Section: Miscellaneous

Review Article

A REVIEW ON LEARNING APPROACHES IN MEDICAL EDUCATION

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ABSTRACT

Background: Learning styles refer to the diverse ways in which individuals prefer to absorb, process, and retain information. Over the years, several models have emerged to classify learning styles, including the VARK model (Visual, Auditory, Reading/Writing, and Kinesthetic), Kolb's Experiential Learning Theory, and Gardner's Multiple Intelligences. Understanding and acknowledging different learning styles can enhance student engagement, promote self-awareness, and improve educational outcomes when used thoughtfully. However, recent educational research also cautions against rigid categorization, suggesting that effective learning is more influenced by the nature of the task, prior knowledge, and context than by a fixed style. This abstract explores the theoretical underpinnings, educational implications, and ongoing debates surrounding learning styles, advocating for a flexible, learner-centered approach that accommodates diversity while encouraging adaptability and metacognition in learners.

INTRODUCTION

A fundamental aspect of understanding the "learning style" is to think critically about the way you learn. Identifying the most effective strategies for mastering coursework allows you to take greater control and adapt to the unique demands of each subject. When you understand your ideal learning styles, you can bring a greater sense of control and flexibility to the demands of each course as required. One of the most used classifications of the learning styles is by Fleming and Mills in 1992; the VKA model (Figure 1). This model categorizes learners into three primary styles: Visual, Auditory, and Kinesthetic, each representing different approaches to processing and retaining information. In this article I will be including few more types of learners in Medical education.

Visual learner: They process and retain information most effectively through images, diagrams, charts, and other visual aids (Fleming & Mills, 1992). They benefit from structured layouts, color-coded notes, and graphical representations that help organize complex concepts. These learners often prefer written instructions and find it easier to understand information presented in a visually engaging format. Research suggests that incorporating visual elements into learning can enhance comprehension and recall, particularly for subjects that involve spatial relationships or intricate details (Pashler et al., 2008).

Kinesthetic learner: They acquire knowledge most effectively through hands-on experiences, movement, and physical engagement with the material (Fleming & Mills, 1992). They benefit from interactive learning strategies such as experiments, role-playing, and real-world applications that allow them to manipulate and experience concepts firsthand. Research indicates that kinesthetic learners retain information more effectively when they engage in active learning environments that incorporate physical activity and experiential learning (Pashler et al., 2008). This approach is particularly beneficial in fields such as anatomy, engineering, and performing arts, where tactile experiences enhance understanding.

Auditory learners absorb and retain information most effectively through listening, discussion, and verbal explanations (Fleming & Mills, 1992). They benefit from lectures, podcasts, group discussions, and reading aloud, as these methods reinforce understanding through sound. Auditory learners often excel in environments where they can engage in verbal interactions and repetition, as hearing information multiple times enhances retention. Research suggests that incorporating auditory elements, such as mnemonic devices and rhythmic

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patterns, can significantly improve learning outcomes for individuals who prefer this modality (Pashler et al., 2008).

Linguistic Learners Linguistic learners, closely related to auditory learners, process information best through words, both spoken and written (Gardner, 1983). They excel in reading, writing, and verbal expression, often thriving in activities such as storytelling, journaling, and debate. Studies indicate that linguistic learners benefit from strategies that involve reading comprehension exercises, structured note-taking, and engaging with new vocabulary in context (Brualdi, 1996). Their strong verbal skills make them adept at analyzing complex texts and articulating ideas effectively.

Solitary learners, also known as intrapersonal learners, prefer to study and process information independently. They excel when working alone, reflecting deeply on concepts, and setting personal learning goals (Gardner, 1983). These learners often engage in self-paced study methods such as journaling, self-assessment, and metacognitive strategies to track their progress. Research suggests that solitary learners benefit from structured independent study environments and introspective learning techniques, such as self-explanation and personal reflection, which enhance understanding and long-term retention (Brualdi, 1996). Solitary learners thrive in settings where they can focus without distractions, often preferring quiet environments over collaborative group work. They tend to develop strong critical thinking skills and intrinsic motivation, as they rely on self-discipline to guide their learning process. Studies indicate that encouraging self-regulation and goal-setting can further improve learning outcomes for individuals with a strong intrapersonal learning preference (Zimmerman, 2002).

Social learners, also known as interpersonal learners, thrive in group settings and learn best through interaction, discussion, and collaboration with others (Gardner, 1983). They benefit from study groups, peer teaching, and cooperative learning environments where they can share ideas and receive feedback. Research suggests that social learners develop a deeper understanding of concepts through verbal communication and collaborative problem-solving, as engaging with others helps reinforce learning and expand perspectives (Brualdi, 1996). Social learners often excel in environments that encourage teamwork and active participation, such as classroom discussions, debates, and project-based learning. Studies indicate that collaborative learning not only enhances knowledge retention but also improves critical thinking and social skills, making this approach particularly effective for students who prefer interpersonal engagement (Johnson & Johnson, 2009). By leveraging their strong communication abilities, social learners can refine their understanding of complex topics through interaction with peers and instructors.

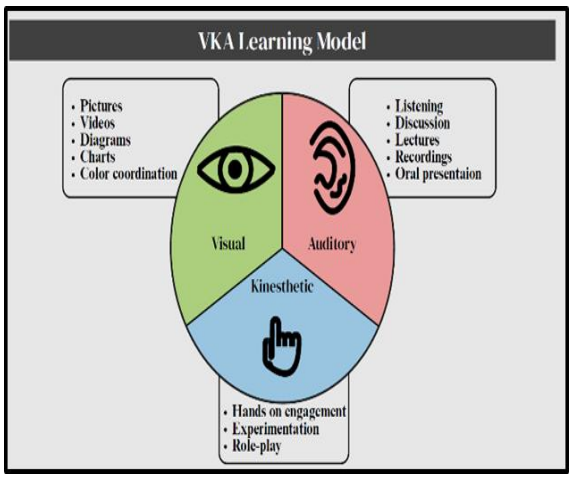

Figure 1: VKA learning modules

According to Kolb's experiential learning theory (ELT) (Figure 2) categorizes learners into four distinct styles based on how they process and apply information: **Diverging, Assimilating, Converging, and Accommodating** (Kolb, 1984). These learning styles help educators tailor medical education strategies to optimize student engagement and comprehension. Diverging (Feeling & Watching): Diverging learners prefer observing situations and generating ideas rather than actively engaging. They excel in patient-centered learning, case-based discussions, and reflective practice. For example, a medical student with a diverging learning style may benefit from analyzing complex patient cases and discussing differentials in a team setting rather than performing hands-on procedures immediately (Yardley et al., 2012). Assimilating (Thinking & Watching): Assimilating learners prefer logical reasoning, structured learning, and theoretical models over hands-on experiences. These students thrive in lectures, reading medical literature, and analyzing research studies. For instance, they may excel in understanding pathophysiology through textbooks, scientific articles, and epidemiological data rather than relying on clinical experience alone (Kolb & Kolb, 2005). Converging (Thinking & Doing): Converging learners prefer problem-solving and applying concepts in practical settings. They thrive in simulation-based learning, clinical skills workshops, and hands-on medical procedures. For example, a student with a converging learning style may excel in performing CPR in a simulation lab or applying medical knowledge to solve clinical cases rather than engaging in abstract discussions (Coffield et al., 2004). Accommodating (Feeling & Doing): Accommodating learners prefer learning by experience, trial-and-error, and interpersonal interactions. They thrive in clinical rotations, hands-on patient care, and procedural training. For instance, a medical student with an accommodating learning style may learn best by actively participating in bedside rounds, assisting in surgeries, or shadowing physicians rather than relying solely on textbooks or lectures (Yardley et al., 2012).

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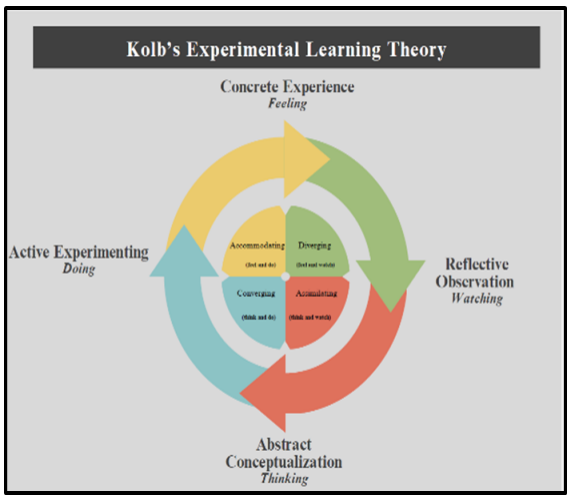

Figure 2: Kolb's experiential learning theory (ELT)

Gardner's Theory of Multiple Intelligences, (figure 3) proposed by Howard Gardner in 1983, redefines the concept of intelligence by suggesting that individuals possess a variety of intelligences rather than a single, fixed IQ. According to this theory, there are eight distinct intelligences: linguistic, logical-mathematical, musical, bodily-kinesthetic, spatial, interpersonal, intrapersonal, and naturalistic. Each person has a unique combination of these intelligences, which influence how they learn, communicate, and solve problems. Gardner's theory emphasizes that traditional education systems, which often prioritize linguistic and logical-mathematical abilities, may overlook the talents of students who excel in other areas. By acknowledging and nurturing multiple intelligences, educators can create more inclusive and effective learning environments that cater to the diverse strengths of all learners (Gardner, 1983).

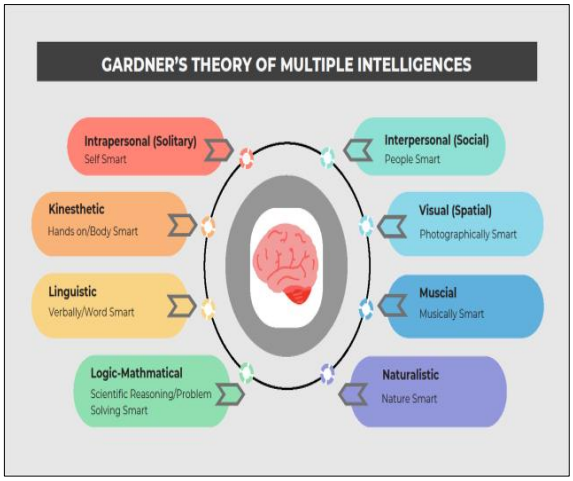

Figure 3: Gardner's Theory of Multiple Intelligences

MATERIALS AND METHODS

A thorough literature searches of Pub Med, Medline, Research gate and Google Scholar for data sources mentioning the modern teaching and learning styles in Medical education to date is included in the study. The various teaching styles were investigated through these sources. The key words used to search the appropriate articles were "Medical education", "Learnings styles"," "Visual learner" or "Kinesthetic learner", "Auditory learners", "Linguistic Learners" and "Kolb's inventory". Descriptive data of each teaching styles and its implementation were compiled from published data of sample sizes greater than 150. Preferred reporting Items or Systemic review and Meta-Analysis (PRISMA) checklist was used as the template for this review (Page et al., 2020).

2-1 **Inclusion Criteria**

Inclusion criteria was set to include studies that were peer-reviewed, open-access, published from 2000 to 2025, articles should be in English.

2-2 **Exclusion Criteria**

Exclusion criteria was set as literature in non-English languages, little or no focus on educational methodologies, studies that did not include at least one of the key search terminology.

2-3 **Participants:** Medical students throughout the world.

2-4 **Interventions:** The included research are observational studies, so we did not have association group.

RESULTS

The search indicated 35 articles which were narrowed down by title and abstract relatedness. 23 articles entered the second phase of the study and after reviewing their full text, finally, 10 articles which were explicitly and implicitly reported the underpinning learning styles remained. These learning styles are well validated and commonly being employed in most of the medical school. We carefully reviewed them to analyze their perceived and proven effectiveness, and challenges in introduction and implementation.

Review of Literature

A cross-sectional study conducted by Daud et all in 2011 on 338 MBBS students using online VARK inventory questionnaire and it showed that medical students use different learning styles.

Visual learners in medical school excel when information is presented through images, diagrams, charts, and other visual formats (Fleming & Mills, 1992). For instance, these students benefit greatly from anatomical illustrations, medical imaging (such as MRIs, CT scans, and X-rays), and flowcharts that outline disease mechanisms. A classic example is the use of color-coded anatomy atlases like Netter's Atlas of Human Anatomy, which helps visual learners retain spatial relationships between structures. Another example is pathology slides and histology images, where medical students analyze microscopic structures to identify disease patterns. Additionally, visual learners often prefer concept maps and mind maps to organize information about complex physiological processes, such as the Renin-Angiotensin-Aldosterone System (RAAS) in

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nephrology. Studies suggest that incorporating visual learning strategies, such as medical illustrations and video-based learning, can significantly enhance comprehension and retention of complex medical concepts (Khalil et al., 2018).

Kinesthetic learners, who learn best through hands-on experiences and active engagement, excel in medical education settings that incorporate practical application and physical interaction (Fleming & Mills, 1992). These students benefit from clinical skills labs, dissections, surgical simulations, and hands-on patient interactions, which allow them to learn by doing rather than by simply reading or listening.

For example, during cadaver dissections, kinesthetic learners develop a deep understanding of human anatomy by physically exploring structures and spatial relationships. Similarly, simulation-based training, such as practicing CPR on a mannequin or using virtual reality for surgical procedures, enhances procedural knowledge and muscle memory (Issenberg et al., 2005). Another example is clinical rotations, where students learn by directly performing medical tasks, such as inserting IV lines, suturing wounds, or conducting physical examinations, reinforcing theoretical knowledge through real-world practice.

Research indicates that active, hands-on learning significantly improves medical students' retention and skill acquisition, making it an essential approach for kinesthetic learners (Issenberg et al., 2005).

Auditory learners, benefit from lectures, discussions, podcasts, and verbal repetition in medical education (Fleming & Mills, 1992). These students excel in environments where they can engage with material through listening, speaking, and verbal reasoning rather than solely relying on written or visual resources.

For example, auditory learners often thrive in case-based discussions and group study sessions, where they can verbally explain medical concepts and hear different perspectives. They may also find clinical rounds particularly effective, as they learn by listening to attending physicians discuss diagnoses, treatment plans, and patient cases. Additionally, medical podcasts, recorded lectures, and oral mnemonics (e.g., "Some Lovers Try Positions That They Can't Handle" for the carpal bones) are powerful tools that reinforce learning through auditory input.

Research suggests that incorporating verbal teaching strategies, such as storytelling, Socratic questioning, and interactive discussions, enhances medical students' comprehension and retention, particularly for those with an auditory learning preference (Sandars & Patel, 2020).

Linguistic learners, who learn best through reading, writing, and verbal expression, excel in medical education settings that involve text-based learning, structured note-taking, and verbal articulation of concepts (Gardner, 1983). These students prefer learning through textbooks, medical literature, written explanations, and discussions, where language plays a key role in knowledge acquisition.

For example, linguistic learners benefit from reading medical textbooks, journal articles, and case reports, as they process information best when it is presented in a detailed, written format. They often excel at writing summaries, creating study guides, and using detailed note-taking techniques, such as the Cornell method, to organize and reinforce their understanding.

Additionally, verbal expression and structured discussion are valuable for linguistic learners. Engaging in case presentations, writing patient notes, or explaining medical conditions aloud to peers helps reinforce their learning. Many linguistic learners also find that translating complex concepts into their own words—whether through essays, mnemonic devices, or teaching others—enhances comprehension and retention (Brualdi, 1996).

Research indicates that written and spoken language-based learning strategies, such as summarization, structured writing exercises, and medical debates, enhance medical students' ability to retain and apply knowledge, particularly for those with a linguistic learning preference (Chen et al., 2021).

Solitary learners, these students excel when they can engage in self-directed study, deep concentration, and introspective learning strategies rather than relying on group discussions or collaborative activities.

For example, solitary learners often thrive when using self-paced learning methods, such as reading medical textbooks, watching recorded lectures, and reviewing medical case studies independently. Many prefer creating detailed personal notes, mind maps, and summaries to structure and reinforce their understanding of complex topics. They may also benefit from writing self-reflections on clinical experiences, which helps them analyze and internalize medical concepts more effectively (Robotham., 2003).

Additionally, solitary learners excel in self-assessment techniques, such as using online question banks, practicing flashcards, or engaging in reflective journaling to track their progress. They are more likely to engage in metacognitive strategies, such as setting personal study goals and self-monitoring their learning progress, which research suggests enhances long-term retention and academic performance (Zimmerman, 2002).

In clinical settings, solitary learners may prefer to observe patient interactions carefully, take personal notes, and reflect on cases before actively engaging in discussions. Their strength lies in internalizing knowledge through independent analysis, which can be complemented by later participation in clinical practice (Muhammad Taha et al., 2018).

Social learners, thrive in collaborative environments where they can engage with peers, discuss medical concepts, and learn through group interactions (Gardner, 1983). These students excel in team-based learning, case discussions, and interactive study

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sessions, where verbal communication and shared problem-solving play a significant role in knowledge acquisition.

For example, social learners benefit from peer study groups, where they can teach and explain medical topics to each other, reinforcing their own understanding while gaining new perspectives. Problem-Based Learning (PBL) and Team-Based Learning (TBL) are particularly effective for these students, as these approaches encourage teamwork, discussion, and critical thinking.

In clinical settings, social learners excel in patient-centered learning, where they engage in case presentations, bedside teaching, and collaborative clinical rounds. They learn effectively by observing and discussing patient cases with attending physicians, residents, and fellow students. Additionally, participating in medical debates, role-playing patient interactions, and engaging in interprofessional education (e.g., working with nurses, pharmacists, and therapists) further strengthens their ability to apply medical knowledge in real-world settings.

Research suggests that interactive and social learning methods, such as cooperative learning and peer-assisted teaching, significantly enhance medical students' engagement, retention, and communication skills (Pashler et al., 2008; Burgess et al., 2014).

Kolb's model highlights the importance of experiential learning in medical training. Research suggests that blending different teaching methods, such as problem-based learning (PBL), clinical simulation, and hands-on practice, can accommodate diverse learning styles and improve knowledge retention (Pashler et al., 2008). Understanding these styles helps medical educators design more effective curricula that balance theory with practical experience (Kolb DA., 2000).

DISCUSSION

Understanding learning styles is essential in fostering effective teaching and meaningful student engagement. Learning styles refer to the varied ways individuals prefer to receive and process information—whether through visual aids, hands-on activities, verbal instructions, or reflective thinking. Theories such as VARK (Visual, Auditory, Read/Write, Kinesthetic) and Gardner's Multiple Intelligences emphasize that learners are not one-dimensional and may draw on multiple strengths.

A cross-sectional study by Amini et al on 71 Medical students in Iran using VARK questionnaire showed that medical students use different learning styles. Majority of students are visual learners, among them most female students were reading-writing style learners and made students were adopted to listening (Amini et al ,2010).

While some critics argue that there is limited empirical evidence supporting the effectiveness of tailoring instruction strictly to learning styles, educators widely acknowledge that incorporating diverse teaching strategies can enhance comprehension, motivation, and retention. Recognizing learning preferences also promotes learner autonomy, encouraging students to adopt study techniques that best suit their needs. Ultimately, while learning styles should not rigidly dictate instructional methods, they serve as a valuable framework for creating inclusive and student-centered learning environments.

A study on medical students at Birjand university using Kolbs questionnaire. The results showed that the most prevalent student learning styles were convergent 52%, absorbing 28.6%, divergent and absorbing 9.7% (Kalbasi et al, 2008).

The VARK questionnaire was distributed Ojeh et al to 157 preclinical students in Barbados. The results showed that 33.8% of the students preferred the reading/writing learning style, closely followed by kinesthetic learners at 32.5%. A higher proportion of kinesthetic learners were male compared to female students (Ojeh et al, 2017).

While the concept of learning styles—such as visual, auditory, reading/writing, and kinesthetic preferences—has been widely popular in education, research suggests limited evidence supporting the effectiveness of tailoring instruction strictly to these styles. However, acknowledging that learners have different preferences and strengths can still play a role in creating engaging and inclusive learning environments. The key lies in using varied teaching strategies that address multiple modalities, promoting deeper understanding and accommodating diverse learners. Ultimately, flexibility, active learning, and reflection remain more impactful than rigid adherence to any single learning style theory.

CONCLUSION

Effective learning techniques are foundational to achieving significant and long-term knowledge retention. Evidence-based strategies such as active recall, spaced repetition, interleaving, and elaborative interrogation have consistently shown to enhance comprehension and application of knowledge. Additionally, incorporating metacognitive approaches—such as self-reflection and self-assessment—empowers learners to take ownership of their educational journey. Ultimately, the integration of varied and student-centered learning techniques not only improves academic performance but also fosters critical thinking, adaptability, and lifelong learning skills.

Authors contributions

Dr. Nagadharshan Devendra: Conceptualization, Methodology, Writing – Original Draft, Supervision.
Dr. Shilpa. Karkera: Conceptualization, Methodology, Writing – Original Draft, Supervision.
Mr. Ethan Carroll: Data Curation, Formal Analysis, Writing – Review & Editing.

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