

## Artificial Intelligence and Immersive Technologies in *Rachana Sharir* Education: Current Perspectives and Future Directions

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### Abstract

Rachana Sharir forms the structural foundation of Ayurvedic education and is essential for understanding human anatomy in relation to physiology, pathology, and clinical practice. Conventional teaching methods, including lectures, cadaveric dissection, anatomical models, and museum specimens, continue to play an important role; however, they often provide limited opportunities for interactive visualization and individualized learning. Rapid advances in Artificial Intelligence (AI), Virtual Reality (VR), Augmented Reality (AR), and Digital Twin technology have introduced innovative educational approaches that can enhance anatomy teaching through immersive and technology-supported learning environments. This narrative review examines the educational applications of these emerging technologies in Rachana Sharir by analysing evidence from classical Ayurvedic literature and contemporary scientific publications. The available evidence suggests that digital learning platforms can improve spatial understanding, student engagement, knowledge retention, and competency-based learning while complementing conventional teaching practices. The integration of intelligent technologies into Ayurveda education may contribute to a more effective and learner-centred educational system. Further educational research is required to evaluate their long-term effectiveness and practical implementation.

**Key words :** Rachana Sharir, Artificial Intelligence, Virtual Reality, Digital Twin, Ayurveda Education, Anatomy Education.

**A**natomy is one of the fundamental structural basis for understanding the normal pillars of medical education, providing the organization of the human body as well as the

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changes associated with disease. In Ayurveda, **Rachana Sharir** occupies a central position because it describes the anatomical organization of the body according to classical Ayurvedic principles and serves as the foundation for the study of physiology, pathology, surgery, and clinical practice. The knowledge of structures such as **Asthi, Sandhi, Snayu, Sira, Dhamani, Marma, Kala, and Srotas** is essential for developing a comprehensive understanding of Ayurvedic medicine.<sup>3,21</sup>

For many years, the teaching of Rachana Sharir has relied primarily on lectures, cadaveric dissection, anatomical charts, museum specimens, and physical models. Although these methods continue to provide valuable educational experiences, they often present limitations in demonstrating complex three-dimensional anatomical relationships and functional concepts.<sup>2,18</sup> Students may also encounter difficulties in visualizing spatial anatomy, correlating classical Ayurvedic descriptions with contemporary anatomical knowledge, and retaining information for long-term clinical application.

Advances in digital technology have significantly transformed medical education worldwide. Artificial Intelligence (AI), Virtual Reality (VR), Augmented Reality (AR), Mixed Reality (MR), and Digital Twin technology have emerged as effective educational tools that promote interactive learning, virtual simulation, and personalized instruction.<sup>19,20,22</sup> These technologies enable learners to manipulate three-dimensional anatomical models, participate in immersive practical sessions, and receive continuous academic feedback, thereby improving

conceptual understanding and learner engagement.<sup>1,7,14</sup>

Despite the increasing adoption of these technologies in modern medical education, their application in Ayurveda education remains limited. Most institutions continue to depend largely on conventional teaching approaches, with comparatively little use of immersive digital learning systems. Integrating intelligent technologies with classical Ayurvedic education may provide an opportunity to modernize Rachana Sharir teaching while preserving its traditional principles and educational philosophy.<sup>16,25</sup>

Therefore, the present narrative review aims to examine the educational role of Artificial Intelligence and immersive technologies in Rachana Sharir education. By analysing available scientific evidence, this review discusses their potential advantages, existing challenges, and future scope in developing a more effective, student-centred, and techno-logically enriched learning environment for Ayurveda education.

The present study was conducted as a narrative review to evaluate the educational applications of Artificial Intelligence (AI) and immersive digital technologies in Rachana Sharir education. A comprehensive literature search was performed using major scientific databases, including **PubMed, Scopus, Web of Science, Google Scholar, Science Direct, SpringerLink, and IEEE Xplore**. Classical Ayurvedic literature, including the **Charaka Samhita, Sushruta Samhita, and Ashtanga Hridaya**, was also reviewed to establish the traditional concepts related to Rachana Sharir.<sup>3,15,21</sup>

**Figure 1. Metaverse-Enabled Rachana Sharir Educational Framework (MEREF)**

*An eight-module integrated framework for immersive, intelligent and interactive Ayurveda anatomy education*



Figure 1. Graphical abstract illustrating the integration of Artificial Intelligence and immersive technologies in Rachana Sharir education.

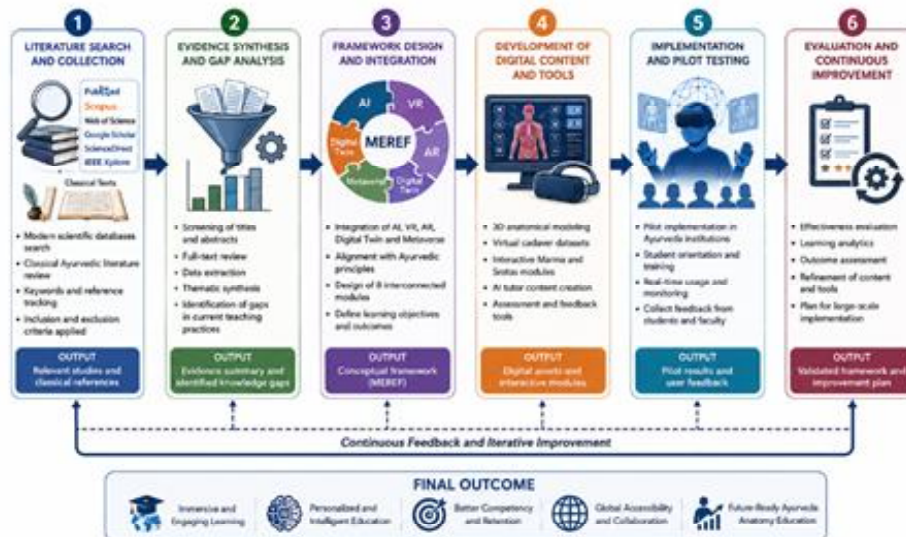
**Figure 2. Educational Workflow for Development of Metaverse-Enabled Rachana Sharir Educational Framework (MEREF)**

Figure 2. Conceptual framework illustrating the integration of AI, VR, AR, Digital Twin technology, faculty, and students in Rachana Sharir education.

Relevant literature published in English was identified using combinations of keywords such as *Artificial Intelligence*, *Virtual Reality*, *Augmented Reality*, *Mixed Reality*, *Digital Twin*, *Metaverse*, *Anatomy Education*, *Medical Education*, and *Rachana Sharir*. Original research articles, review papers, educational studies, and policy documents relevant to anatomy education were included in the review. Conference abstracts without full text, duplicate publications, editorials, and studies unrelated to anatomy or medical education were excluded. The selected publications were critically analysed to identify common themes related to immersive learning, personalized education, virtual anatomy laboratories, competency-based assessment, and future technological developments in anatomy teaching. The available evidence was synthesized narratively to evaluate the potential contribution of emerging digital technologies to Rachana Sharir education and to identify future directions for technology-assisted learning in Ayurveda.

**The reviewed literature indicates that emerging digital technologies have**

**considerably influenced contemporary anatomy education by improving the quality of teaching and learning. Artificial Intelligence (AI), Virtual Reality (VR), Augmented Reality (AR), and Digital Twin technology have been widely recognized as effective educational tools capable of enhancing visualization, learner engagement, and competency development.<sup>1,7</sup> Although their implementation in Ayurveda education is still developing, available evidence suggests significant potential for improving the teaching of Rachana Sharir.** One of the most consistent observations reported in the reviewed literature is the ability of immersive technologies to improve the understanding of complex three-dimensional anatomical relationships.<sup>1,18</sup> Virtual simulations allow learners to interact with anatomical structures from different perspectives, making it easier to appreciate spatial orientation and structural relationships.<sup>13,14</sup> Repeated virtual exploration also enables students to reinforce anatomical concepts without the limitations associated with cadaver availability or laboratory access.<sup>10</sup>

Table-1. Educational Applications of Emerging Digital Technologies in Rachana Sharir Education

| Technology              | Educational Application                      | Expected Educational Outcome    |
|-------------------------|----------------------------------------------|---------------------------------|
| Artificial Intelligence | Personalized learning and automated feedback | Improved learning efficiency    |
| Virtual Reality         | Immersive three-dimensional anatomy          | Better spatial understanding    |
| Augmented Reality       | Interactive visualization                    | Enhanced conceptual learning    |
| Digital Twin            | Virtual human anatomical models              | Repeated anatomical exploration |
| Metaverse               | Collaborative virtual classroom              | Improved learner engagement     |

Artificial Intelligence has emerged as an important component of technology-assisted learning. AI-supported educational platforms are capable of analysing learning patterns, generating personalized learning pathways, providing instant feedback, and

supporting competency-based assessment.<sup>4,6,9,17</sup> These adaptive learning systems encourage independent learning while assisting teachers in identifying areas requiring additional academic attention.<sup>5,20,22</sup>

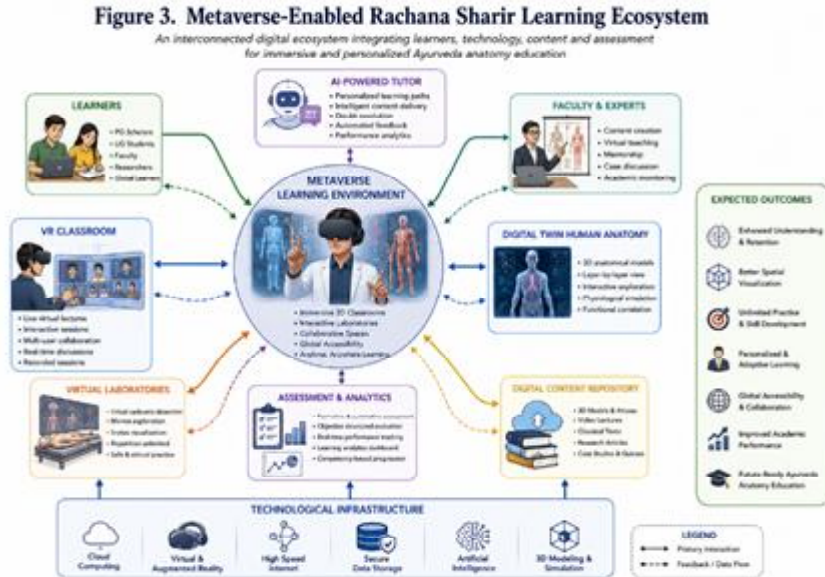


Figure 3. Educational workflow demonstrating the integration of Artificial Intelligence and immersive technologies into Rachana Sharir teaching and learning.

Digital Twin technology represents another promising advancement in anatomy education. By creating realistic virtual representations of human anatomical structures, Digital Twin systems facilitate repeated anatomical exploration and improve conceptual understanding through interactive visualization.<sup>10,11</sup> Such digital models also provide opportunities to correlate traditional Ayurvedic anatomical concepts with contemporary anatomical knowledge, thereby strengthening interdisciplinary learning.<sup>2</sup>

Overall, the available evidence indicates that intelligent digital technologies can

significantly improve learner engagement, conceptual clarity, and educational accessibility when integrated with conventional anatomy teaching. However, most published studies have been conducted in modern medical education, and evidence specifically related to Ayurveda education remains limited.

The findings of the present review demonstrate that Artificial Intelligence and immersive digital technologies have the potential to significantly improve anatomy education by complementing traditional teaching practices. Conventional methods such as classroom lectures, cadaveric dissection, museum specimens, and

anatomical models remain indispensable for developing fundamental anatomical knowledge.<sup>2,3</sup> Nevertheless, these approaches often present challenges in explaining dynamic

anatomical relationships and maintaining long-term learner engagement. Digital technologies offer additional opportunities to overcome many of these limitations.

Table-2. Comparative features of conventional and technology-assisted teaching methods in Rachana Sharir education

| Parameter             | Conventional Teaching       | Technology-Assisted Teaching          |
|-----------------------|-----------------------------|---------------------------------------|
| Teaching Method       | Lecture-based               | Interactive and blended learning      |
| Learning Resources    | Textbooks, charts, cadavers | 3D models, VR, AR, AI platforms       |
| Student Participation | Passive                     | Active and self-directed              |
| Visualization         | Two-dimensional             | Immersive three-dimensional           |
| Assessment            | Written examinations        | AI-assisted continuous assessment     |
| Learning Flexibility  | Limited                     | Anytime, anywhere learning            |
| Knowledge Retention   | Moderate                    | Improved through interactive practice |



Figure 4. Comparison between conventional and technology-assisted approaches to Rachana Sharir education

Virtual Reality and Augmented Reality provide highly interactive educational environments that allow students to visualize anatomical structures in three dimensions and repeatedly

explore complex anatomical regions. These technologies encourage active learning and improve students' ability to understand spatial relationships, which are often difficult to

appreciate using conventional two-dimensional illustrations.<sup>12,18</sup> Similar benefits have been reported across several medical education studies, where immersive learning environments have demonstrated improvements in learner motivation and knowledge retention.<sup>8,13,14,19</sup>

Artificial Intelligence has further expanded the possibilities of anatomy education through adaptive learning systems. AI-assisted educational platforms can evaluate student performance, provide individualized recommendations, and generate immediate feedback during the learning process.<sup>4,9</sup> Such personalized educational support may improve self-directed learning while enabling faculty members to monitor academic progress more efficiently.

Digital Twin technology represents an emerging innovation that may further enhance anatomy education by creating realistic virtual representations of human anatomical structures. These models permit unlimited exploration without damaging biological specimens and may facilitate the integration of classical Ayurvedic anatomical concepts with contemporary scientific understanding.<sup>10,11</sup> Such an approach has particular relevance in Rachana Sharir education, where functional and structural concepts require comprehensive visualization.

Despite these educational advantages, the implementation of advanced digital technologies requires adequate infrastructure, trained faculty, financial investment, and reliable technical support.<sup>4,23</sup> The adoption of AI-based educational tools also requires careful attention to ethical use, data privacy,

and governance in health professions education.<sup>23,24</sup> In addition, the development of high-quality digital educational resources specifically designed for Ayurveda remains an important challenge.<sup>16</sup> Future educational research should therefore focus on evaluating the effectiveness, feasibility, and cost-effectiveness of these technologies in undergraduate and postgraduate Ayurveda programmes.<sup>25</sup>

The present review supports the concept that digital technologies should be viewed as complementary educational resources rather than substitutes for conventional anatomy teaching. A balanced educational model integrating traditional instruction with intelligent digital innovations may provide a more effective and learner-centred approach to *Rachana Sharir* education.

Table-3. Advantages and Challenges of Integrating Digital Technologies into Rachana Sharir Education

| Advantages                  | Challenges                                  |
|-----------------------------|---------------------------------------------|
| Improved visualization      | High implementation cost                    |
| Interactive learning        | Faculty training requirements               |
| Personalized education      | Technical infrastructure                    |
| Competency-based assessment | Limited Ayurveda-specific digital resources |
| Better learner engagement   | Need for further educational research       |

The present review highlights the growing importance of Artificial Intelligence and immersive digital technologies in

strengthening the teaching and learning of **Rachana Sharir**. Emerging technologies such as Virtual Reality, Augmented Reality, Digital Twin systems, and intelligent learning platforms have created new opportunities to improve anatomical visualization, learner engagement, and competency-based education. These innovations can facilitate a better understanding of complex anatomical concepts while supporting individualized and interactive learning.

Although conventional teaching methods continue to remain essential in Ayurveda education, the integration of modern digital technologies may significantly enrich the overall learning experience. Technology-assisted education should therefore be considered a complementary approach that enhances, rather than replaces, traditional methods such as classroom teaching, cadaveric dissection, and museum-based learning.

The successful implementation of these technologies requires institutional support, faculty training, appropriate digital infrastructure, and the development of educational resources specifically designed for Ayurveda. Future multicentre educational studies are needed to evaluate their effectiveness, feasibility, cost-effectiveness, and long-term educational outcomes. A balanced integration of traditional knowledge with modern educational technologies may contribute to the future advancement of Rachana Sharir education and support the digital transformation of Ayurveda teaching.

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