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The Practice of Artificial Intelligence Technology in the Teaching of Human Anatomy

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Abstract: As a foundational discipline in medical education, human anatomy teaching has long been constrained by the scarcity of specimen resources and students' weak spatial cognitive abilities. The introduction of artificial intelligence (AI) technology offers new possibilities for resolving this predicament, but it also reveals deep-seated contradictions such as the experiential gap between digital cognition and physical touch, and the paradox of efficiency between technological convenience and knowledge internalization in practical application. Based on field observations of anatomy teaching in medical colleges and universities, this paper analyzes the adaptation difficulties existing in the current integration of technology and proposes a practical framework for reconstructing technology to serve the essence of anatomy from four dimensions: clarifying teaching positioning, reengineering cognitive processes, developing intelligent exercises, and establishing a collaborative mechanism between industry and academia. The aim is to provide an operational path reference for the reform of anatomy teaching in the era of artificial intelligence.
Keywords: Artificial intelligence; Human anatomy; Virtual anatomy; Teaching practice; Deep learning

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1. Introduction

The process from the registration of a donated body to its preservation and subsequent use in teaching often takes several years or even longer. The wear and tear of specimens during repeated teaching sessions further exacerbates the already scarce resource, a common lament heard by the author during visits to multiple medical school anatomy departments. However, the introduction of technology is not merely an additive of tools' it creates new tensions while solving old problems. For instance, can the spatial cognition gained by rotating a virtual heart in a 3D software be equivalent to the tactile memory formed by holding a real specimen and feeling its weight and texture? Does the massive supply of digital resources dilute students' in-depth understanding of core structures? These questions form the starting point of the problem awareness in this article.

2. The evolutionary trajectory of anatomy teaching from physical to digital

2.1. The intrinsic motivation for innovation in teaching methods driven by the limitation of specimen resources

The structural shortage of specimen resources is not an isolated case for a single institution but a common reality in medical education. This shortage stems from the lag in the growth of body donations against the backdrop of stricter ethical regulations and the expansion of medical school enrollment. Based on the statistics of a provincial medical college in the fall semester of 2024, the ratio of students enrolled in the human anatomy course to available teaching specimens has reached 40:1, far exceeding the ideal threshold of 20:1 recommended by the International Federation of Medical Education. More challenging is the issue of structural integrity degradation of specimens. After three to four teaching cycles, the superficial structures of a specimen used for systemic anatomy teaching become significantly less identifiable, and exposing the deep structures means irreversible damage to the superficial ones. It is precisely this resource constraint that has driven the exploration of innovative teaching methods, from initial wall charts and models to later cross-sectional imaging and plastinated specimens, and now to 3D reconstruction and virtual reality. The underlying driving force of each technological iteration points to the same proposition, which is how to achieve more comprehensive teaching coverage under the condition of limited physical resources [1].

2.2. The new spatial cognition tools offered by 3D reconstruction and virtual anatomy platforms

3D reconstruction technology converts continuous cross-sectional image data into interactive 3D models, allowing students to perform observations on the screen that are difficult to achieve on a traditional anatomy table. For instance, they can “remove” the liver from the abdominal cavity and rotate it to any angle to examine the grooves and fissures on its visceral surface, or “make transparent” the skull to directly observe the pathways of intracranial nerves.

2.3. The transformation of teaching models brought by mobile applications and fragmented learning

The popularity of smartphones has broken the physical barriers of the laboratory for accessing anatomy knowledge. Students can review the origin and insertion points of upper limb muscles on the “3D4Medical” app during their commute or complete a few identification questions about bony landmarks using the “People’s Medical Anatomy” mini-program while queuing in the cafeteria. This fragmented learning model complements traditional centralized classroom teaching, yet its efficacy boundaries are also clear, where fragmented time is suitable for reinforcing and strengthening learned knowledge but is insufficient for the systematic cognitive construction of new structures [2].

3. The adaptation challenges of integrating anatomy knowledge transmission with technology

3.1. The experience gap between 2D screen cognition and tactile spatial perception of physical structures

No matter how exquisite the 3D model on the screen is, it is ultimately a visual projection on a 2D plane. The spatial sense obtained by students by sliding their fingers on the screen to rotate the model is fundamentally different from the proprioception established by holding a real specimen in both hands. This disparity may not be obvious during the preclinical teaching stage, but it becomes evident when students enter the practical training of regional anatomy or surgical internships. During observations in the operating room of a certain affiliated hospital, the author found that some students were extremely familiar with the layer structure of the inguinal region on virtual platforms, but when faced with the soft and adhered tissues in the surgical field, they showed obvious hesitation in positioning. The gaps idealized in virtual models often need to be identified through blunt dissection in real human bodies, and this sense of touch is something that no digital platform can convey. The lack of tactile experience is becoming a hidden weakness for the digital native generation of medical students, and this weakness has not been fully recognized in the current evaluation system because the anatomy stations of the objective structured clinical examination still rely mainly on visual recognition.

3.2. The contradiction between the visual reinforcement of dynamic demonstrations and the weakening of students' autonomous exploration process

The dynamic demonstration function of digital platforms enables teachers to present the contraction process of muscles or the flow path of blood through smooth animations, which undoubtedly enhances the attractiveness of the classroom. However, it also invisibly compresses the space for students' autonomous exploration [3]. The exploratory learning experience of "give me a scalpel and I'll find that nerve myself" in traditional anatomy teaching is being replaced by the passive reception mode of "click play and watch the demonstration". A worrying phenomenon is that after watching a carefully made animation demonstration, students often have the cognitive illusion that they already understand, but when asked to independently label the same structure on a static image, their error rate is significantly higher than that of the control group that did not watch the animation demonstration. Based on the comparative test data from a certain university in the spring semester of 2024, the immediate test accuracy rate of the demonstration group was 15% higher than that of the control group, but this advantage completely disappeared in the delayed test one week later, and even reversed. The smoothness of the demonstration seems to suppress students' cognitive efforts in actively constructing knowledge representations, which is highly consistent with the prediction of the desirable difficulty theory in educational psychology.

3.3. The dilemma of convenient access to a vast amount of digital resources and insufficient internalization of the knowledge system

Opening any mainstream anatomy learning platform, students will be faced with thousands of 3D models, tens of thousands of labeled images, and hundreds of teaching videos. This abundance of resources was unimaginable in the traditional teaching era, but it also brings new cognitive burdens: when everything is within easy reach, students lose the motivation to screen and deeply process. In interviews, more than one student admitted, "When I encounter a structure I don't know, I just search on the platform, watch it, and forget it. When I encounter it again, I search again." This "search and use immediately, discard after use" learning mode reduces anatomy knowledge to temporary external information rather than stable schemas internalized in long-term memory. A deeper problem is that the search logic of digital platforms reinforces the fragmented presentation of knowledge. Students can precisely locate the branches of the facial nerve, but it is difficult for them to establish cross-level knowledge connections such as the functional relationship between the facial nerve and the facial expression muscle group or the clinical manifestations of facial nerve injury under the guidance of the platform.

3.4. The deviation between the development logic led by technology suppliers and the core goals of anatomy teaching

Most of the current mainstream digital platforms for anatomy are developed by technology companies rather than medical education institutions. This misalignment of the development subject leads to subtle deviations between the product design logic and teaching needs. Technology companies pursue visual impact and interactive coolness because these features are more likely to impress procurement decision-makers. What front-line teachers may need more are those less glamorous functions, such as the modular settings that allow for customizing structural groupings to match the school's teaching syllabus, the learning analysis backend that can track students' dwell time and operation trajectories on specific structures, and the hybrid interface that can juxtapose virtual models with real photos from the school's specimen library. These "unsexy" features often rank low in the priority list of commercial products, leaving teachers to make limited adaptations within the existing framework rather than truly leveraging technology to serve teaching objectives [4].

4. Reconstructing the teaching practice framework for technology to serve the essence of anatomy

4.1. Clarifying the teaching position of digital models as complementary to, rather than replacing, physical specimens

The clarification of the positioning of technological tools is the logical prerequisite for all practical innovations. The advantage of digital models lies in their repeatability and manipulability' they can be reset to their original state an infinite number of times for students to practice repeatedly, and can be zoomed, rotated, and dissected to present perspectives that are difficult to show with physical specimens. However, they can never convey the texture feedback and spatial depth of real tissues. Based on this understanding, the principle of teaching design should be that for learning objectives involving spatial relationships and the identification of adjacent structures, digital models can be used as pre-study and post-strengthening tools. For learning objectives involving layer perception and surgical approach simulation, it is essential to ensure that students have sufficient hands-on time with physical specimens. In the teaching reform of a certain school in the autumn semester of 2024, the required hours for digital models and required hours for physical specimens were set separately and independently assessed. Students must meet the qualified standards in both modules to obtain course credits. This design prevents the crowding out effect of digital learning on physical learning from a systemic perspective.

4.2. Designing a spiral cognitive enhancement process of “Observation-virtual-physical-re-virtual”

Research in cognitive science indicates that the construction of spatial representations requires the coordinated input and repeated calibration of multiple sensory channels. Reinforcement through a single channel often leads to the partiality of representations. Based on this, the research and teaching team designed a four-stage spiral learning process: in the observation stage, students first watch the 3D model animations of the target structure on platforms such as Complete Anatomy or “Digital Human” to establish a preliminary visual impression. In the virtual operation stage, students independently rotate the model on a tablet and attempt to label key structures, with the system recording their operation trajectories and labeling accuracy. In the physical operation stage, students locate the same structure on real specimens in the anatomy laboratory, and the teacher asks them to orally describe “What is the difference between what I see now and in the virtual model?” This oral description forces students to conduct cross-modal cognitive comparisons in the re-virtual stage, students return to the digital platform to complete advanced tests, where the test questions are no longer simple structure recognition but require students to label on the virtual model “From which layer should I cut to expose this nerve?” and other integrative questions. Based on the pilot data from the autumn semester of 2024, students who completed the entire four-stage process performed significantly better in the final practical exam than those who only completed the first two stages.

4.3. Developing interactive intelligent exercises and error attribution systems to promote deep learning

Traditional anatomy exercises are mainly “what is” type memorization questions, which can test students' short-term memory but are difficult to promote deep understanding. With the help of AI technology, more cognitively challenging exercise types can be developed: teachers can use the multi-round dialogue function of Wenxin Yiyan to design Socratic questioning scenarios, where the system asks “Why do you think so?” after the student gives an initial answer, and continues to ask “What symptoms would the patient have if this nerve were damaged here?” Based on the student's explanation, forcing students to establish causal connections between structures and functions through continuous questioning. The error attribution system is another key feature. When students select the wrong answer in exercises, the system not only indicates “The correct answer is B”, but also further analyzes “You chose A possibly because you confused structure X with structure Y. The difference between the two lies in...”. This attribution feedback turns mistakes into learning opportunities. The “Anatomy Smart Learning” mini-program developed by a certain school in collaboration with a technical team has initially realized the above-mentioned function. The backend data of the program shows that the repeated error rate of students using the error attribution function in similar questions has decreased by about 40% compared to those who did not use it.

4.4. Forming a collaborative mechanism for anatomical teachers to deeply participate in the R&D of educational technology products

The mismatch between technology products and teaching needs stems from the lack of teacher voice in the development process, and the solution lies in establishing a collaborative mechanism deep teacher participation. A case in point is the "Anatomy Digital Teaching Resources Co-construction Plan" launched by a provincial medical education society in 2024, invites more than a dozen medical colleges' anatomical backbone teachers to form a "Teaching Needs Expert Group" to connect with the technical development team on a regular basis. Teachers responsible for proposing a list of functional requirements and reviewing the pedagogical suitability of product prototypes, while the technical team is responsible for converting the requirements into feasible technical solutions. "Demand-first" collaborative model anchors product design to teaching goals from the start, rather than having teachers adapt passively after the product is finalized. Furthermore, some institutions have to explore the construction path of "school-based digital resource libraries," which uses high-precision scanning modeling to form school-based resources that complement commercial platforms, with typical specimens their own specimen libraries. These resources have an advantage in cognitive transfer effects that are difficult for commercial products to match due to their high correspondence with specimens that students actually handle in the laboratory.

5. Conclusion

The application of artificial intelligence technology in human anatomy teaching is at a critical juncture, transitioning from technology-driven to aching-driven. The value of technology does not lie in its own advanced nature, but in whether it can serve the fundamental goals of anatomical teaching, helping students establish and robust cognitive schemas of human structures. When virtual models are properly positioned as auxiliary rather than substitutes for physical learning, when the learning process is designed as multi-modal collaborative healing reinforcement rather than one-dimensional information indoctrination, and when intelligent systems are developed as cognitive tools to promote deep thinking rather than as question banks for memory testing, the tension technology and teaching can be transformed into a synergistic effect that empowers each other.

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References

[1] Zang Y, 2025, Application of Artificial in Human Anatomy Teaching. *Western Quality Education*, 11(21): 133–136.

[2] Fang X, Xu X, 2025, Construction and Practice of AI-Empowered Systemic Anatomy "Big Ideological and Political" Education System. *Basic Medical Education*, 2025(11): 1085–1088.

[3] Cheng Q, Liu P, Liu H, et al., 2025, Artificial Intelligence-Driven New Paradigm of Personalized Teaching in Local Anatomy: Taking the Anterior Chest Wall Local Anatomy as an Example. *Anatomical Papers*, 56(5): 601–606.

[4] Liu Z, 2025, Practice Artificial Intelligence Technology in Human Anatomy Teaching. *Campus*, 18(12): 43–45.