

GREEK AND LATIN BASED TEACHING STRATEGIES IN ANATOMY FOR UNDERGRADUATE STUDENTS: A SYSTEMATIC REVIEW

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Primljen/Received: 13. 06. 2026.

Prihvaćen/Accepted: 24. 07. 2026.

Online First: July 2026

Abstract: Background: Anatomy education relies heavily on Greek and Latin terminology, which often poses a challenge for undergraduate students because of its complexity and unfamiliarity. Traditional rote memorization methods limit conceptual understanding and long-term retention.

Objective: To systematically review the evidence on Greek- and Latin-based teaching strategies in anatomy education for undergraduate students and evaluate their effectiveness in improving comprehension, retention, and clinical application.

Methods: A systematic search of educational and anatomical literature was conducted using databases and academic sources focusing on anatomy teaching strategies, terminology learning, and etymology-based instruction. Studies included undergraduate medical and allied health education contexts. Data were analyzed to identify key teaching strategies and outcomes.

Results: Evidence suggests that root-based learning, contextualized instruction, multimodal teaching approaches, and active learning strategies significantly enhance students' understanding of anatomical terminology. Linguistic based approaches improved knowledge retention, confidence, and the ability to interpret unfamiliar terms.

Conclusion: Greek- and Latin-based teaching strategies transform anatomy learning from memorization to meaningful understanding. Integrating etymology with clinical and experiential learning improves academic performance and supports the development of professional competencies.

Keywords: Anatomy education, Greek terminology, Latin terminology, medical education, undergraduate students, teaching strategies.

INTRODUCTION

Anatomy is widely recognized as a foundational discipline in medical and allied health education, form-

ing the basis for clinical diagnosis, patient assessment, and therapeutic decision-making. Central to the study of anatomy is its terminology, which is predominantly derived from Greek and Latin languages, providing a standardized and universally accepted system of communication across healthcare professions (1, 2, 3).

The use of classical languages in anatomical nomenclature ensures precision, clarity, and consistency in describing the human body. Standardized anatomical terminology plays a critical role in reducing ambiguity and improving interdisciplinary communication in clinical practice (4, 5).

In addition, evidence suggests that standardized terminology contributes to improved patient safety by minimizing errors associated with miscommunication (6).

Despite its importance, mastering anatomical terminology remains one of the most challenging aspects of early medical education. The terminology is often complex, unfamiliar, and linguistically dense, leading many undergraduate students to rely on rote memorization rather than meaningful understanding (5, 7). This challenge is further compounded by the inherently detailed and spatial nature of anatomy, which imposes a significant cognitive load on learners (8, 9). High cognitive demands can hinder knowledge retention and limit the ability to integrate anatomical concepts into clinical contexts.

Modern educational theories emphasize the importance of deep learning approaches, where knowledge is actively constructed rather than passively received. Constructivist theory suggests that students develop understanding by linking new information with prior knowledge and engaging in meaningful learning activities (10, 11). In the context of anatomy education, this perspective highlights the need for innovative teaching strategies that move beyond traditional lecture-based instruction.

One such approach involves the integration of Greek and Latin etymology into anatomy teaching, enabling students to decode the meaning of complex terms through their linguistic components. Anatomical terms often describe structure, function, shape, or location, making etymological understanding a powerful tool for conceptual learning (7).

Evidence indicates that incorporating etymology into anatomy curricula enhances student comprehension, retention, and confidence in using medical terminology (3).

Furthermore, integrating terminology learning with clinical and surface anatomy applications enables students to contextualize knowledge and develop practical skills. Constructive, collaborative, and contextual learning environments have been found to improve both knowledge acquisition and student satisfaction in anatomy education (11).

Taken together, these findings suggest that combining Greek and Latin linguistic strategies with modern educational approaches offers a promising framework for improving anatomy education. However, there remains a need to systematically evaluate the effectiveness of these strategies in undergraduate settings.

Therefore, this study aims to conduct a systematic review of Greek and Latin-based teaching strategies in anatomy education and to assess their impact on student learning outcomes, including comprehension, retention, and clinical application.

MATERIAL AND METHODS

This study was conducted as a systematic review following the principles outlined in the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA 2020) guidelines. The PRISMA framework was adopted to ensure a transparent, reproducible, and structured approach to identifying, screening, and synthesizing relevant literature.

A comprehensive literature search was performed to identify studies investigating Greek- and Latin-based teaching strategies in anatomy education. Electronic databases searched included: PubMed, Scopus, ERIC (Education Resources Information Center), ScienceDirect, and Google Scholar.

The search strategy combined keywords related to anatomy education, terminology learning, and pedagogical methods using Boolean operators. The search string included: ("anatomy education" OR "medical education") AND ("Greek terminology" OR "Latin roots" OR "etymology") AND ("teaching strategies" OR "learning methods") AND ("undergraduate students"). The search was limited to English-language publications and studies relevant to undergraduate education.

Boolean operators were applied to refine the search.

Inclusion Criteria

Studies were included if they: a) involved undergraduate medical or allied health students, b) focused on anatomy teaching or terminology learning, c) reported Greek- or Latin terminology-based or etymology-based approaches and d) included measurable outcomes such as knowledge retention, comprehension, or application

Exclusion Criteria

Studies were excluded if they: a) Focused exclusively on postgraduate or specialist training, b) Did not address teaching or learning strategies, c) Were opinion articles without evaluative data and d) Were not available in full text

All identified studies were initially screened based on titles and abstracts. Duplicate records were removed prior to screening. Full-text articles were then assessed independently for eligibility based on predefined inclusion and exclusion criteria. Any discrepancies in study selection were resolved through discussion and consensus.

The study selection process was documented using a PRISMA flow diagram, which summarizes the number of records identified, screened, excluded, and included in the final analysis (Figure 1).

Relevant data from each included study were systematically extracted and organized into a standardized format, including:

- Author(s) and year of publication
- Study design and sample size
- Educational setting and population
- Teaching intervention (e.g., etymology-based learning, multimodal approach)
- Outcome measures (knowledge, retention, engagement)
- Key findings

This structured extraction enabled comparison across studies and facilitated thematic analysis.

The methodological quality of included studies was evaluated using a descriptive appraisal approach. Studies were assessed based on:

- Clarity of study design
 - Sample size adequacy
 - Validity of outcome measures
 - Relevance to undergraduate anatomy education
- Studies were categorized as:
- High quality – Experimental or controlled studies
 - Moderate quality – Quasi-experimental or mixed-methods studies

- Low quality – Descriptive or observational reports

Due to variability in study designs, populations, and outcomes, a quantitative meta-analysis was not feasible. Therefore, a qualitative thematic synthesis was performed.

Studies were grouped into key thematic categories:

- Etymology-based learning (Greek/Latin root analysis)
- Contextual and clinical integration
- Multimodal teaching approaches
- Active learning strategies
- Surface anatomy integration

This approach allowed identification of patterns, similarities, and differences across studies while maintaining methodological rigor.

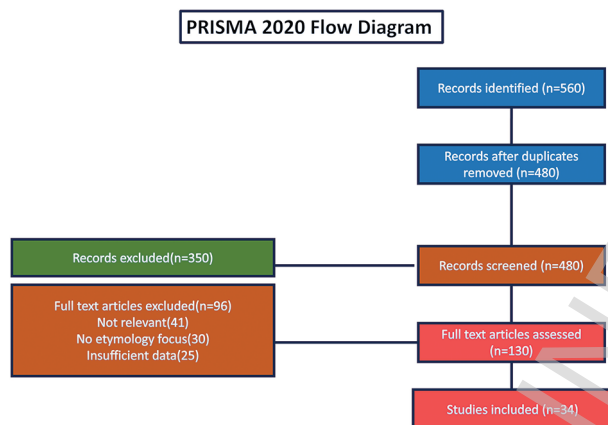


Figure 1. PRISMA flow diagram illustrating the systematic review process, including identification, screening, eligibility assessment, and inclusion of studies evaluating Greek and Latin-based teaching strategies in anatomy education

RESULTS

A total of 560 records were identified through database searches. After the removal of duplicates, 480 records remained and were screened based on titles and abstracts. Of these, 350 studies were excluded due to irrelevance to the research topic, focused on post-graduate education, or did not report educational outcomes.

Subsequently, 130 full-text articles were assessed for eligibility. Among these, 95 studies were excluded due to lack of focus on etymology-based teaching, insufficient methodological rigor, or absence of relevant learning outcomes. Finally, 34 studies were included in the qualitative synthesis (Table 1).

The included studies consisted of experimental, quasi-experimental, and descriptive designs and

primarily involved undergraduate medical and allied health students. Analysis of the included studies identified three major themes: 1. etymology-based learning, 2. cognitive and conceptual learning approaches, and 3. contextual application of anatomical terminology.

These categories align with contemporary anatomy education frameworks emphasizing active and contextual learning (11, 12).

Etymology-Based Learning

The majority of included studies reported positive outcomes associated with teaching Greek and Latin roots, prefixes, and suffixes. Students who learned terminology through etymological analysis demonstrated a greater ability to interpret unfamiliar anatomical terms and reported reduced reliance on memorization (7, 13-17).

Several studies found that etymology-based instruction improved terminology recall, spelling accuracy, and overall confidence in the use of medical language (16, 17). Students reported that terminology as more meaningful and easier to remember when roots and word origins were explicitly taught.

Cognitive and Conceptual Learning

Several studies highlighted the importance of organizing terminology learning in ways that reduce cognitive burden and promote meaningful knowledge construction (8, 9, 10, 15, 18-21).

Teaching strategies that emphasize relationships between word roots and anatomical concepts facilitated deeper understanding and improved information retention. Studies applying principles of cognitive load theory suggested that dividing complex terms into meaningful linguistic components reduced the mental effort required to learn anatomical terminology (8, 18).

Contextual Application of Terminology

A number of studies indicated that terminology learning was more effective when integrated with anatomical concepts and clinical examples (11, 20-34)

Students were better able to retain terminology when they understood its relationship to structure, function, and clinical practice. Educational approaches that connected terminology to broader anatomical knowledge promoted long-term retention and transfer of learning (25, 29-34).

Overall, the reviewed studies consistently indicated that Greek- and Latin-based instruction improves the acquisition of anatomical terminology, particularly when linguistic analysis is combined with meaningful learning activities and contextual application.

Table 1. *Characteristics of included studies (n = 34)*

No	Author (Year)	Study Design	Population	Teaching Strategy	Key Findings
1	Smith et al. (2007) (3)	Descriptive	Medical students	Etymology-based	Better understanding
2	Singh (2024) (4)	Review	Students	Terminology teaching	Improved communication
3	Strzelec et al. (2017) (5)	Review	Medical learners	Terminologia	Standardization
4	Pampush & Petto (2011) (7)	Cross-sectional	Undergraduates	Latin/Greek terminology	Improved recognition
5	Rizvi et al. (2026) (8)	Review	Students	Cognitive load	Improved learning
6	Bolatli & Bolatli (2024) (9)	Experimental	Students	Concept mapping	Better retention
7	Taber (2024) (10)	Theory	Education	Constructivism	Meaningful learning
8	Bergman et al. (2013) (11)	Experimental	Medical	Contextual	Improved skills
9	Freeman et al. (2014) (12)	Meta-analysis	STEM	Active learning	Higher performance
10	Wulff (2004) (13)	Review	Medical learners	Linguistic approach	Logical interpretation
11	Cortés et al. (2024) (14)	Assessment study	Medical students	Greek/Latin roots	Conceptual clarity
12	Burhonova (2024) (15)	Descriptive	Students	Latin learning	Reduced difficulty
13	Ebenezer & Mohanraj (2020) (16)	Experimental	MBBS	Etymology teaching	Better recall
14	Chmielewski (2023) (17)	Review	Medical	Terminology	Improved comprehension
15	Sweller (2011) (18)	Theory	Education	Cognitive load	Efficient learning
16	Mayer (2009) (19)	Theory	Education	Multimedia	Better retention
17	Kolb (1984) (20)	Theory	Education	Experiential	Improved learning
18	Biggs (2014) (21)	Theory	Higher education	Alignment	Better outcomes
19	Prince (2004) (22)	Review	Students	Active learning	Better engagement
20	Cook (2014) (23)	Review	Medical	Technology	Enhanced knowledge
21	Hattie (2009) (24)	Meta-analysis	Education	Evidence-based	Strong effect
22	Bloom (1956) (26)	Theory	Education	Taxonomy	Structured learning
23	Schmidt (1983) (27)	Theory	Medical	PBL	Better understanding
24	Ausubel (1968) (28)	Theory	Education	Meaningful learning	Retention improved
25	McBride (2018) (29)	Experimental	Students	Reinforcement	Retention improved
26	Chan & Pawlina (2015) (30)	Guide	Medical	Teaching methods	Integrated learning
27	Drake et al. (2020) (31)	Textbook	Students	Terminology integration	Concept clarity
28	Moore et al.(2018) (32)	Textbook	Students	Clinical terminology	Application
29	Standring (2020) (33)	Reference	Students	Standard language	Consistency
30	Tennakoon (2023) (34)	Review	Students	Applied anatomy	Better understanding
31	Turney (2007) (35)	Review	Medical	Anatomy teaching	Improvement needed
32	Estai& Bunt (2016) (36)	Review	Students	Teaching methods	Higher engagement
33	Wong et al. (2026) (37)	Curriculum	Students	Root-based	Better decoding
34	Abu Bakar et al. (2025) (38)	Experimental	Allied health	Applied teaching	Improved outcomes

DISCUSSION

The present review examined the role of Greek- and Latin-based teaching strategies in anatomy education. The findings suggest that etymological instruction supports terminology acquisition by enabling students to interpret anatomical language through understanding rather than memorization. The effectiveness of these approaches can be explained through two educational frameworks frequently discussed in anatomy education: constructivist theory and cognitive load theory.

Constructivist Theory and Terminology Learning

Constructivist theory proposes that learners actively construct knowledge by connecting new information to previously acquired knowledge and experiences (10, 21).

Learning is therefore most effective when students understand relationships and meanings rather than passively memorizing isolated facts.

In anatomy education, Greek and Latin roots provide meaningful building blocks that enable students to connect unfamiliar terms with familiar concepts. For example, understanding that the prefix *hypo-* means “below” and *derm* refers to “skin” allows students to understand the meaning of *hypodermic* without memorizing the term separately. This process encourages active knowledge construction rather than rote learning.

The findings of this review support this explanation. Studies reported that students who learned terminology through etymological analysis demonstrated improved comprehension and greater confidence in interpreting unfamiliar anatomical vocabulary (7, 13, 16, 17).

Thus, constructivist theory provides a theoretical explanation for why Greek- and Latin-based instruction promotes deeper learning.

Cognitive Load Theory and Terminology Learning

Cognitive load theory explains learning in terms of the limitations of working memory (8, 9, 18). When learners are required to memorize large amounts of unfamiliar information simultaneously, cognitive resources become overloaded, reducing learning efficiency.

Anatomical terminology presents precisely this challenge because students encounter hundreds of unfamiliar words derived from classical languages. Understanding Greek and Latin word components can

reduce cognitive load by organizing terms into meaningful patterns. Instead of memorizing each word individually, students learn recurring roots, prefixes, and suffixes that can be applied across multiple terms.

For example, knowledge of roots such as *oste-* (bone), *myo-* (muscle), and *cardio-* (heart) allows students to interpret numerous related terms. This approach decreases the amount of information that must be memorized separately and facilitates more efficient processing of terminology (8, 18).

Therefore, cognitive load theory explains why etymology-based instruction improves terminology learning: it reduces unnecessary cognitive burden while promoting the organization of information into meaningful structures.

The reviewed studies suggest that teaching strategies should not be selected merely because they are traditional or commonly used; their effectiveness should be grounded in learning theory.

Constructivist theory supports Greek- and Latin-based teaching because it promotes meaningful learning through the construction of relationships between linguistic roots and anatomical concepts (10, 21). Cognitive load theory supports the same strategy because it reduces the memory burden associated with learning large volumes of unfamiliar terminology (8, 18).

Furthermore, the effectiveness of etymology-based teaching reported by multiple studies suggests that students benefit when terminology is presented as a meaningful linguistic system rather than as isolated vocabulary items (7, 14-17).

Together, these theories explain why etymology-based approaches are consistently associated with improved comprehension, retention, and confidence among anatomy students. Rather than functioning solely as a language exercise, Greek and Latin terminology serves as an organizational framework that helps students understand and retain anatomical knowledge.

Educational Implications

The findings indicate that the educational value of Greek and Latin terminology extends beyond vocabulary acquisition. Etymology-based strategies help students understand the logic of anatomical language and develop skills that enable them to interpret unfamiliar terms independently. Such skills are particularly important in medicine, where new terminology is encountered throughout professional practice (3-5, 13, 14, 35, 36).

Additional evidence (11, 25, 30-34) indicates that terminology learning is most effective when integrated with anatomical concepts and clinical applications. Such skills are particularly important in medicine,

where learners continually encounter new terminology throughout their professional careers.

Consequently, the teaching of Greek and Latin terminology should be incorporated systematically within undergraduate anatomy curricula. Rather than treating terminology as a list of words to memorize, educators should use etymological analysis as a tool for promoting conceptual understanding and long-term retention.

CONCLUSION

The findings of this review indicate that Greek and Latin-based teaching strategies improve anatomical terminology learning by promoting meaningful understanding of word structure and reducing reliance on rote memorization. Constructivist theory explains these benefits through active knowledge construction, whereas cognitive load theory explains them through the reduction of unnecessary memory burden. Together, these frameworks suggest that etymology-based instruction functions as an effective cognitive and educational scaffold for learning anatomical language. Therefore, Greek and Latin terminology should be integrated systematically into undergraduate anatomy curricula as a means of enhancing comprehension, re-

tention, and the ability to interpret unfamiliar medical vocabulary throughout professional practice.

Acknowledgment: None.

Financial Support: None.

Conflict of Interest Statement: The author declare that there is no conflict of interest related to this paper.

Author contributions and responsibilities: The corresponding author confirms having conceived the study, designed the methodology, collected and analyzed the data, interpreted the results, drafted and revised the manuscript, and approved the final version. The author takes full responsibility for the accuracy and integrity of the content, as well as the validity of institutional affiliations. The publisher remains neutral regarding jurisdictional claims in institutional affiliations.

Data availability statement: Requests to access the datasets should be directed to the corresponding author.

Note: Artificial intelligence was not utilized as a tool in this study.

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Sažetak

NASTAVNE STRATEGIJE ZASNOVANE NA GRČKO-LATINSKOJ TERMINOLOGIJI U ANATOMIJI ZA STUDENTE OSNOVNIH STUDIJA: SISTEMATSKI PREGLED

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Uvod: Nastava anatomije u velikoj meri se oslanja na grčku i latinsku terminologiju, što često predstavlja izazov za studente osnovnih studija zbog njene složenosti i nepoznatosti. Tradicionalne metode učenja napamet ograničavaju konceptualno razumevanje i dugoročno zadržavanje znanja.

Cilj: Sistematski pregledati dokaze o nastavnim strategijama zasnovanim na grčkoj i latinskoj terminologiji u nastavi anatomije za studente osnovnih studija i proceniti njihovu efikasnost u unapređenju razumevanja, zadržavanja znanja i primene u kliničkom kontekstu.

Metode: Sprovedena je sistematska pretraga obrazovne i anatomske literature korišćenjem baza podataka i akademskih izvora, sa fokusom na nastavne strategije u anatomiji, učenje terminologije i nastavu zasnovanu na etimološkom pristupu. U analizu su uključene studije koje su obuhvatale studente osnovnih studija medicine i drugih zdravstvenih struka. Podaci

su analizirani radi identifikovanja ključnih nastavnih strategija i ishoda.

Rezultati: Dokazi ukazuju na to da učenje zasnovano na korenima reči, kontekstualizovana nastava, multimodalni nastavni pristupi i strategije aktivnog učenja značajno unapređuju razumevanje anatomske terminologije kod studenata. Lingvistički zasnovani pristupi poboljšali su zadržavanje znanja, samopouzdanje i sposobnost tumačenja nepoznatih termina.

Zaključak: Nastavne strategije zasnovane na grčkoj i latinskoj terminologiji transformišu učenje anatomije sa pukog memorisanja na smisleno razumevanje. Integracija etimologije sa kliničkim i iskustvenim učenjem unapređuje akademski uspeh i podržava razvoj profesionalnih kompetencija.

Ključne reči: Nastava anatomije, grčka terminologija, latinska terminologija, medicinsko obrazovanje, studenti osnovnih studija, nastavne strategije.

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How to cite this article: Pandurangam G. Greek and Latin Based Teaching Strategies in Anatomy for Undergraduate Students: A Systematic Review. Sanamed. Online First, July. 2026. doi: 10.5937/sanamed0-68219.

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