Engagement and Satisfaction in Team-Based Learning and Generative AI for Medical Terminology Learning

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ABSTRACT

While medical terminology is commonly taught to healthcare or science-based students, business and management students in health-related programs often struggle due to the complexity of medical word roots, prefixes, and suffixes. The incorporation of diverse teaching approaches helps bridge the learning gap by supporting students in mastering essential medical terms that are critical for their future roles in health administration and management. The objectives of this study were to assess the satisfaction, engagement, and academic achievement of students in medical terminology course using Team Based Learning (TBL) and artificial intelligence (AI) powered learning versus lecture-based method. Methods: A cross-sectional study was conducted from March to July 2025 within a health administration undergraduate program at a major public university in Malaysia, evaluating three instructional delivery modes across a 14-week course using paired sample t tests. A total of 79 students taking the Health Terminological course participated in the study. Results: Academic achievement and engagement were significantly higher under TBL and AI powered learning compared to traditional lectures. However, these gains were not reflected in the affective domain, as overall student satisfaction levels remained comparable across all three instructional methods. Conclusion: These findings reveal that a significant engagement-satisfaction trade-off is at play. To capture the full value of active methods, instructional design must address this imbalance, prioritizing not only cognitive engagement but also efforts to strategically mitigate the perception of excessive workload so that increased rigor fully translates into positive affective and learning outcomes.

Keywords: medical terminology, team-based learning, AI powered learning, Malaysia.

INTRODUCTION

Team-Based Learning (TBL), originally designed by Larry Michaelsen in the 1970s for business education, was subsequently modified for application in medical education in the early 2000s. (Fatmi et al., 2013). Since then, TBL has achieved international prominence, being adopted in medical schools throughout diverse healthcare systems, including those in the United States, Canada, the United Kingdom, Australia, and several Asian countries such as Singapore (Sterpu et al. 2023). As a teacher-facilitated method, TBL promotes students' application of information via organized small-group activities. This approach promotes active learning and enhances student participation (Burgess et al. 2014). TBL transcends the mere dissemination of content, highlighting the application of knowledge via conceptual comprehension and procedural problem-solving (Michaelsen et al. 2008). TBL promotes active learning among students for three primary reasons. Firstly, collaborative group work is essential for consolidating students' comprehension and improving their capacity to apply course contents. Secondly, a substantial amount of class time is allocated to these group activities, ensuring ongoing participation. Finally, TBL integrates various team-oriented tasks aimed at improving learning outcomes and promoting the formation of self-directed learning groups (Ghorbani et al. 2014).

Artificial intelligence (AI) is revolutionizing modern education. AI-driven algorithms and educational robots have emerged as essential elements of learning management and training systems, augmenting various instructional and learning processes (Costa et al., 2017). Utilizing data-driven machine learning methodologies, AI improves learning outcomes, streamlines instructional processes, and tailors educational resources to address specific student requirements (Wang et al. 2021). The use of AI into educational instruments, such as chatbots, automated grading systems, intelligent tutoring platforms, and student performance prediction models, offers a viable strategy for individualized learning and improved academic success (Chiu et al. 2023; Adewale et al. 2024). A systematic analysis of AI in education reveals that AI technologies have been included into four important educational domains: teaching, learning, evaluation, and administration (Chiu et al., 2023). For example, intelligent tutoring systems can recommend subject matter, assignments, and pedagogical approaches; chatbots can offer feedback to facilitate student self-regulated learning and address administrative questions; and automated grading systems can improve the efficiency and precision of assessment procedures.

The implementation of AI in education is progressing rapidly, profoundly altering the teaching and learning landscape (Popenici & Kerr, 2017). The advent of generative AI tools has created new opportunities, fostering investment and innovation in the educational AI field. In 2021, the global market for AI in education was valued at USD 1.82 billion and is projected to rise at a compound annual growth rate of 36% from 2022 to 2030 (GrandViewResearch, 2021). Concurrently, there has been a notable surge in research about AI in education in recent years, leading to an expanding corpus of literature that explores several dimensions including design, effectiveness, and impact (Chiu et al., 2023). This expanding field has attracted attention from review studies that offer a comprehensive overview of the AI in education research landscape (Hwang et al., 2020; Srinivasan, 2022). The impact of AI integration on students' academic achievement is inadequately explored (Adewale et al. 2024).

At UiTM, despite the issuance of an official academic circular by the Academic Affairs Division (Academic Circular, 2023) regarding the utilization of AI tools like ChatGPT in teaching and learning, the extent of acceptance and adoption of this technology among lecturers across various disciplines remains uncertain. The absence of empirical data regarding the degree of widespread and effective use of ChatGPT prompts inquiries into the efficacy of its implementation and the preparedness of academic personnel to include AI technologies into their pedagogical methods. Previous studies (Azizam et al., 2019; Azizam et al., 2020) have examined the perception and effectiveness of TBL in delivering the health terminology module within the same educational setting, there remains a gap in understanding how TBL compares with other instructional strategies. In particular, no study to date has conducted a comprehensive comparative analysis involving traditional lectures, TBL, and AI-powered learning methods, such as the use of ChatGPT. As higher education shifts towards more dynamic and flexible learning environments, it is critical to explore how combining active learning strategies like TBL with emerging AI technologies can enhance student engagement and learning outcomes. This study seeks to address this gap by evaluating the relative effectiveness of these three instructional approaches in supporting student learning and satisfaction, particularly within the context of medical terminology education.

The objective is to compare the student satisfaction between TBL and AI powered learning and traditional lectures, evaluate engagement by analyzing improvements in pre-test and post-test scores via Individual Readiness Assurance Tests (IRAT) and Group Readiness Assurance Tests (GRAT), and assess academic achievement by comparing quiz scores to final examination results.

METHODOLOGY

Study Design

TBL and AI powered learning intervention will be applied on the Health Terminology course from March 2025 to July 2025. The participants consisted of second-year students enrolled in the Bachelor of Business in Health Administration program under the Faculty of Business and Management, Universiti Teknologi MARA (UiTM) Selangor, Puncak Alam Campus, Selangor Malaysia. In the March 2024/25 semester, a total of 79 students were enrolled. The implementation will be conducted in accordance with the course objectives and with the approval of the Ethics Committee of the Faculty of Business and Management, Universiti Teknologi MARA (UiTM) Selangor.

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Course Description

The Health Terminology course is designed to introduce students to the fundamental principles of building medical terms using word parts, enabling them to form and interpret a wide range of terms. Additionally, the course aims to enhance students' understanding of medical terminology in relation to various human body systems. The terminology section provides a comprehensive list of combining forms and suffixes that are essential for building medical terms. Furthermore, the pathology component covers signs and symptoms, grouping diseases based on the affected organs. At the end of the course, the students should be able to; 1) assess in-depth knowledge on the anatomy and physiology of the human body systems, 2) apply comprehensive knowledge and concepts to provide appropriate medical terms related to diseases and medical procedures and 3) use a wide range of digital technologies and relevant software to present information on medical terms effectively.

The class is held twice a week for a total of four hours, with students attending all sessions over a 14-week period. The course comprised 10 chapters, starting with an introduction to medical terminology, followed by the musculoskeletal, cardiovascular, respiratory, digestive, urinary, special senses (eye and ear), integumentary, and reproductive systems. The same group of students was taught using traditional lectures, Team-Based Learning (TBL), and ChatGPT. At the beginning of the semester, students were provided with a detailed lesson plan, including the dates for the midterm and final examinations, study materials, and textbook references. Notably, the course did not include a laboratory component. The midterm examination covered the first five topics, while the final examination assessed the remaining chapters; i.e. topic 6 to topic 10.

Teaching Approaches

Three teaching methods were adopted for teaching Health Terminology course which were 1) traditional lecture, 2) TBL and 3) ChatGPT.

Lecturer-Based Learning

In the six weeks of the semester, the traditional lecture-based method for teaching anatomy and physiology for the first four topics was used; this included twenty-four hours (24 hours) of teaching. This strategy was implemented on the first four topics which were: introduction of health terminology, musculoskeletal, cardiovascular and respiratory systems. The traditional lecture method remains the most employed approach for theoretical classes, serving as a direct strategy to foster student motivation and intellectual engagement. All essential lecture-related content was thoroughly explained to the students. Students were required to complete five short-answer questions related to the lecture both at the beginning and end of the class as part of the pre- and post-tests. Additionally, during the mid-term examination, they were required to complete 30 multiple-choice questions (MCQs) covering the first five topics.

Team Based Learning

Over the following six weeks, TBL was applied to the digestive, urinary, nervous, and special senses (eye and ear) systems. This included twenty hours (20 hours) of teaching. One week before the first TBL session, students were divided into five groups (n = 6). Additionally, a week prior to the class, all students were provided with a study guide outlining the learning objectives and assigned reading materials. Prior to the start of the class, students independently reviewed the preparatory materials, and the TBL procedure was explained to them. Before the session began, they were required to complete a pre-test consisting of five short-answer questions related to the lecture within five minutes. The individual readiness assurance test (IRAT) evaluated students' comprehension and application of key concepts related to the anatomy and physiology of body systems. Immediately following the IRAT, pre-assigned teams of six students reassessed the same quiz within 15 minutes, reaching a consensus on their answers. This collaborative assessment was referred to as the group readiness assurance test (GRAT). The team responses were reviewed by having all groups present their answers simultaneously. In cases where discrepancies arose, teams were asked to justify their answers through a structured discussion on the Readiness Assurance Test (RAT) questions. This discussion phase was allocated 15 minutes. The entire process was conducted within the first hour of the class session (Mody, 2013; Chung et al, 2009)

AI-Assisted Learning

ChatGPT (OpenAI) is an AI-powered learning tool designed to enhance student engagement and comprehension (OpenAI, 2023). In this study, it was implemented for the final two topics, the integumentary and reproductive systems. To ensure standardisation and maintain internal validity during the AI-assisted learning phase, the implementation of ChatGPT was structured and guided. ChatGPT was utilized to support students in building and translating medical terminology while also providing detailed explanations of the anatomy and physiology of various body systems. Through ChatGPT, students could input medical terms to receive instant definitions, pronunciation guides, and contextual examples. Additionally, the platform reinforced vocabulary acquisition through AI-generated flashcards. For instance, students could prompt ChatGPT to generate flashcards for key reproductive system terms (e.g., ovulation, endometriosis, epididymis), including definitions, mnemonics, and example sentences. This approach was expected to enhance students' retention and comprehension of medical terminology, particularly as many of the participants did not have a background in the sciences. Furthermore, the variation in instructional hours across the three methods; including 24 hours for lectures, 20 hours for TBL, and 12 hours for AI that was a necessary constraint dictated by natural conceptual density of predetermined syllabus topics, rather than an intentional experimental variable.

Statistical Analysis

This study evaluates three key outcomes: student satisfaction, engagement and academic achievements. After students completed three sessions, students' satisfaction was measured using five-item questionnaire, developed by Ghorbani et al. (2014) which included five options of strongly agree, agree, neutral, disagree and strongly disagree, to evaluate their levels of satisfaction with each session. To provide a systematic interpretation of the satisfaction levels, the 5-point Likert scale items were analysed as composite continuous data using mean scores, a standard practice supported by educational and psychometrics studies (Koo & Yang, 2025; Sullivan & Artino, 2013). A 3-tier Evaluation Framework was utilised transforming the scale averages into categorical descriptive data. The interval width for each level was calculated by dividing the scale range by the desired number of tiers, resulting in three distinct levels of agreement; including low level (1.00 - 2.33, moderate level (2.34 – 3.67) and high level (3.68 – 5.00).

Student engagement was measured by the improvement in students' scores between the pre-test and post-test of IRAT and GRAT. The pre-test scores were analysed in comparison to the post-test scores, while the midterm examination results following the lecture sessions were evaluated against the final examination scores obtained after the implementation of TBL and AI powered learning sessions, to evaluate the academic achievements of these strategies in comparison to traditional lecturing. The data was presented as mean ± standard deviation (SD) and was analysed using a paired sample t-test. A significance level of $p < 0.05$ was applied.

RESULTS

Findings of this study are presented in three domains; including student satisfaction, engagement and academic achievement. Student satisfaction was measured using a standardised five items survey questions, student engagement was evaluated through improvements in individual and group readiness assurance test scores, and academic achievement was determined by comparing two assessments results; midterm and final examinations. Detailed findings are explained in the following sections.

Satisfaction

Across all five satisfaction items, no statistically significant differences were found between lecture, TBL, and AI-assisted learning methods ($p > 0.05$). Based on the 3-Tier Evaluation Framework, the findings report a high level of student agreement of the satisfaction level (3.68 – 5.00) across all items of satisfaction for all three instructional approaches. Mean satisfaction scores were consistently exceeded the high-tier baseline (ranging from 4.12 to 4.46 on a 5-point scale), indicating that students generally perceived all three methods positively

(Table 1). Lecture was rated slightly higher for promoting interaction (M = 4.46, SD = 0.78). TBL showed a marginally higher mean score for encouraging consistent study habits (M = 4.42, SD = 0.96). The AI tool received the highest mean for improving problem-solving skills (M = 4.32, SD = 0.71). These findings suggest that while none of the teaching methods demonstrated superiority in satisfaction outcomes, each method may contribute uniquely to different aspects of student learning experiences.

Table 1. Student satisfaction score

Questions	Satisfaction Mean (SD)			p value
	Lecture	TBL	AI tool	
I found that this learning style helped me understand anatomical concepts.	4.27(0.73)	4.28(0.80)	4.23 (0.72)	p>0.05
I found that this style of learning encouraged clinical anatomy problem-solving.	4.19(0.78)	4.19(0.92)	4.17(0.77)	p>0.05
I found that this type of learning encouraged questions, discussions and interactions.	4.46(0.78)	4.32(0.84)	4.29(0.74)	p>0.05
I found that this type of learning forced me to study more consistently.	4.27(1.0)	4.42(0.96)	4.12(0.85)	p>0.05
I found that this learning style improved my problem-solving skills.	4.19(0.92)	4.22(1.0)	4.32(0.71)	p>0.05

Engagement

The paired sample t-test showed a statistically significant difference between the Individual IRT and the GRT scores ($p < 0.01$). Students scored substantially higher in the GRT (Mean = 83.13, SD = 11.38) compared to the IRT (M = 40.94, SD = 19.72) (Table 2).

This indicates that group collaboration in TBL greatly enhanced student performance. The marked improvement from individual to group performance suggests that peer discussion and teamwork promoted engagement with the course content.

Table 2. Comparison of IRT and GRT Scores in TBL

Test	Mean (SD)	p-value
IRT	40.94(19.72)	<0.01
GRT	83.13(11.38)	

Academic Achievement

Three teaching methods were adopted for teaching Health Terminology course which were 1) Lecture-based learning, 2) Team-based learning and 3) AI assisted learning.

The paired sample t-test showed that the mean score for the assessment 2 (M = 48.00, SD = 20.52) was slightly higher than the mean score of the assessment 1 (M = 44.56, SD = 21.63). The difference approached statistical significance ($p = 0.05$), suggesting a trend toward knowledge gain from the midterm examination to the final examination (Table 3).

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Table 3. Midterm and final examination scores

Measure (score)	Mean (SD)	p-value
Quiz	44.56(21.63)	0.05
Final Exam	48.00(20.52)	

DISCUSSION

This study was conducted to evaluate the effects of different teaching styles on the academic performance and learning experiences of second-year Health Administration students at Universiti Teknologi MARA. This study extends the findings of previous studies (Azizam et al., 2019; Azizam et al., 2020) by incorporating an AI strategy into TBL and comparing it with conventional lectures. The enhancement of teaching quality has become a crucial goal in higher education due to limited educational resources and differences in talent development. An expanding corpus of scholarly literature has evidenced the substantial impact of pedagogical approaches on students' academic outcomes and engagement levels. The methodologies employed by educators can influence not only the students' drive and emotional commitment to learning but also their cognitive achievements and overall academic prosperity (Zhou et al. 2025).

In general, medical terminology, anatomy and human physiology are fundamental subjects for students in nursing, allied health sciences and medical programs. To enroll in these programs, students are required to meet the entry requirements by passing science subjects such as biology, chemistry, and physics, in accordance with the program standards set by the Malaysian Qualifications Agency (MQA) (Malaysian Qualification Agency, Program Standard Medical and Health Science, 2016). However, unlike students in the health administration program under the Faculty of Business and Management (FBM), this program follows the program standards of Business Studies, where students are not required to have a science background (Malaysian Qualification Agency, Program Standard Business Studies 2nd Edition 2021: Student Admission Portal UiTM, 2024). This imposes additional pressure on lecturers, necessitating the adaptation of their pedagogical methods to ensure these students are learning effectively.

In the past, the prestige of an academic program was closely associated with the content (the syllabus, the faculty's expertise) that conventional curriculum design models were structured and prescriptive. Traditionally, the curriculum was delivered systematically through teacher centered approach (Zhao et al. 2025) which made students passive recipients of knowledge. The importance of student-centered learning, accountability for learning outcomes, and the quality of the student experience has shifted, necessitating a focus on delivery methods. The rapid transition to remote learning has necessitated that academic institutions focus on pedagogical methods and delivery modalities (blended, online, virtual) to sustain student engagement. This recent shift requires that delivery be prioritized (Mariam et al., 2023).

Overall, students rated higher satisfaction on three teaching approaches; however, there were no statistically significant differences in satisfaction scores between them. While some students expressed positive reactions towards TBL, others reported negative experiences due to perceived higher workloads and challenges associated with the method (Fatmi et al., 2013; Haidet et al., 2014). In TBL, students are required to undertake extensive preparation during the preparatory phase, followed by the IRT and the GRT (Burgess et al., 2014), This heavy preparatory phase may be overly demanding for students who lack a foundational background in science, which could account for the observed findings. Another possible explanation for this might be associated with students' familiarity and learning habits. This course is taken in Semester 3, which means that students were already accustomed to lectures and may feel comfortable with this traditional format since Semester 1. Therefore, satisfaction levels may not differ significantly, as students tend to adapt to lectures more quickly than to newer methods such as TBL and AI. Furthermore, the short duration of TBL exposure in this study may not have been sufficient for students to fully recognize its advantages, resulting in satisfaction scores comparable to lectures.

Findings showed improved knowledge acquisition when the students adopted the TBL approach. The findings align with previous study who demonstrated superior cognitive outcomes compared to lecture-based instruction in the short term (Alizadeh, et.al., 2024). Moreover, it consistent with the cognitive load theory, which suggests that collaborative learning environments can reduce extraneous cognitive load and enhance constructive cognitive load, facilitating deeper learning (Sweller, et.al., 2019). The collaborative environment enhances individual learning outcomes while fostering the development of teamwork and communication skills, which are essentially needed for professional success. These activities distribute the cognitive load among various cognitive processes, including information processing, decision-making, and reflection. TBL thus consistently enhances students' cognitive performance, positioning it as a valuable pedagogical approach. Kozanitis and Nenciovici (2023) conducted a meta-analysis across 104 studies and found that active learning methods, including TBL, yielded significantly higher academic achievement than traditional lectures. Consistently, Wijnia et al. (2024) found that problem-driven learning approaches including TBL and PBL moderately positively affected the motivation and cognitive engagement among students, particularly in healthcare domains. These current findings suggest that TBL approach enhances immediate performance as reflected in GRAT scores as well as contributes to deeper cognitive processing and sustained academic growth. A recent study conducted by Xie, et. al., (2025) further supports these findings, indicating that TBL pedagogy contributes significantly to the overall quality of education. Similarly, a study in China explored the integration of TBL with Peer Teaching (PT) among dental students and found that the combined strategy not only improved performance in key clinical procedures but also fostered stronger emotional investment and teamwork (Wang et al., 2025).

The results demonstrated a substantial level of engagement, as evidenced by the disparity between the IRT and GRT scores. The substantial increase in student engagement is a direct result of the inherent structural design of TBL, which effectively precludes the prospect of passive learning and compel active participation. By mandating students to process, discuss, and apply information during application exercises, the methodology guarantees sustained cognitive and behavioural effort, which is a dynamic clearly reflected in the heightened engagement scores. This mandatory engagement is further exacerbated by social accountability, which is one of the four fundamental components of TBL (Michaelsen et al. 2008). Students are encouraged to participate in team discussions and complete preparatory work by the immediate, high-stakes peer pressure introduced by the GRT. This external social pressure is a structural driver of engagement that is particularly effective for students with no foundation in the subject, as it functions largely independently of a student's prior content knowledge. Additionally, a study has demonstrated that students' greatest individual academic performance is frequently surpassed by the collaborative nature of TBL, as they work in diverse teams (Carlos et.al., 2023). Similar results were reported by Pérez-Guillén et al., (2025) which found that TBL fostered deeper engagement, promoted skill development, autonomous learning, and self-regulation among students in Spain. A recent meta-analysis has further indicated a favorable effect of TBL in contrast to conventional lecture-based methods when it comes to getting students more motivated, encouraging them to work together, and getting them to participate more (Xie et al., 2025). Nevertheless, a critical distinction is evident in the affective domain: the current findings indicate that there is no significant difference in satisfaction scores between TBL and the alternative teaching methods, even though the previous study also reported higher satisfaction. This discrepancy implies that there is a distinction between affective perception and behavioral change. Although active learning methods such as TBL generally improve student engagement and performance, which should theoretically lead to an increase in satisfaction, the concurrent demands for a substantial increase in effort and responsibility may limit the satisfaction of students who lack prior expertise.

Study Implications and Limitation of Study

Findings from this study indicate that while both TBL and AI-powered instruction effectively improved student engagement and knowledge acquisition, they did not lead to a statistically significant increase in student satisfaction compared to traditional methods. This mixed outcome reveals a critical knowledge gap: while these innovative pedagogies are effective in terms of cognitive gains, their impact on the affective domain of learning is not guaranteed. The study's mixed results warrant further investigation, specifically through a subgroup analysis to reveal concealed effects. Such an analysis could help determine if these methods were satisfying for specific groups of students, such as those with different learning preferences or prior levels of familiarity with the subject. Furthermore, to fully capture the student experience, future research on teaching styles must move beyond simple cognitive outcomes (e.g., test scores) and simple affective outcomes (e.g., overall satisfaction) in

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accordance with the proposed trade-off. Furthermore, with the breakthrough of AI as other way of learning platform, more tools that are AI-based should be incorporated into the learning session. For example, the instructor might provide command prompts to AI specific engine to the students to enhance the student's learning experience and test their cognitive skills at the end of AI learning session simultaneously.

While this study offers valuable empirical evidence into the integration of active learning and generative artificial intelligence (AI) within non-science backgrounds students, several limitations must be acknowledged. A primary limitation of this study is the uneven instructional time allocated across the three teaching approaches. Lecture-based learning was performed over 24 hours, Team-based learning (TBL) over 20 hours, and the ChatGPT platform over 12 hours only. Thus, this variance may have restricted the students' capacity to fully adapt to and benefit from the AI-powered learning environment (Alizadeh et.al., 2024). Furthermore, the curricular content was delivered sequentially rather than parallelly. This is introducing potential confounding variables related to topic difficulties. A complex and structurally dense human systems (for example cardiovascular and respiratory systems) were taught via traditional lectures, whereas less conceptually granular topics were taught using the AI-powered delivery modes. Consequently, the observed academic achievement trends may be partially reflective of varying intrinsic topic difficulty rather than pedagogical efficacy. Lack of assessment separation was another limitation of the study. This study could not statistically separate the independent cognitive impact of ChatGPT from TBL framework during final assessment because the final examination assessed all remaining topics taught under both the TBL and AI framework combined.

Lastly, the sample of study was small, relying on a single cohort, localised sample of health administration students enrolled during the semester of March 2024/25 at a single campus of Universiti Teknologi MARA. The limited sample size restricted the broader generalisability of the results. To build upon these preliminary findings, future research should expand this framework across multiple institutions. Utilising a multi-centre approach with larger, randomised cohorts will be crucial to validate the generalisability of the engagement-satisfaction trade-off observed here, and to better isolate the independent cognitive impacts of TBL and AI-based learning environments.

CONCLUSION

The findings suggests that while active engagement from TBL is effective for increasing cognitive outcomes such as deeper learning and behavioral outcomes such as preparation, attendance, the concurrent, the IRT and extensive preparatory load create a perception of high workload and effort. This perceived increase in effort acts as a dampening factor on affective outcomes, specifically overall student satisfaction. Consequently, the satisfaction scores do not rise as significantly as the high level of engagement and perceived learning gains might predict. Students perceive a distinct trade-off between the affective comfort (lower tension, less preparation) frequently correlated with traditional, inert learning models and the increased effort required for active engagement. Consequently, the effective implementation and evaluation of active learning must transcend conventional metrics of performance and satisfaction. To prevent the intellectual benefits of engagement from being emotionally neutralized by the demands of the process, educators must strategically design and construct these methods to mitigate the perceived burden of the rigor (e.g., by explicitly articulating the value of the effort). The genuine challenge is to optimize the active learning experience to minimize the perception of an excessive, comfort-reducing workload and maximize engagement.

Declaration of AI tool usage in research

ChatGPT as an instructional intervention variable. In accordance with the research design of this study, generative artificial intelligence through the ChatGPT platform (OpenAI, 2023) was explicitly utilized instructional delivery medium and pedagogical treatment method for the final two topics of the Health Terminology course (the integumentary and reproductive systems). The tool functioned as an active learning aid to support non-science background students particularly in vocabulary retention, term translation, and contextual applications mnemonics flashcard generation. The cognitive and affective data obtained from this cohort were evaluated against the lecture-based learning and Team-based learning approaches. The AI tool was implemented strictly as environmental variable under empirical observation.

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