledge, Attitude, and Practice of Active recall

Many students do not fully understand the direct benefits of using active recall in their studies. A survey of university students in UCLA found that over 70% often test themselves with questions or practice problems, and more than 60% often read their notes or textbooks again as part of their studying. However, when asked why they test themselves, most said it was mainly to check how well they already know the material, not to actually help them remember it for longer (14,15). This shows that many students see self-testing as a way to measure their learning rather than a way to improve it. Research also shows that students often do not know how to use retrieval practice in the most effective way. For example, many stop testing themselves as soon as they get a few answers right, instead of continuing until they can recall the correct answer most of the time. They also find it hard to judge their own learning without feedback from teachers or answer keys, which means they may not notice if they are remembering the wrong information. Another problem is that students may not know how to use testing and feedback techniques in different subjects or types of learning tasks, even though these strategies can help in many areas (32). Because of these gaps in knowledge, students may miss out on the full benefits of active recall and spaced repetition.

Similarly, many students think of active recall as harder than just rereading notes, and this affects how often they use it. In one study, students said that trying to recall information took more mental effort than simply reading it again (16). Because it felt harder, majority of students wrongly believed that active recall was a less effective way to study (17). This misunderstanding fits with a common pattern: when learning feels more difficult, students often think they will remember less, even though research shows that more effort can lead to better learning. A meta-analysis also showed that when students put in more effort, they often give themselves lower ratings for how well they think they will remember the material, even if the extra effort improves results (33). This negative view of effort strongly affects study choices. When students had to choose how to prepare for a test, most (about 69%) chose to reread instead of using active recall (17). Their main reason was the belief that active recall was less effective a belief directly linked to how much mental effort it seemed to require. This shows that attitudes about effort can keep students from using active recall, even though it is proven to help learning.

Empirical evidence supports the effectiveness of retrieval practice for learning, yet students often underuse it. A literature review on active recall found that while many acknowledge the value

of self-testing, they still prefer less effortful strategies such as rereading, and their engagement with retrieval is limited. In practice, students frequently overlook available retrieval tools. For example, in a study offering optional online practice quizzes, fewer than 15% participated. Among users, 55% aimed to assess knowledge, while 40% of non-users cited alternative study methods or a perceived lack of need. Many completed the quizzes only shortly before exams, indicating they were used primarily as a last-minute check rather than a sustained learning strategy (34). Self-regulated learning experiments show similar trends. Students often choose retrieval but discontinue after a single correct recall instead of practicing to mastery (32). Survey data reveal that 84% report rereading, 40% use flashcards, and only 11% explicitly engage in testing as a study technique (35). Overall, retrieval practice remains recognized but underutilized in real learning contexts(36).

2.3. Knowledge, Attitude and Practice of Spaced repetition

An early web-based survey among undergraduate students found that most participants (84.9%) believed that spreading study sessions over time gives better results for long-term memory, compared to cramming in a single sitting. Only 5.8% thought studying in one continuous session was more effective, while 9.3% believed both methods were equally good for retention (35). A more recent replication–extension study confirmed these findings, showing that 91.6% of students recognized spaced study as the more effective method, 1.1% believed cramming was better, and 7.4% rated both strategies equally effective (37). These results suggest that most students have accurate knowledge about the benefits of spaced repetition. However, the persistence of a small group favoring cramming highlights that awareness alone may not guarantee the use of the most effective study habits.

A quasi-experimental study among 51 nursing students compared spaced learning with traditional teaching methods. While there was no significant difference in evaluation scores between the two groups, students in the spaced learning group rated the quality of education significantly higher showing positive attitude towards spacing. This suggests that even if spaced repetition does not always lead to immediate score improvements, students may still view it as a more valuable and effective learning experience. Another study integrated spaced learning with team based learning to improve engagement in a large first-year class (19). This approach included individual preparation, in class tests, and breaks with physical activities to keep students alert and

improve retention. Both quantitative and qualitative feedback showed that students valued this method, reporting better understanding, more enjoyment, and greater engagement compared to traditional lectures. Positive attitudes were linked to active participation and supportive teacher interactions, though some students recommended shorter pre-class materials and improved assessments. Overall, these findings indicate that students generally have a favorable attitude toward spaced repetition, especially when it is combined with other active learning strategies. (38).

Research shows that although most students understand the benefits of spaced study, their actual use of it is limited. In one study, 84.9% of participants recognized spaced study as effective for long-term retention, yet it was only ranked sixth among their most commonly used study strategies ($M = 3.24$), just slightly ahead of massed study ($M = 2.93$). Decisions on whether to space or cram were influenced by factors such as workload, confidence, interest in the subject, and the stakes of the assessment. Interestingly, community college students reported more study days than their peers at four-year universities. This points to a clear gap between awareness and practice, emphasizing the need to better understand the cognitive mechanisms behind the spacing effect to encourage broader adoption. A semester-long behavioral study in a college course provided further insight. (36) By tracking students' actual study patterns daily, researchers found that most underutilized spacing, often spreading their study over only a few days. Optional, non-graded study tools were rarely used, whereas nearly all students used required resources at least once. Crucially, the degree of self-selected spacing strongly predicted both course-specific and overall college grades. These findings suggest that while spaced repetition is linked to better academic performance, students often fail to implement it without structured requirements or incentives. (39)

3. Objectives of study

3.1. General objective

To assess the knowledge, attitude, and practice of active recall and spaced repetition as learning strategies among medical students at St Paul Hospital Millennium Medical College, Addis Ababa, Ethiopia in 2026.

3.2. Specific objectives

1. To assess the knowledge of active recall and spaced repetition among medical students.
2. To assess the attitudes of medical students toward active recall and spaced as study techniques among medical students
3. To assess the practice of active recall and spaced repetition in their study routines.

4. Methods and Materials

4.1. Study area and period

This study took place at St. Paul's Hospital Millennium Medical College in Addis Ababa, Ethiopia, between November 5 and November 21, 2025.

St. Paul's Hospital was originally established in 1968 by Emperor Haile Selassie. The medical school officially started in 2007, and in 2010, it was formally recognized as a medical college by a decree from the Council of Ministers. The college is managed by a board under the Federal Ministry of Health. It was the first medical school in Ethiopia to launch an integrated, modular, and problem based curriculum for undergraduate medical students. Since then, the college has been expanding its postgraduate training and adding more undergraduate programs. SPHMMC provides healthcare and training to its students through its different biomedical and clinical departments, including Anatomy, Physiology, Biochemistry, Pharmacology, Public health, Pathology, General Surgery, Internal Medicine, Obstetrics and Gynecology, Pediatrics and child health, Emergency Medicine, Urology, Neurology, Orthopedics, Psychiatry, Ophthalmology, ENT, Dentistry and Maxillofacial Surgery, Radiology, Anesthesiology, Nursing, ICU, ART , Endoscopy, Physiotherapy, Laboratory and Pharmacy. Total amount of medical students currently enrolled are 600 students.

4.2 Study design

A cross sectional study design of was used for this study.

4.3 Population

Source population: All medical students who were enrolled in SPHMMC at November, 2025.

Study population: Medical students at SPHMMC who met the inclusion criteria and was willing to participate in the study.

Study unit: Individual medical student at SPHMMC

4.4 Eligibility criteria

4.4.1. Inclusion Criteria

Eligible participants comprised medical students officially enrolled at St. Paul's Hospital Millennium Medical College (SPHMMC) during the November 2025 data collection period. Inclusion was further dependent upon the voluntary provision of informed consent prior to study participation.

4.4.2. Exclusion Criteria

Participants were excluded from the study if they submitted questionnaires with incomplete or missing responses to key variables. Additionally, any student who declined to provide informed consent or withdrew consent at any stage of data collection was excluded from participation, in accordance with ethical research standards.

4.5 Sample size determination and sampling technique

Using the single population proportion formula

$$n = Z^2 * p * (1-p) / d^2$$

Where:

$$Z = 1.96 \text{ (standard normal value at 95\% CI)}$$

$$p = 0.5 \text{ (assumed prevalence due to lack of local data)}$$

$$d = 0.05 \text{ (margin of error)}$$

$$n = (1.96)^2 * 0.5 * 0.5 / (0.05)^2 = 3.8416 * 0.25 / 0.0025 = 0.9604 / 0.0025 = 384$$

Applying finite population correction for N=600

$$n = 384 / 1 + (384 - 1 / 600) = 384 / 1 + (383 / 600) = 384 / 1.638 = 234$$

Adding 10% for non-response

$$n = 234 / 1 - 0.10 = 234 / 0.90 = 260$$

4.5.2 Sampling technique and procedure

Simple random sampling was used for this study. First, a sampling frame will be prepared using the official list of all registered medical students obtained from the registrar or academic office of the college. This list will include students from all academic years.

4.6 Study variables

4.6.1. Independent Variables

- Age
- Gender
- Year of study
- Previous exposure to study strategy training or workshop

4.6.2. Dependent Variables

- Knowledge of active recall and spaced repetition
- Attitude towards active recall and spaced repetition
- Practice/use of active recall and spaced repetition

4.7 Operational definitions

Operational definitions were derived using Bloom's cut-off point as form other healthcare research on knowledge, attitude and practice(40).

1. **Knowledge:** Refers to whether a student has heard of or understands the basic concepts of active recall and spaced repetition. The knowledge of medical students regarding active recall and spaced repetition was assessed using a 6 item questionnaire. Each correct response was assigned one point, while incorrect or 'uncertain' responses received zero points. Participants' knowledge levels were categorized into three tiers: 'Good Knowledge' for those scoring 80% or higher, 'Moderate/Partly Knowledgeable' for scores between 60% and 79%, and 'Poor Knowledge' for scores below 60%.

2. **Attitude:** Refers to students' beliefs, feelings, and perceptions about the usefulness, ease, and value of using active recall and spaced repetition. Students' attitudes toward active recall and spaced repetition were evaluated using a 7-item Likert scale, with responses ranging from "Strongly Disagree" (1 point) to "Strongly Agree" (5 points). An overall attitude score was determined by calculating the mean of all items. A mean score of 4.0 or higher was classified as a

"Positive Attitude," a score between 3.0 and 3.99 indicated a "Neutral Attitude," and a score of less than 3.0 was categorized as a "Negative Attitude."

3. ***Practice:*** Refers to how often and how regularly a student uses active recall or spaced repetition in their study habits. The practice of learning concepts was measured through two sub-sections focusing on the frequency of using active recall (6 items) and spaced repetition (3 items). Responses were collected on a 5-point frequency scale. To maintain scoring consistency, one item (Q20) was reverse-coded prior to analysis. The level of practice for each domain was determined by the mean score of the respective items. A mean score of 4.0 or higher was classified as "Frequent Practice," a score between 3.0 and 3.99 indicated "Moderate Practice," and a score of less than 3.0 was categorized as "Low or Infrequent Practice."

4.8 Data collection tools, methods and procedures

Data for this study was gathered via structured, self-administered electronic questionnaires, distributed through Google Forms on social media. The primary research instrument was adopted from validated scales used in previous literature, with strategic modifications to align with the current study's objectives(35). The questionnaire asked participants about their age, gender, and year of study, as well as prior exposure to study strategy training. It also included items assessing attitudes toward active recall and spaced repetition, and self-reported usage of these methods in daily study routines. Responses were measured using Likert scales to ensure standardized data comparison and analysis. This approach helped ensure that the collected information was clear, reliable, and suitable for drawing valid conclusion

4.9 Data quality control

Prior to the actual data collection, we have pretested our data collection tools on 27 people in the study population. The pretest the questionnaire were checked for clarity, understandability, completeness, reliability, consistency and sensitivity. After check the language use for each question was simplified for better understandability.

Prior to analysis, the collected data was be verified, cleaned, and quality tested

4.10 Data processing and analysis

We used IBM SPSS Statistics software (version 27) to input and analyze all the statistical data. For our analysis, we'll primarily use descriptive statistics, showing findings as

frequencies and percentages. These results was summarized clearly in tables and figures. For continuous variables (like age), we reported the mean, standard deviation, and minimum and maximum values, while for categorical variables (like gender), we used frequencies.

4.11 Ethical consideration

We got approval from the medical school's ethics and research committee before starting. We received cooperation letters from all involved parties. We made sure to protect the privacy of everyone participating. We got informed consent from each person, explained the study and made sure they were willing to participate. All the information we collected were anonymous. we won't include anything that could identify individuals. Finally, this data was only be used for this research and will not be shared with anyone not directly involved in the study.

4.12 Plan for dissemination of result

The results of this study was presented to the Public Health Department of SPHMMC, Addis Ababa, in 2026. The findings will be made accessible to interested parties through the college library and online platforms.

5. Results

5.1 Demographics of participants

A total of 261 completed the survey with no missing demographic data. The majority of respondents were aged 21–23 years (50.2%), followed by 24–26 years (25.3%) and 18–20 years (24.5%), and females constituted 59.4% of the sample. Participants represented all levels of training, with the largest proportion in their first clinical year (31.4%), followed by second clinical year (17.6%), pre-clinical year 1 (16.9%), pre-clinical year 2 (14.9%), internship (13.0%), and freshman year (6.1%). Most respondents (80.1%) reported no prior formal instruction in study skills or learning strategies, while only 19.9% had received such training. (Table 1)

Table 1. Demographic characteristics of medical students in SPHMMC, 2025 (n=261).

Variables	Response categories	Percentage	Frequency
1. Age	18-20	24.5%	64
	21-23	50.2%	131
	24-26	25.3%	66
2. Gender	Female	59.4%	155
	Male	40.6%	106
3. Year of Study	C1 major and minor	31.4%	82
	C2 major and minor	17.6%	46
	Freshman	6.1%	16
	Internship	13.0%	34
	PC1	16.9%	44
	PC2	14.9%	39
4. Have you ever received formal instruction or training on study skills or learning strategies? (Multiple choice)	No	80.1%	209
	Yes	19.9%	52

5.2 Knowledge towards Active recall and spaced repetition

Participants' knowledge of active recall was assessed using three items, including a direct question, a revision strategy question, and a scenario-based comparison. Overall, knowledge was variable, with only 46.4% correctly identifying active recall as superior to re-reading for long-term retention, while 34.9% favored re-reading and 18.8% considered both equally effective. Similarly, 39.1% correctly selected recalling from memory as the ideal post-reading strategy, whereas others preferred less effective approaches such as re-reading (20.7%), highlighting (13.0%), summarizing with the text (11.9%), or believed no single method is optimal (14.9%). In a comparative scenario, 44.8% correctly identified a recall based approach as more effective, while 41.4% favored re-reading and 13.8% viewed both methods as equally effective, indicating notable gaps and misconceptions in understanding active recall. (table 2)

Table 2. Distribution of responses to active recall knowledge assessment items among undergraduate medical students at St. Paul's Hospital Millennium Medical College, Addis Ababa, Ethiopia, 2025.

Item Code	Response	Percentage	Frequency
B1-1	Both are equally effective depending on the user	25.3%	66
	Multiple short sessions over time	45.2%	118
	One long study session	29.5%	77
B1-2	1 hour every day, Monday through Friday.	26.1%	68
	2 hours on Wednesday afternoon and 3 hours on Thursday night.	24.5%	64
	3 hours on Monday and 2 hours on Tuesday.	11.9%	31
	All 5 hours on Thursday night.	37.5%	98
B2-6	Student A (reviews with in short time before forgetting content read)	48.7%	127
	Student B (reviews after he started forgetting but not completely)	51.3%	134

Knowledge of spaced repetition was assessed using three items, including a direct comparison of massed versus distributed practice, a scheduling application question, and a timing-

based scenario. When asked about optimal strategies for long-term retention with equal study time, 45.2% correctly identified distributed practice as superior, while 29.5% favored massed practice and 25.3% believed both methods were equally effective. In a practical scheduling scenario, only 26.1% selected the optimal spaced approach of studying one hour daily, whereas a larger proportion chose less effective strategies, including massed practice in a single session (37.5%) or partially spaced approaches (24.5%), with a minority opting for early massed study (11.9%).

In a scenario evaluating the timing of review, 51.3% of participants correctly identified delayed review after some forgetting as more beneficial for long-term retention, while 48.7% favored immediate review. Overall, these findings indicate moderate awareness of spaced repetition principles but highlight substantial misconceptions, particularly in the practical application and scheduling of study sessions.

Table 3. Distribution of responses to spaced repetition knowledge assessment items among undergraduate medical students at St. Paul's Hospital Millennium Medical College, Addis Ababa, Ethiopia, 2025

Item	Response	Percentage	Frequency
B1-3	Both strategies are equally effective	18.8%	49
	Re-reading the material multiple times until comfortable with content	34.9%	91
	Reading once, then trying recalling without looking and correct your self	46.4%	121
B1-4	Close the book and try recall from memory	39.1%	102
	Highlight or underline important points	13.0%	34
	Make summary notes while looking at the text	11.9%	31
	Re-read the chapter carefully	20.7%	54
	There is no optimal study method since study is personal	14.9%	39
B2-5	Both methods are equally effective for students depending on preference	13.8%	36
	Student A (re-reads slides for tomorrow's exam)	41.4%	108

	Student B (reads once last week and then tries recalling from memory for tomorrow's exam with corrections)	44.8%	117
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For active recall, 83 students (31.8%) met the threshold for being classified as Knowledgeable, having correctly answered all relevant knowledge questions. An additional 33 participants (12.6%) demonstrated partial understanding and were categorized as Partially Knowledgeable. The majority, 145 students (55.6%), scored below the threshold and were classified as not knowledgeable.

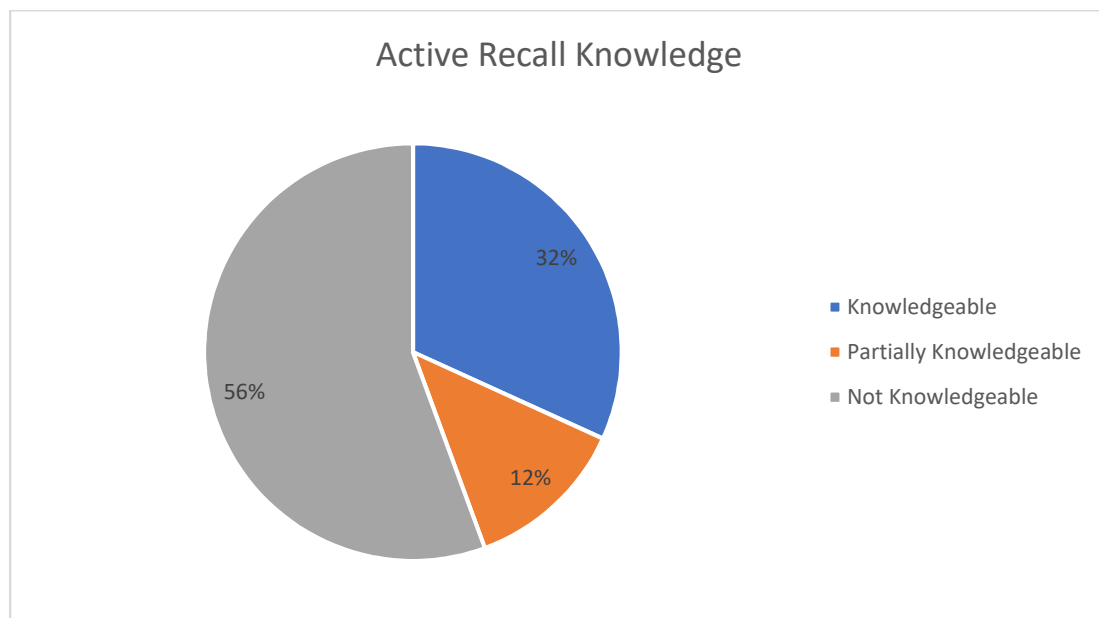


Figure 1. Distribution of knowledge levels regarding active recall among undergraduate medical students at St. Paul's Hospital Millennium Medical College, Addis Ababa, Ethiopia, 2025.

Regarding spaced repetition, 88 participants (33.7%) were classified as Knowledgeable, indicating accurate understanding of distributed practice principles. Only 20 students (7.7%) were deemed Partially Knowledgeable, while the largest group—153 students (58.6%)—were classified as Not Knowledgeable (Figure 2).

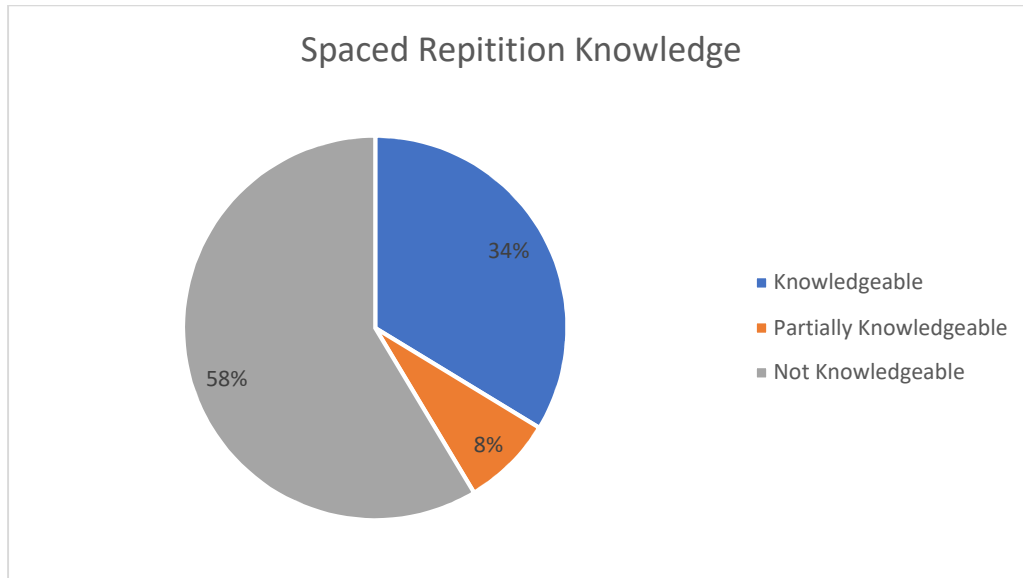


Figure 2. Distribution of knowledge levels regarding spaced repetition among undergraduate medical students at St. Paul's Hospital Millennium Medical College, Addis Ababa, Ethiopia^{5.3} Attitude towards spaced repetition and active recall, 2025.

Most students agreed that recalling learned information is an effective learning method, with 46.7% selecting “Agree” and 37.5% “Strongly Agree,” while smaller proportions reported disagreement or neutrality. Similarly, 37.5% agreed and 24.5% strongly agreed that spaced repetition improves long-term retention, whereas 16.5% disagreed, 6.1% strongly disagreed, and 15.3% remained neutral. In contrast, fewer students reported positive perceptions of delayed recall after mild forgetting, with 26.4% agreeing and 8.4% strongly agreeing, while 33.7% disagreed, 10.7% strongly disagreed, and 20.7% selected neutral. (table 4)

Regarding perceived difficulty, 34.5% agreed and 23.4% strongly agreed that using recall-based methods such as questions and flashcards is difficult to maintain regularly, while 30.3% disagreed or strongly disagreed and 8.0% were neutral. A majority of participants agreed (55.2%) or strongly agreed (30.3%) that these strategies are useful in medical school, with minimal disagreement. Confidence in using such techniques was more varied, as 23.4% agreed and 16.9% strongly agreed that they felt confident using questions in their study routine, whereas 23.8% disagreed, 5.7% strongly disagreed, and 30.3% remained neutral. (table 4)

Concerns related to time and planning were also reported, with 37.9% agreeing and 24.1% strongly agreeing that spacing study sessions requires excessive time and planning, while 24.5% disagreed or strongly disagreed and 10.3% were neutral. Finally, willingness to attend a workshop on these study techniques was reported by 34.9% who agreed and 22.6% who strongly agreed, while 18.8% disagreed, 7.3% strongly disagreed, and 16.5% selected neutral. (table 4)

Table 4. Distribution of responses to spaced repetition knowledge assessment items including massed versus distributed practice, study scheduling, and timing of review scenarios among undergraduate medical students at St. Paul's Hospital Millennium Medical College, Addis Ababa, Ethiopia, 2025.

Items	Response	Percentage	Frequency
[Trying to recall learned information is an effective way to learn.]	Agree	46.7%	122
	Disagree	1.5%	4
	Neutral	1.9%	5
	Strongly Agree	37.5%	98
	Strongly Disagree	12.3%	32
[Spacing study sessions helps me remember information longer.]	Agree	37.5%	98
	Disagree	16.5%	43
	Neutral	15.3%	40
	Strongly Agree	24.5%	64
	Strongly Disagree	6.1%	16
[trying to remember studied content after waiting for mild forgetfulness makes studying more enjoyable.]	Agree	26.4%	69
	Disagree	33.7%	88
	Neutral	20.7%	54
	Strongly Agree	8.4%	22
	Strongly Disagree	10.7%	28
[I find using recall, questions and flashcards difficult to use regularly]	Agree	34.5%	90
	Disagree	30.3%	79
	Neutral	8.0%	21
	Strongly Agree	23.4%	61

	Strongly Disagree	3.8%	10
[These strategies are useful in medical school.]	Agree	55.2%	144
	Disagree	0.4%	1
	Neutral	2.3%	6
	Strongly Agree	30.3%	79
	Strongly Disagree	11.9%	31
[I feel confident using questions in my study routine.]	Agree	23.4%	61
	Disagree	23.8%	62
	Neutral	30.3%	79
	Strongly Agree	16.9%	44
	Strongly Disagree	5.7%	15
[Spacing my studies requires too much time and planning.]	Agree	37.9%	99
	Disagree	24.5%	64
	Neutral	10.3%	27
	Strongly Agree	24.1%	63
	Strongly Disagree	3.1%	8
[I would attend a workshop on study techniques like these.]	Agree	34.9%	91
	Disagree	18.8%	49
	Neutral	16.5%	43
	Strongly Agree	22.6%	59
	Strongly Disagree	7.3%	19

Participants' overall attitudes toward active recall and spaced repetition were classified into three categories—Positive, Neutral, and Negative—based on mean scores derived from eight Likert-scale items, with reverse coding applied to two negatively worded statements (Annex 3).

Of the 261 respondents, 67 students (25.7%) demonstrated a Positive Attitude, defined as a mean score of 4.0 or higher. 103 participants (39.5%) exhibited a Neutral Attitude (mean score between 3.0 and 3.99). The remaining 91 students (34.9%) were classified as having a Negative Attitude (mean score below 3.0) (Figure 3).

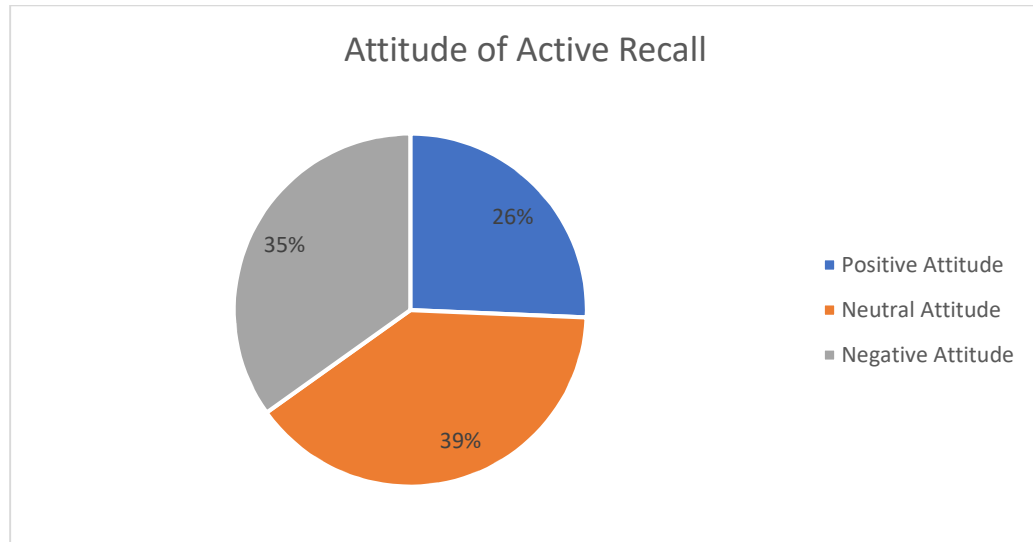


Figure 3. Distribution of attitude levels toward active recall and spaced repetition among undergraduate medical students at St. Paul's Hospital Millennium Medical College, Addis Ababa, Ethiopia, 2025.

5.4 Practice of Active recall and spaced Repetition

Participants' self-reported use of active recall strategies varied across different practices. For self-quizzing without notes, 8.0% reported "Always," 30.7% "Often," and 21.8% "Sometimes," while 28.7% did so "Rarely" and 10.7% "Never." Similarly, explaining topics to others was reported as "Always" by 7.3%, "Often" by 26.1%, and "Sometimes" by 35.6%, whereas 24.9% and 6.1% indicated "Rarely" and "Never," respectively. (Table 5)

Use of flashcards was less frequent compared to other active recall methods. Only 18.0% reported "Always" using flashcards and 8.8% "Often," while 21.8% used them "Sometimes." A larger proportion reported infrequent use, with 39.5% selecting "Rarely" and 11.9% "Never." (Table 5)

For spaced repetition practices, 3.1% reported "Always" reviewing material at spaced intervals, 21.8% "Often," and 37.2% "Sometimes," while 21.1% and 16.9% reported "Rarely" and "Never," respectively. Structured planning for spaced review showed that 23.8% "Always" used a planner or app, whereas 38.3% "Never" did so, with smaller proportions selecting "Often" (1.5%), "Sometimes" (31.0%), and "Rarely" (5.4%). Massed study was widely reported, with

53.6% indicating they “Always” study in one sitting, 22.6% “Often,” and 21.1% “Sometimes,” while only 1.9% and 0.8% reported “Rarely” and “Never,” respectively. (Table 5)

Table 5. Distribution of self-reported frequency of active recall and spaced repetition practice behaviors including self-quizzing, flashcard use, spaced review, and massed study patterns among undergraduate medical students at St. Paul's Hospital Millennium Medical College, Addis Ababa, Ethiopia, 2025.

Items	Response	Percentage	Frequency
[I quiz myself without looking at notes.]	Always	8.0%	21
	Never	10.7%	28
	Often	30.7%	80
	Rarely	28.7%	75
	Sometimes	21.8%	57
[I explain topics to others to remember them.]	Always	7.3%	19
	Never	6.1%	16
	Often	26.1%	68
	Rarely	24.9%	65
	Sometimes	35.6%	93
[I use flashcards to test my knowledge.]	Always	18.0%	47
	Never	11.9%	31
	Often	8.8%	23
	Rarely	39.5%	103
	Sometimes	21.8%	57
[I review material at spaced intervals only when it start forgetting]	Always	3.1%	8
	Never	16.9%	44
	Often	21.8%	57
	Rarely	21.1%	55
	Sometimes	37.2%	97
[I use a planner or app to schedule review sessions.]	Always	23.8%	62
	Never	38.3%	100

	Often	1.5%	4
	Rarely	5.4%	14
	Sometimes	31.0%	81
[I study most materials in one sitting if I understand them fully.]	Always	53.6%	140
	Never	0.8%	2
	Often	22.6%	59
	Rarely	1.9%	5
	Sometimes	21.1%	55

Participants' self-reported use of active recall and spaced repetition was classified into three categories High Practice, Moderate Practice, and Low Practice based on mean scores derived from relevant items in the practice section of the questionnaire, with reverse coding applied to negatively worded items (Annex 3).

For active recall, 65 students (24.9%) were classified as engaging in High Practice, 75 (28.7%) demonstrated Moderate Practice, and the majority—121 (46.4%)—reported Low Practice (Figure 4).

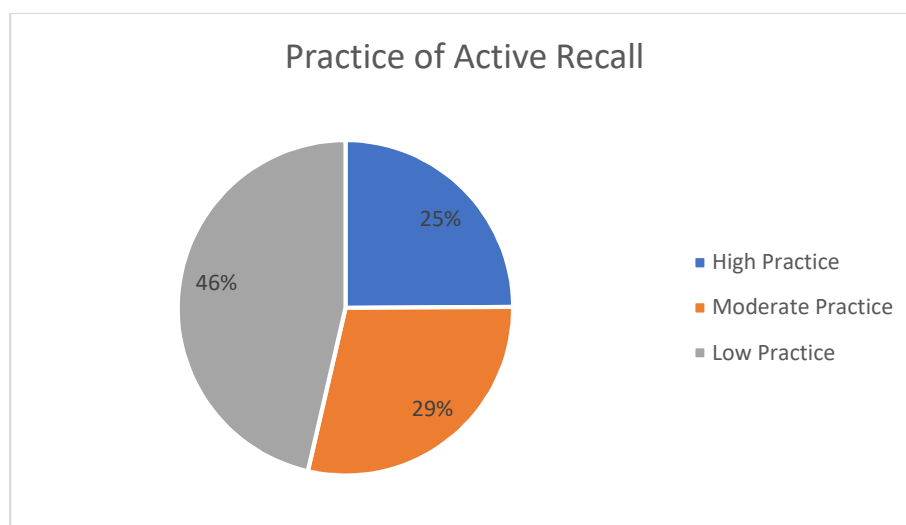


Figure 4. Distribution of self-reported practice levels of active recall among undergraduate medical students at St. Paul's Hospital Millennium Medical College, Addis Ababa, Ethiopia, 2025.

In contrast, practice of spaced repetition was more prevalent: 146 participants (55.9%) were categorized as having High Practice, 113 (43.3%) exhibited Moderate Practice, and only 2 students (0.8%) reported Low Practice (Figure 5).

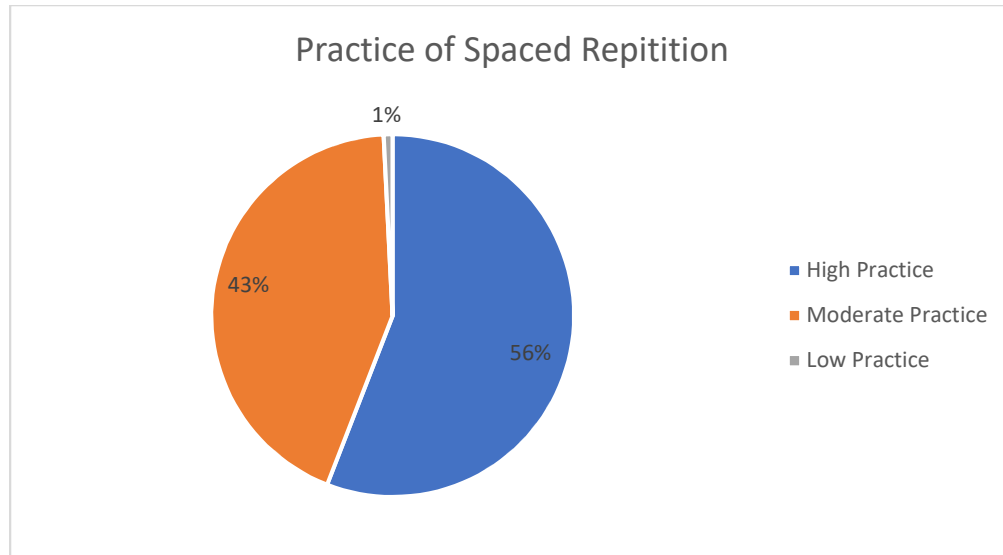


Figure 5. Distribution of self-reported practice levels of spaced repetition among undergraduate medical students at St. Paul's Hospital Millennium Medical College, Addis Ababa, Ethiopia, 2025

To examine if there were any associations with academic progression and prior exposure to study skills training with students' knowledge, attitudes, and practices regarding active recall and spaced repetition, chi-square tests of independence were conducted. Results indicated a statistically significant association between year of study and knowledge of active recall, $\chi^2(10) = 189.998$, $p < .001$, with clinical-year students (C1 and C2) more likely to be classified as knowledgeable (33/82, 40.2% and 31/46, 67.4%, respectively) compared to pre-clinical and internship groups. Similarly, year of study was significantly associated with knowledge of spaced repetition, $\chi^2(10) = 83.201$, $p < .001$, and with attitude levels, $\chi^2(10) = 180.973$, $p < .001$, suggesting that exposure to clinical curricula may facilitate greater awareness and more favorable perceptions of evidence-based learning strategies. Regarding prior training, students who reported having received formal instruction on study skills were significantly more likely to demonstrate knowledgeable levels of active recall (30/52, 57.7% vs. 53/209, 25.4%; $\chi^2(2) = 22.282$, $p < .001$) and spaced repetition (28/52, 53.8% vs. 37/209, 17.7%; $\chi^2(2) = 34.261$, $p < .001$), as well as to report positive attitudes (27/52, 51.9% vs. 40/209, 19.1%; $\chi^2(2) = 29.326$, $p < .001$) and higher practice levels for both strategies (active recall: $\chi^2(2) = 34.261$, $p < .001$; spaced repetition: $\chi^2(2) = 47.689$, $p < .001$).

6. Discussion

This study investigated the knowledge, attitude, and practice of active recall and spaced repetition among medical students at SPHMMC. The findings reveal varying levels of understanding, perception, and application of these evidence-based learning strategies.

Regarding active recall, a significant portion of the students demonstrated a foundational understanding, with 31.8% classified as knowledgeable and an additional 12.6% as partially knowledgeable. However, this also implies that a majority of students either lacked or had an incomplete understanding of active recall principles. This aligns with observations in other studies, which suggest that college students often lack the technical 'know-how' of retrieval practice, including when to apply it effectively across different subjects (32). The nuances of active recall, such as distinguishing between mastery and single correct recall, appear to be areas where students require further guidance.

In contrast, knowledge of spaced repetition presented a more polarized distribution. While 33.7% of participants were knowledgeable, a substantial 58.6% were categorized as not knowledgeable, with only 7.7% showing partial understanding. This indicates a significant gap in the theoretical understanding of distributed practice among the medical students at SPHMMC. This finding contrasts sharply with studies conducted at UCLA, where a high level of theoretical knowledge regarding spacing was reported, with 84.9% to 91.6% of students correctly identifying spaced study as superior to cramming for long-term retention (35,37). The discrepancy suggests a potential need for targeted educational interventions at SPHMMC to enhance students' foundational knowledge of spaced repetition.

Further analysis of specific attitude statements provides insight into these predominantly neutral or negative perceptions. While a significant majority of students (46.7% Agree, 37.5% Strongly Agree) acknowledged that "Trying to recall learned information is an effective way to learn," and similarly, 37.5% Agreed and 24.5% Strongly Agreed that "Spacing study sessions helps me remember information longer," these positive perceptions of effectiveness did not consistently translate into positive overall attitudes. A key contributing factor appears to be the perceived difficulty and time commitment associated with these strategies. Many students (34.5% Agree, 23.4% strongly Agree) affirmed, "I find using recall, questions and flashcards difficult to use regularly." Furthermore, a substantial proportion (37.9% Agree, 24.1% strongly Agree) expressed concerns that "Spacing my studies requires too much time and planning." The enjoyment factor

also played a role, as fewer than one-third (26.4% Agree, 8.4% Strongly Agree) found that "Trying to remember studied content after waiting for mild forgetfulness makes studying more enjoyable," with a notable 33.7% disagreeing. Although the utility of these strategies in medical school received strong support (55.2% Agree, 30.3% strongly Agree), confidence in their personal implementation was mixed, with 30.3% remaining neutral on "I feel confident using questions in my study routine." These findings suggest that despite recognizing the academic value, the practical challenges, perceived effort, and lack of immediate enjoyment contribute significantly to the observed neutral to negative attitudes, creating a potential disconnect between perceived utility and willingness to adopt .

The practical application of active recall among SPHMMC medical students was found to be relatively low, with 46.4% reporting low practice, 28.7% moderate practice, and only 24.9% engaging in high practice. This underutilization of active recall, despite its known benefits, is consistent with other research. For instance, a web-based survey by Jonathan A. Susser revealed that only 11% of students explicitly listed testing as a primary study technique, with a vast majority (84%) still relying on rereading. Furthermore, other studies indicate low engagement with optional retrieval tools, with fewer than 15% of students utilizing them until just before exams. These findings highlight a significant theory-practice gap, where knowledge of effective strategies does not necessarily translate into their consistent application. (35)

Conversely, the practice of spaced repetition was more prevalent among the students, with 55.9% categorized as having high practice and 43.3% exhibiting moderate practice, and only a minimal 0.8% reporting low practice. This suggests a relatively higher adoption of spaced repetition compared to active recall. However, it is important to consider the quality and consistency of this practice. Other research indicates that spacing is often ranked lowly (6th) among actual used strategies, and students typically spread study over only a few days, rarely utilizing optional resources unless mandatory. While our study shows higher reported practice, further investigation into the specific methods and consistency of spaced repetition application would be beneficial to understand its true effectiveness (39)

7. Strengths and Limitations

This study's key strengths include its comprehensive assessment of knowledge, attitudes, and practices related to active recall and spaced repetition using a structured, theory based questionnaire aligned with established cognitive science principles.

However, the study has notable limitations. Its cross-sectional design precludes causal inference, and reliance on self-reported data may introduce social desirability or recall bias particularly in practice measures, where students might overestimate their use of effective strategies.

8. Conclusion

This study identified substantial gaps in medical students' knowledge, attitudes, and practices regarding evidence-based learning strategies at St. Paul's Hospital Millennium Medical College. Although a majority of participants acknowledged the utility of active recall and spaced repetition in medical education, only 31.8% and 33.7%, respectively, demonstrated adequate knowledge of these techniques, with over half classified as not knowledgeable which is a finding consistent with the observation that 80.1% had never received formal instruction in study skills. Attitudinal assessments revealed a notable paradox: while most students endorsed the theoretical effectiveness of these strategies, over one-third expressed negative attitudes, citing perceived difficulty, time constraints, and limited confidence in implementation, aligning with the "misinterpreted-effort hypothesis" wherein cognitive demand is conflated with inefficacy. Practice patterns further underscored a theory–practice disconnect; despite 55.9% reporting high use of spaced repetition, only 24.9% engaged in high-frequency active recall despite its established superiority over passive review and massed study remained prevalent, with 76.2% frequently or always studying material in a single session. Collectively, these findings highlight the need for targeted educational interventions that not only enhance foundational knowledge of evidence-based learning strategies but also address attitudinal barriers and provide structured, practical support to facilitate their consistent adoption within medical curricula.

9. Recommendations

Based on the findings, the following targeted recommendations are proposed:

1. Integrate evidence-based learning instruction into the SPHMMC curriculum by the medical academic body. A mandatory, brief module on active recall and spaced repetition should be incorporated into orientation or early pre-clinical courses, emphasizing their scientific basis, practical application, and alignment with medical education demands.
2. Provide accessible, low effort implementation tools. Promote free digital resources (e.g., Anki for flashcards) and simple scheduling templates by lecturers and school of medicine to reduce perceived barriers related to time, planning, and confidence particularly for active recall, which was widely viewed as difficult despite its recognized utility.
3. Address misconceptions through faculty modeling. Encourage instructors to explicitly use retrieval practice in assessments (e.g., low-stakes quizzes) and model spaced review in course design, thereby normalizing these strategies and countering the “misinterpreted-effort” bias.
4. Facilitate optional workshops or peer learning by the student council. Given that 57.5% of students expressed willingness to attend training, structured workshops potentially linked to academic support services could bridge knowledge practice gaps, especially for students with neutral or negative attitudes.

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Annex 1: Consent sheet

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Study Participant

Study Title: Knowledge, Attitude and Practice of active recall and spaced repetition among medical students of St Paul Hospital Millennium Medical College , Addis Ababa, Ethiopia

KAP on of active recall and spaced repetition among medical students of St Paul Hospital Millennium Medical College , Addis Ababa, Ethiopia is conducted to assess the level of knowledge, attitudes, and practices regarding spaced repetition and active recall, thereby providing data to improve education quality in SPHMMC. Your honest participation in filling out this questionnaire is greatly appreciated as it is essential for the study's success. The survey consists of a self-administered questionnaire. We want to assure you that your name will not be recorded, all information will be kept strictly confidential and will not be shared with any third party. There are no anticipated risks or harms associated with this study, and your answers will be used for research purposes only and will not be graded or have any impact on your academic performance or other school-related activities. Your participation is entirely voluntary, and you have the full right to refuse to participate, skip any question, or withdraw from the study at any time without any penalty.

Respondent signature_____

Annex 2: Questionnaire

Section A: Demographic Information

Section / Question	Response Options
1. Age	1. 18–20 2. 21–23 3. 24–26 4. 27 and above
2. Gender	1. Male 2. Female
3. Year of Study	1. Freshman 2. PC1 3. PC2 4. C1 major and Minor 5. C2 major and Minor 6. Internship
4. Have you ever received formal instruction or training on how to study effectively?	1. Yes 2. No

Section B: Knowledge

No.	Question	Response Options
B1	Direct Knowledge Questions	
1.	Which of the following strategies do you think research has found to be better for long-term retention of	1. (a) Re-reading the material multiple times

	material, assuming the total amount of study time is the same?	2. (b) Reading the material once and then recalling it from memory 3. (c) Both strategies are equally effective
2.	If you had to study a chapter for an upcoming exam, IDEALLY how would you test yourself after reading it once?	1. (a) Re-read the chapter again carefully 2. (b) Close the book and try to recall as much as you can 3. (c) Highlight and underline important points 4. (d) Make summary notes while looking at the text
3.	Which of the following strategies do you think research has found to be better for long-term retention of material, assuming the total amount of study time is the same?	1. (a) Studying the material in multiple shorter sessions spread out over time 2. (b) Studying the material in one long session on a single day 3. (c) Both strategies are equally effective
4.	If you had a total of 5 hours to study for an upcoming test on Friday, IDEALLY how would you spread out your studying?	1. (a) 5 hours on Thursday 2. (b) 2 hours on Wednesday, 3 hours on Thursday 3. (c) 1 hour each day from Monday to Friday

		4. (d) 2 hours Monday, 2 hours Wednesday, 1 hour Friday 5. (e) Other: _____
B2	Scenario-Based Questions	
5.	Scenario 1: Which student is more likely to remember the material? (Student A reads twice; Student B reads once and recalls).	1. Student A 2. Student B
6.	Scenario 2: Which student is more likely to retain the information? (Student A reviews the next day; Student B reviews after a week).	1. Student A (Reviewing the next day) 2. Student B (Reviewing after a week)

Section C: Attitude

No.	Question / Statement	Response Options (Scale 1–5)
Section C	Attitude	1=Strongly Disagree, 2=Disagree, 3=Neutral, 4=Agree, 5=Strongly Agree
7.	Active recall is an effective way to learn.	1-5
8.	Spaced repetition helps me remember information longer.	1-5
9.	Using these techniques makes studying more enjoyable.	1-5
10.	I find active recall difficult to use regularly.	1-5
11.	I think these strategies are especially useful in medical school.	1-5
12.	I feel confident using active recall in my study routine.	1-5
13.	Spaced repetition requires too much time and planning.	1-5
14.	I would be willing to attend a workshop on effective study techniques like these.	1-5

Section D: Practice

Section D	Practice	1=Never, 2=Rarely, 3=Sometimes, 4=Often, 5=Always
15.	I quiz myself on material I've studied without looking at notes.	1-5
16.	I explain topics to others as a way of remembering them.	1-5
17.	I use flashcards to test my knowledge.	1-5
18.	I review material several times over spaced intervals at which point the topics have become not as clear in my head.	1-5
19.	I use a planner or app to schedule my review sessions.	1-5
20.	Study most materials in one session if I am able to read and understand it fully.	1-5

Annex 3: Scoring

- Knowledge of spaced repetition**

Items Used	Section B1 → Q3 & Q4; Section B2 → Q6
Scoring Key	
Q3	Correct: (a) multiple shorter sessions → 1 point
Q4	Best spacing: (c) or (d) → 1 point Partial spacing: (b) → 0.5 points Poor spacing: (a, or massed → 0 points
Q6	Correct: Student B (review after a week) → 1 point
Total Score	0–3 points (or 0–3.5 if partial scoring in Q4 is used)
Classification	
Knowledgeable	≥ 3 points
Partly Knowledgeable	2–2.5 points
Not Knowledgeable	≤ 1.5 points

Category	Details
Items Used	Section B1 → Q1 & Q2; Section B2 → Q5
Scoring Key	
Q1	Correct: (b) (recall from memory) → 1 point
Q2	Correct: (b) (close book & recall) → 1 point
Q5	Correct: Student B (recall vs. re-read) → 1 point
Total Active Recall Knowledge Score	0–3 points
Classification	
Knowledgeable	3/3 points
Partly Knowledgeable	2/3 points
Not Knowledgeable	$\leq 1/3$ points

- **Attitudes of student on active recall and spaced repetition**

This assessment measures a person's attitude toward active recall and spaced repetition

We will be using eight items from Section C (Q7 through Q14).

Responses are given on a 5-point scale, where 1 is "Strongly Disagree" and 5 is "Strongly Agree."

Two of the items, Q10 ("Active recall is difficult...") and Q13 ("Spaced repetition requires too much time..."), are reverse-coded. To score these, you subtract the response from 6.

The final Attitude Score is the mean of all eight item scores, which will fall within a range of 1 to 5.

A score of 4.0 or higher indicates a positive attitude.

A score between 3.0 and 3.99 suggests a neutral attitude, and a score of less than 3.0 is classified as a negative attitude.

- **Practice of student active recall and spaced repetition**

Active Recall Practice:

This assessment measures a person's practice of active recall,

We use three items from Section D (Q15 through Q17).

Responses are given on a 5-point frequency scale, where 1 is "Never" and 5 is "Always."

The final Active Recall Practice Score is the mean of the three item scores, which will fall within a range of 1 to 5.

A score of 4.0 or higher indicates frequent use of active recall strategies.

A score between 3.0 and 3.99 suggests moderate practice, and a score of less than 3.0 is classified as low or infrequent practice.

Spaced Repetition Practice:

This assessment measures a person's practice of spaced repetition,

We use three items from Section D (Q18 through Q20).

Responses are given on a 5-point frequency scale, where 1 is "Never" and 5 is "Always."

One of the items, Q20 ("Study most materials in one session if I am able to read and understand it fully"), is reverse-coded. To score this, you subtract the response from 6.

The final Spaced Repetition Practice Score is the mean of the three item scores, which will fall within a range of 1 to 5.

A score of 4.0 or higher indicates frequent use of spaced repetition strategies.

A score between 3.0 and 3.99 suggests moderate practice, and

a score of less than 3.0 is classified as low or infrequent practice.

Declaration

I, the undersigned student, declare that this research project is my original work in partial fulfillment of the requirement for the **Degree of Doctor in Medicine**, MD. I also declare that it has never been presented in this or any other higher institution and that all resources and materials used in the research work have been duly acknowledged.

Name of the student: _____Amanuel Aklilu_____

Signature: __________

Date: _____17/04/26_____

Approval of Advisors

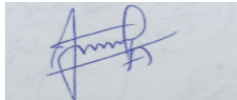
This research work has been submitted for examination with my approval.

Name of School of Public health advisor 1: Biruktawit Fekade

Signature: __________

Date: _____17/04/26_____

Name of Clinical advisor 2: _____Dr. Abate Gashaw_____

Signature: __________

Date: _____17/04/26_____