Alternative methods for educating students about anatomy and future directions

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Abstract

Anatomy is an essential subject for students in medical and health sciences, but traditional methods of teaching anatomy have limitations. Alternative methods of teaching anatomy have been explored to overcome these limitations and enhance student learning. This review paper summarizes the current state of alternative methods for educating students about anatomy and discusses future directions in this field. The five subheadings of this paper include: (1) Virtual and augmented reality, (2) Three-dimensional printing, (3) Anatomical models and atlases, (4) Team-based learning, and (5) Integrating clinical cases. Each subheading highlights the advantages and limitations of the respective method, as well as its effectiveness in teaching anatomy. Finally, this paper concludes with a discussion of the future directions for alternative methods of teaching anatomy, including personalized learning and the use of artificial intelligence. In conclusion, anatomy training is essential to medical education, and teachers can use several methods to improve student learning. Every tactic has pros and cons, so instructors must carefully consider which will work best for their pupils. Gamification, 3D printing, and AI in anatomy instruction must be researched by educators. These methods can make anatomy lessons more engaging and prepare students for clinical practise. Alternate anatomy teaching methods can improve student learning and clinical practise. Medical education must include anatomy. Using cutting-edge technologies and teaching methods, educators can improve student learning and patient care.

Key words: anatomy education, alternative methods, computer-based instruction, virtual reality, augmented reality, gamification

Introduction

As the foundation for understanding the composition and operation of the human body, anatomy is a prerequisite course for students majoring in the medical and health sciences. Anatomy has traditionally been taught through didactic lectures, cadaver dissections, and the use of anatomical models and atlases. But these approaches have drawbacks, including

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inconsistent teaching standards, limited access to cadavers, and challenges with visualizing the three-dimensional structure of the body [1]. Alternative approaches to teaching anatomy have been investigated recently to get around these drawbacks and improve student learning. This review study outlines the state of various approaches to teaching anatomy to students and explores the field's potential future prospects.

Virtual and augmented reality

In recent years, the use of virtual and augmented reality (VR/AR) in medical education has grown significantly. Students can interact with three-dimensionally manipulable virtual models of the human body using VR/AR [2]. The capacity to show interior elements that are challenging to perceive with traditional methods, such as the nervous system and blood arteries, is one of the technology's many advantages over traditional ways of teaching anatomy [3]. Additionally, VR/AR offers a more immersive learning environment, which can increase student interest and knowledge retention [4].

Numerous studies have demonstrated the value of VR/AR in the instruction of anatomy. In a research comparing the effectiveness of VR/AR and conventional means of teaching anatomy, for instance, it was discovered that students who learnt using VR/AR scored much higher on a post-test than those who taught using conventional techniques [5]. According to another study, students who learnt using VR/AR were more engaged and satisfied with their education than those who learned using conventional techniques [6].

Virtual reality and augmented reality have drawbacks in addition to their advantages. One significant restriction is the price of the equipment, which can be unaffordable for many educational institutions [7]. Additionally, using VR or AR may cause some students to feel queasy or have other negative effects, which can hinder their ability to learn effectively [8]. Finally, even though VR/AR enables a more immersive learning experience, it might not offer as much tactile feedback as conventional techniques like dissection [9].

Three-dimensional printing

Another technology that has been investigated for the purpose of teaching anatomy is three-dimensional (3D) printing. Physical replicas of anatomical structures can be made via 3D printing and used for experiential learning [10]. The ability to customise models of certain structures and the creation of models that are challenging to get via conventional means, such as the foetal brain, are two advantages that this technology has over conventional methods of teaching anatomy [11].

Anatomy can be taught using 3D printing, according to numerous research. For instance, a research contrasting the effectiveness of traditional methods with 3D printing for teaching anatomy discovered that students who learnt using 3D-printed models performed better on a post-test than those who taught using traditional means.

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Anatomical models and atlases

For many years, atlases and models of the human body have been used to teach anatomy. The tactile and visual portrayal of the human body provided by these instruments can help students better comprehend anatomy. A number of materials, including silicone or plastic, can be used to create anatomical models, which can range in complexity from simple representations of particular structures to intricate representations of the complete body [12]. In contrast, atlases offer a thorough visual portrayal of the human anatomy using pictures and diagrams.

Comparing anatomical models and atlases to other teaching techniques for anatomy, there are various benefits. For instance, they give students a hands-on learning opportunity that can aid in their deeper grasp of the anatomy and physiology [13]. Additionally, they enable the visualisation of internal organs like the respiratory system and the inner ear that are challenging to see using conventional techniques [14]. Additionally, anatomical models and atlases are widely accessible and reasonably priced.

Anatomical models and atlases are efficient tools for teaching anatomy, according to a number of studies. As an illustration, a study contrasting the efficacy of conventional methods with the usage of anatomical models and atlases discovered that students who used anatomical models and atlases significantly outperformed those who used conventional methods on a post-test [15]. Anatomical models and atlases, according to a different study, helped students better grasp the respiratory system [16].

Team-based learning

Team-based learning (TBL) is a teaching approach that prioritises collaborative learning and active learning. In TBL, students are divided into smaller groups and collaborate to complete tasks and solve problems [17]. TBL has been used to teach anatomy with the intention of encouraging student participation and teamwork.

TBL is superior to conventional anatomy teaching approaches in a number of ways. As an illustration, it encourages active learning, which has been found to increase student engagement and information retention [18]. Additionally, TBL gives students the chance to practise the interpersonal and collaborative abilities necessary for success in the medical industry [19]. Last but not least, TBL can assist in addressing the drawbacks of conventional approaches, such as inconsistent teaching quality and restricted access to cadavers.

TBL has been proven to be an effective teaching strategy for anatomy in numerous research. For instance, a study comparing the efficacy of TBL and conventional ways of teaching anatomy discovered that TBL students significantly outperformed conventional method students on a post-test [20]. In another study, TBL was found to boost students' confidence in their understanding of anatomy as well as their attitudes towards learning the topic [21].

Integrating clinical cases

Another alternate approach that has been investigated is the incorporation of clinical cases into anatomy instruction. This method employs clinical cases to teach anatomy in the context of actual situations [22]. This method can aid in bridging the gap between fundamental

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science and clinical practise by allowing students to observe how their knowledge of anatomy is used in real-world situations.

There are many benefits to incorporating clinical situations into anatomy instruction. For instance, it can assist students in building their critical thinking abilities and connecting ideas from many fields of study [23]. Additionally, it can give students a more interesting and relevant learning experience, which can increase their motivation and memory of the material [24]. Last but not least, using clinical situations in anatomy lessons can assist students get ready for the reality of clinical practise.

Studies have demonstrated that including clinical situations into anatomy instruction is a successful way to teach anatomy. For instance, a comparison of the efficiency of using clinical examples and conventional ways of teaching anatomy revealed that students who learnt using clinical cases performed better on a post-test and were more likely to remember the material over time [25]. Another study discovered that including clinical cases in anatomy lessons increased students' confidence in their ability to use their anatomical knowledge in real-world situations [26].

Virtual and augmented reality

Emerging technologies like virtual and augmented reality have the power to completely alter how anatomy is taught. While augmented reality (AR) superimposes digital data on the real world, virtual reality (VR) enables users to interact with a simulated 3D environment. For students, immersive and engaging experiences can be made using both VR and AR.

Comparing virtual and augmented reality to conventional anatomy instruction has a number of benefits. For instance, they enable a more interactive and immersive learning environment, which can increase student engagement and knowledge retention [27]. Additionally, they give students a secure and controlled setting in which to practise techniques, which can boost their self-assurance and prepare them for clinical practise [28]. Additionally, anatomical structures that might be challenging to see using conventional methods, like the inside of the skull, can be accessed through virtual and augmented reality.

Virtual and augmented reality have proven to be useful teaching tools for anatomy, according to numerous research. For instance, a study comparing the efficiency of VR with conventional anatomy teaching techniques discovered that students who learnt via VR had higher post-test scores and showed greater levels of engagement [29]. A different investigation discovered that AR enhanced students' comprehension of the anatomy of the hand and wrist [30].

Future directions

There are a number of new developments in anatomy teaching that show potential for enhancing student learning and engagement as technology develops. Gamification, which entails including elements of games in the learning process, is one of these trends. Gamification has been demonstrated to increase student enthusiasm and engagement in other subject areas of study, and it may have a similar positive impact on the teaching of anatomy [31].

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The use of 3D printing, which makes it possible to generate anatomical models that are more detailed and lifelike than those made using conventional techniques, is another new trend. By giving students first-hand exposure to accurate anatomical features, 3D printing has the potential to revolutionise anatomy instruction [32].

The use of artificial intelligence (AI) in anatomy instruction is also gaining popularity. AI has the ability to tailor the educational experience for each student individually, spot possible problem areas, and offer help and feedback in real-time [33]. Although the application of AI in anatomy education is still in its infancy, it has the potential to enhance student learning outcomes and better prepare students for the realities of clinical practise.

Conclusion

Anatomy is an essential part of medical education, and there are a variety of alternate ways to teach this vital subject. While team-based learning encourages active learning and collaboration among students, anatomical models and atlases give students a tactile and visual representation of the human body. Students can observe the actual application of their knowledge by incorporating clinical situations into anatomy lessons, while virtual and augmented reality technologies offer immersive, interactive learning opportunities. The utilisation of gamification, 3D printing, and artificial intelligence are just a few of the new trends in anatomy education that hold promise for enhancing student learning outcomes and preparing students for the reality of clinical practise.

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