

Metaverse in surgical education: A disruptive innovation

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Abstract

Metaverse is a combination of two words meta and verse. Meta means beyond and verse is the root of universe conveying the presence of a new realm or world which is beyond this real world. This term was first used in a novel snow crash in 1992 by Neal Stephenson ¹

Metaverse is a 3d based virtual reality world where the participants are depicted as avatars and they go about doing their daily activities or some form of specialized activity like economic or cultural activity ²

It is an extension of the real world or a merger with the virtual world. This new realm tries at its best to replicate the real physical world.

It all began with a game called the second life, where there were multi users and play the game together in different roles. Following this many other games similar appeared but the importance of this virtual world with the user called the avatars did not gained importance until recently. This probably is due to the advancements

in the related technologies like the augmented reality (AR) and virtual reality (VR).

Metaverses can bring huge change in how professionals of various subjects can be trained. It can enter various fields like engineering, medical, armed forces or airline industry. The big advantage is that a real-life situation can be created in the Metaverse and the trainees can practice in handling the situation with no loss of real life or property and it can be repeated numerous times till the desired proficiency is achieved in the student.

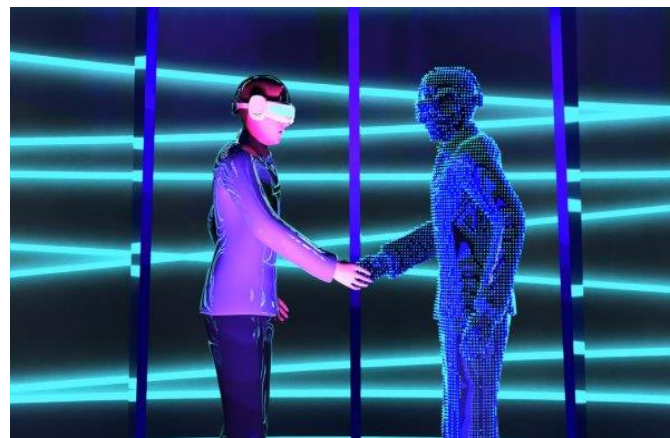


Fig 1: The merger of real life with virtual Avatar

Numerous technologies like the holography, internet of things, block chain and crypto currencies have amalgamated in this virtual world emulating the real world at its best. The internet is the platform plus the embedded data for this simulated world. The key feature of Metaverse is the fast synchronization and low latency, this allows the players to experience immediate or real time response of the avatar in the virtual world. This is possible in the present time with the advent of 5G communication system.⁵

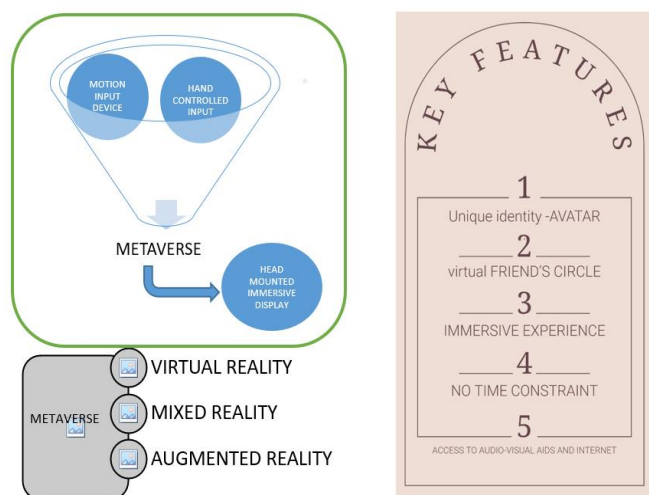


Figure 2

The term avatar initially meant to convey the presence of the universal or the god in human form. Presently in the world of Metaverse it means outward appearance of the user in the virtual world. It can be enabled to suit any form the user wants and replicates the gestures of the real world onto the virtual realm. The Metaverse is created with scenes from the real world, like it can be famous places like the white house or the local neighborhood. Many of the Metaverses have educational places like the college, school with classrooms. The classroom is as real as possible with every item like the black board, the stage, the media display and it can have even a desktop or laptop system.⁶

Surgical education has evolved since decades. In the earlier days the craft of surgery was transferred to the next generation through the so called “apprenticeship,”⁷ Surgical education in a broader perspective can be seen in two parts namely cognitive and psychomotor skill acquisition. There are multiple ways of acquiring these skills to master the science and art of surgery. Conventionally lectures, seminars, observing the procedures in the operating room and assisting the surgeon in surgical procedures. But in the present era of surgical education innumerable options of learning methods have come. Some of them are animal models, 3D print technology, simulator, robotic surgery learning console, virtual reality, endotainers etc. The advent of minimal invasive surgery drastically changed the world of surgery. And along with the operative outcomes, even the learning modalities had to adapt to this new art.⁸

The Metaverse has arrived with great expectations and probably with huge potential to shape itself and provide the user the best possible learning environment. This mini and rapid review attempts to explore the current situation and find an answer on whether the Metaverse will be a disruptive innovation in surgical education.

Material and Methods

A nonsystematic advanced literature search was conducted on PubMed on April 4, 2023. The key words used were “Metaverse AND surgical education”. No language filter was applied, and all article published in last 5 years were include in this mini review. All original articles and review articles from all field of medicine was included. The retrieved publications were studied in depth and summary was drawn.

Results

With the key words “metaverse AND surgical education” filters of English and 5 years, only 6 articles

were retrieved from the PubMed database. The articles were studied in detail and summary was tabulated as follows.

Metaverse And Surgical Education				
Sn.	Title of Abstract	First Author	Year	Conclusion
1	Dynamics of Metaverse and Medicine: A Review Article	Mrudul A. Kawarase, et al	2022	Metaverse is still in its infancy. The issues of privacy and security is yet to be resolved. Even though has not reached the point of perfection, it demonstrates huge potential for development and will help multiple fields including medical.
2	The Trend of Metaverse and Augmented & Virtual Reality Extending to the Healthcare System	Kunal Bhugaonkar, et al	2022	Even though it is unexplored arena, the Metaverse has to be encouraged to reap its full potential. It is helpful for patient education, exhibits positive prospects for professionals with innovative medical education.
3	Future of virtual education and telementoring	Ian Seddon, et al	2023	The remote viewing brings huge advantage of removing the constraints of distance. Creates new outlets to improve learn, teach and operate in ophthalmology.
4	Metaverse and Virtual Health Care in Ophthalmology: Opportunities and Challenges	Ting Fang Tan, et al	2022	Raise the need for the challenges that could be encountered in implementation of these emerging healthcare technologies. Encourage to utilise and innovate with these newer tools to provide better eye care.
5	Virtual neurosurgery anatomy laboratory: A collaborative and remote education experience in the metaverse	Nicolas I. Gonzalez-Romo., et al	2023	This virtual world provides huge and novel resource for neurosurgery education. Volumetric models help in bringing good coordination between the trainers and student. Hybrid syllabus might soon be the norm.
6	How do Plastic Surgeons use the Metaverse: A Systematic Review	Pengfei Sun., et al	2023	Being in its preliminary stage of development the metaverse needs to be assessed. Further the definite role of this technology in plastic surgery is yet to be ascertained.

Discussion

Surgical education one of the key areas which needs attention for the growth and evolution of the surgical field. Various innovations need to be attempted to foster The surgical education. The newer generation of surgical residents are the technology savvy generation. This is highly helpful and easy to attempt to utilize technological tools like metaverse.

Mrudul A. Kawarase, et al discuss about the conventional ways of teaching and explore the utilization of platforms like the augmented reality, life logging, virtual reality and the mirror world. They mention about the limitations of these, some being the machine-generated errors, software errors, and human errors.

Virtual reality (VR) has been used to manage acute and chronic pain ⁹and has demonstrated huge potential for clinical application in the near future.

Metaverse a new world brings huge potential for many fields including surgical education. It has interested many researchers to explore this new tool and see how it can be utilized for the benefit of the future surgeons.

In a Review Article" by Kawarase et titled "Dynamics of Metaverse and Medicine", the authors discuss the capabilities of this new tool. The versatility is appreciated, and suggestions of teaching programs and awareness events is provided.

Similarly, Bhugaonkar et al.'s review article, "The Trend of Metaverse and Augmented & Virtual Reality Extending to the Healthcare System," explores how the metaverse and augmented and virtual reality technologies can bring change in the field of education. Addressing that it's in its initial phase the authors recommend to research further and nurture the concept.

"Future of virtual education and tele mentoring," by Seddon et al. Summarize about the new social

communication space and attempt to explore the potential regarding medical education.

Tan et al highlights that how the pandemic has opened new avenues to be looked for the remote teaching. One of them being the virtual world of metaverse.

Masseti and Chiariello's article writes about the avatar and how the new protocols can be tried and work as a trial.

"Virtual neurosurgery anatomy laboratory: A collaborative and remote education experience in the metaverse," by Gonzalez-Romo et al discusses the likelihood of virtual reality didactic lectures, and additionally a multiuser virtual anatomy laboratory experience.

Lastly, Sun et al. Addresses the use of the metaverse in plastic surgery and agrees that the new technological innovation will bring great change and be good adjunct to surgical education.

With this new concept of the metaverse capturing the imagination of many people, and it is yet to be seen if the metaverse be the next frontier in surgical education. The access to audio-visual aids brings huge potential and endless possibilities.

The metaverse gives the students to immerse in this new world of simulated reality. It has an advantage of being safe, repetitive, and controlled environment to train the residents. Situations like the pandemic bought challenges to the surgical education and the technology came to the rescue and one of them is the metaverse. This is bound to stay and grow. It will probably adapt to the needs and more mergers of other innovations like the artificial intelligence will make it one of highly capable medium of transferring knowledge.

Surgical planning and practice in the virtual world of metaverse will surely improve the preparedness of the

surgeons before performing on the real-world patients¹⁰. The avatars in the metaverse can also be used for patient participation for patient education which will ensure better patient care.

Future research and conclusion

Metaverse for surgical education needs to be further researched to understand its strength and weakness. The collaborations of other technological tools must be curated and customized. The metaverse opens a platform where the participants can be from any part of the world making it borderless.

To conclude, the metaverse is a huge revolutionary innovative tool which can be adapted for surgical education and with detailed modules for teaching it is bound to transform the learning process for better.

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