**Statistical Study on Increasing Usage of AR/VR in Real World**

**Abstract**

Augmented and Virtual Reality have emerged as powerful technologies to learn skills, revolutionizing the way people learn skills related to various fields. This study provides an overview of their impact on skill acquisition, how does it improve the process of learning a skill and what aspects make it different from traditional learning and its future prospects in this direction. In this research paper we explore how environments created by AR/VR facilitate experiential learning, improve motor skills and enhance a wide range of mental/cognitive processes. The implications of AR/VR technology for training programs, professional development, and educational setting are also studied and discussed.

**1. Introduction**

Augmented Reality (AR) and Virtual Reality (VR) are two great technologies that have evolved the way people interact with the digital world. AR is the technology to add digital elements to the real world around us, while VR is the technology to create immersive digital environments that may or may not replicate the real world in sense and form. Both technologies use special equipment such as headset or glasses to bring these experiences to life.

**Augmented Reality (AR)**

AR enriches the real-world environment by superimposing digital information on it, resulting in an enhanced experience of whatever activity it is used on. It uses the human senses, such as sight, sound, and touch, to combine computer-generated data with reality via hardware and software. Gaming, product visualization, marketing, architecture, education, and other fields all benefit plentifully from various different implementations of AR. It is rapidly being used in metaverse implementations and corporate applications, contributing to the expanding trend of immersive computer experiences.

**Virtual Reality (VR)**

Virtual reality refers to a simulation of a 3D environment that allows users to explore and interact with the said virtual surroundings in a way that may or may not approximate reality, as perceived through the users’ senses. Whether or not the interaction with the 3D environment will approximate to reality would depend on the purpose of the creator of said virtual environment. The 3D environment is created using relevant computer hardware and software, while users need helmets and goggles to interact with the environment. The development of VR technology is aiming for a direction wherein the users would be immersed in the created environment in such a manner that the virtual surroundings would be indistinguishable from reality in all senses.

**Education and skill training**

VR systems have had a pivotal role in offering efficient training for real life activities through realistic simulation. An example would be notably seen in the first commercial simulation, the flight simulator, which use for military training in the 2nd World War. These systems relying on visual motion feedback, simulated flying sensations, promoting cost-effective and safer training methods.

AR/VR technology has been enriching the learning process across various domain through simulations, enhancing experiential learning by placing people in a diverse set of scenarios. For instance, healthcare utilizes simulated surgical training for skill enhancement under less risky conditions. Police departments in countries like the Netherlands and the UK employ AR/VR for training to prepare for emergency scenarios.

**Increasing Usage and Adoption**

The global shipments of AR/VR headsets were 5.5 million units in 2020 and are projected to reach 43.5 million by 2025.The market size of VR headsets was $5.5 billion in 2019 and is projected to reach $18.6 billion by 2026.The global AR/VR software and hardware market size was valued at $2.6 billion in 2020, which will jump to $5.1 billion by 2023.[1]The AR market is projected to hit a value of $50 billion by 2024.

Industry Adoption:

The strongest demand for AR/VR currently comes from industries in the creative economy—specifically, gaming, live events, video entertainment, and retail. AR/VR technologies have increasingly been employed by a wide range of sectors —from education and healthcare to retail and real estate.AR technology blends the physical and digital worlds - be it gaming or consumer goods, AR and VR help businesses provide a better experience to their customers.

Various applications and software for AR/VR which are widely popular include things like OSSOVR, PokemonGo for Gaming, Tilt Brush for Painting, Enscape for architectural design**, Hyundai Virtual Guide**, **Toyota’s TeenDrive 365** etc.

This Research paper will further explore and discuss such innovations, their degree of benefit and effectiveness, as well as further and upcoming implementations. This study will mainly employ existing literature, case studies and empirical research to elucidate the role of AR/VR technology in shaping the future of skill acquisition and lifelong learning.

**2. Examples, Implementations and Related Work**

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| --- | --- | --- | --- |
| Reference | Subject | Method | Findings |
| Abdullah M. Al-Ansi | AR and VR development in Education | Analyzing | Adoption of AR and VR in education recent years |
| Dr A Udaya Shankar | Impact of AR and VR in Education | Literature Review | Improvement in teaching and learning experience |
| Patrice Labedan | VR in pilot training | Case Study | Cardiac activities during training |
| Zain Hussain | Use of AR and VR for improving knowledge and skills in medical students | Randomized Trials and Pre-test, Post-test | Effectiveness of AR/VR devices for teaching medical students |
| Min-Chai Hsieh | AR for primary marine wildlife education | ADDIE model with Pre and Post test | Using augmented reality to enhance learning experience of children for marine wildlife education |
| İbrahim Yaşar Kazu | Engagement of AR and VR in higher studies | Data Analysis | VR's adaptability and potential for personalized learning experiences contributing to more efficient and effective learning |
| Jing Zhang | Trends in the Use of Augmented Reality, Virtual Reality, and Mixed Reality in Surgical Research | Global Bibliometric and Visualized Analysis | [use of augmented reality (AR), virtual reality (VR), and mixed reality (MR) in surgical research](https://link.springer.com/article/10.1007/s12262-021-03243-w) increased globally |

**Al Ansi et al.** analysed AR/VR in education, noticing a dramatic research increase in the preceding decade. Highlighted exponential adoption during COVID-19 and how it enhances e-learning interactions. Similarly, **Dr A Udaya Shankar et al.** conducted a literary review showing how strong the impact of AR/VR is on education by utilising descriptive methods and questionnaires. **Patrice et al.**  Performed a Case study on use of VR in pilot training, comparing real life and simulation data to propose improvements. **Zain et al.** used randomized trials to studying the effectiveness of AR/VR in improving knowledge and skill gain for medical students. **Min-Chai et al.** applied ADDIE model to study the effect of AR in marine wildlife education, finding improvement in learning experiences for children. **İbrahim et al.** performed data analysis on the engagement of AR and VR in higher studies. The findings showed that VR’s adaptability and potential for personalized learning experiences contribute to more efficient and effective learning. Lastly, **Jing et al.** conducted a global analysis on AR/VR/MR trends in surgical research, which indicated rise in its usage globally with USA leading in contributions, also suggesting continued growth.

The amalgamation of such studies shows not only the different areas in which implementations of AR/VR technology being developed but also that AR/VR is helpful and would be growing in usage in the future. Thus comes our hypotheses,

H1: The usage and implementation of AR/VR in various fields is still increasing.

H2: Developing implementations will have a majorly positive impact on the AR/VR technology field.

H3: Common use commercial implementations of AR/VR are becoming increasingly popular.

**3. Information Study**

**Hypothesis 1:**



Various stats regarding AR/VR in different fields

Graph 1: Top 5 countries in terms of AR/VR penetration

Graph 2: Top 5 countries in terms of AR/VR revenue

Graph 3: Market Size of AR/VR

The various graphs present the increase in usage, market size and revenue of different distributions, they represent the fact that the usage and implementation for AR/VR in various fields globally is increasing throughout the years thereby suggesting that H1 is true.

**Hypothesis 2:**

AR and VR technologies are continuously reshaping multiple sectors, like education, healthcare, gaming, automotive, engineering, military, manufacturing and entertainment. Throughout all fields it can be said that immersiveness is the common attraction, as the AR/VR technologies allow the simulation of various things with good accuracy, allowing people to gain experience without experiencing those situations in reality. In learning and training part of the various fields especially education, AR/VR also allows catering to different learning styles.

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| --- | --- |
| Fields | Use/ Benefits |
| Healthcare | Training, diagnostics, surgery, and fitness. Foster a deeper understanding of complex concepts, ignite student curiosity, and promote collaborative learning. |
| Gaming | Immersive Interaction, smell, touch, physics, movements. |
| Automotive | Design, production, sales and marketing |
| Engineering | Architecture, Engineering and Construction. Enhance comprehension of intricate processes |
| Military | Equipment training, flight training, weapons training etc. Revolutionize the way armed forces personnel access information, plan mission strategy, and conduct critical operations. |
| Manufacturing | Modernize and streamline processes, eliminate costly errors and reduce downtime |
| Entertainment | Enhance product visualization and the customer experience. |

**1. Spatial computing:** It refers to technology that would allow computers to better understand and interact with the physical world, enabling AR/VR application to accurately map and overlay content onto the user’s environment.

Benefits: Spatial computing boost user immersion through its seamless integration of virtual content, it enables better intuitiveness of interactions and opens up further possibilities for enhancing productivity, visualization, gaming, education etc.

**2. Immersive Commerce Platforms:** This implementation involves leveraging AR/VR technology to transform the way consumer buy and interact with products online. Such platforms would allow things like virtual try-ons, interactive product visualization etc.

Benefits: Immersive Commerce platforms would enhance the online shopping experience, providing users with a more realistic and immersive preview of products, helping them in making purchase decisions. With the enhanced customization things like customer engagement and conversion rates would also increase.

**3. Emotion Recognition:** This technology would work using biometric sensors and machine learning algorithms to analyze the users’ expressions, gestures and other physiological responses, such systems would raise emotional engagement and personalization in VR experiences.

Benefits: Emotion recognition in VR would allow empathetic and adaptive experiences by dynamically adjusting content based on the emotional state of its users. Things like communication, therapy and training applications would experience enhancement in online medium because of the provided real time feedback on emotional responses.

**4. Haptic Feedback Technologies:** This technology aims to simulate tactility in various sensation like vibrations, force, texture etc., for AR/VR environments.

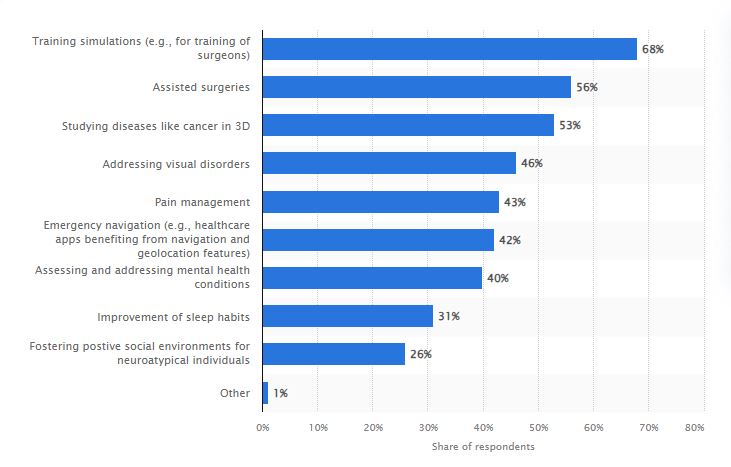
Benefits: Haptic feedback technology would enhance the usage experience in AR/VR by adding the various senses of daily life into the virtual world thereby allowing users feel things like sense of touch, smell etc. Allowing users to feel and interact with virtual objects more realistically would improve things like simulations, gaming experience, medical applications etc.

**5. 6 Degrees of Freedom Tracking:** This technology allows users to move freely in the physical space while simultaneously tracking their movements in the six degrees of freedom accurately. (6DOS – forward/backward, up/down, left/right, roll, pitch, yaw).

Benefits: 6DOS enhances the immersion and realism in the VR experience by allowing users to explore virtual environments with natural movements. The accurate enabling of such movements improves user comfort, reduces motion sickness and widens the range of interactive applications that can be supported.

**Summarize of hypothesis 2**  
Spatial computing integrates virtual content seamlessly into the physical world, enhancing user immersion and interaction in AR/VR applications. This technology enables accurate mapping and overlay of virtual content onto the user's environment, boosting intuitiveness and opening up possibilities for improved productivity, visualization, gaming, and education. Immersive Commerce Platforms leverage AR/VR to revolutionize online shopping by offering realistic product previews, virtual try-ons, and interactive visualizations, enhancing the shopping experience and increasing customer engagement and conversion rates.

Emotion recognition in VR utilizes biometric sensors and machine learning algorithms to analyze users' expressions and gestures, enhancing emotional engagement and personalization in virtual experiences. This technology dynamically adjusts content based on users' emotional states, improving communication, therapy, and training applications. Haptic feedback technologies simulate tactile sensations in AR/VR environments, allowing users to feel and interact with virtual objects realistically, enhancing simulations, gaming experiences, and medical applications. Six Degrees of Freedom Tracking enables users to move freely in physical space while accurately tracking their movements in six dimensions, enhancing immersion, comfort, and reducing motion sickness in VR experiences.



**7. AR/VR in healthcare:** Augmented Reality (AR) and Virtual Reality (VR) are revolutionizing healthcare, with their applications spanning across various departments within hospitals. The most significant use case is in training simulations, particularly for surgeons, with 68% of respondents utilizing these technologies. This allows for a realistic, risk-free environment for practice, enhancing the training process. Assisted surgeries, another major application area, leverage AR and VR to improve surgical precision and outcomes, with 56% of respondents indicating its use. Studying diseases like cancer in 3D is another critical application, with 53% of respondents utilizing AR and VR for this purpose, leading to a better understanding of the disease and improved treatment strategies.

AR and VR are also being used to address visual disorders (46%) and manage pain (43%), showcasing their versatility in patient care and treatment. Emergency navigation features facilitated by geolocation are utilized by 42% of respondents, proving particularly useful in emergency situations. Assessing and addressing mental health conditions accounts for a 40% share, with AR and VR providing immersive therapies and aiding in monitoring patient progress. Improvement of sleep habits (31%) and fostering positive social environments for neuroatypical individuals (26%) are other areas where these technologies are being applied. These statistics highlight the transformative potential of AR and VR in healthcare, promising a future where these technologies are integral to patient care and treatment.

The previously mentioned applications/implementations of AR/VR and many more such implementation indicate the positive impact that such implementations will have in development of AR/VR as well as information science and even commerce. Thereby proving H2 to be right.

**Hypothesis 3:**

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| --- | --- | --- | --- | --- | --- |
|  | Apple ARkit | Google ARcore | Meta quest | HTC Vive | Sony Playstation |
| Launched date | 5 June 2017 | 1 March 2018 | 21 May 2019 | 5 April 2016 | 13 October 2016 |
| Developed by | Apple Inc. | Google | Meta platforms | HTC corporation | Sony Group |
| Based on | AR(augmented reality) | AR(augmented reality) | VR( Virtual Reality) | VR( Virtual Reality) | VR( Virtual Reality) |
| Features | * device motion tracking * world tracking * scene understanding * display conveniences | * Motion tracking. * Environmental understanding. * Depth understanding. * Light estimation. * User interaction. * Oriented points. * Anchors and trackable. * Augmented Images. | * Boundary, Pass-through and Spatial Anchors * Voice commands and voice dictation * Display settings * Accessibility features | * Eye tracking * Motion Tracking * Audio Strap * Wireless Adapter * Facial Tracker | * 5.7 inch OLED panel * 1080p resolution * Social Video screen enabled * 3D audio effect * 360 degree head movement |
| Usage Area | IOS Mobile Applications like IKEA place, MeasureKIt, jigshaw, kings of pool etc. | Android applications like Measureapp, INKHUNTER, Mole Catch AR, Beer Pong etc. | Gaming, Entertainment, Fitness and Wellness, Travel, Design and playing virtually with friends | Gaming, Education and business sector | Entertainment and gaming |
| Market Revenue | 50.37 billion in 2023 | No data available | 1.9 billion in 2023 | 3 million | 25.96 billion |
| No. of Units Sold | Not applicable | Not applicable | 2.03 million | 1 million | 50 million |

The previously tabulated data well indicates how AR/VR is being used in day-to-day life and how its reach and sales is increasing thereby signifying the increasing popularity of AR/VR commercial products worldwide, proving H3 to be true.

**4. Apple Vision Pro Discussion and Future Scope**

**Apple Vison Pro**

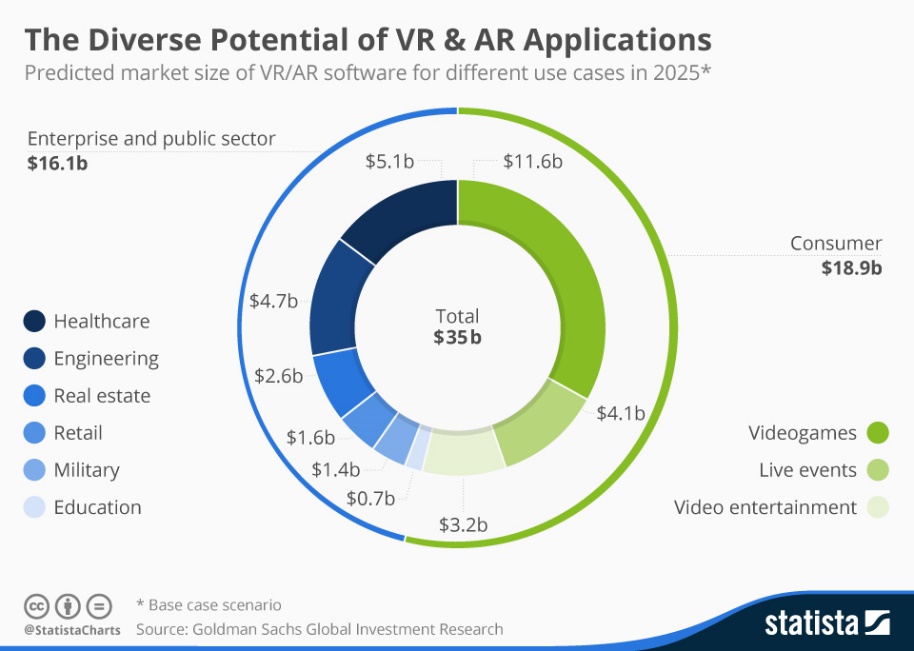
The Apple Vision Pro is currently setting a new trend in the AR and VR industry. It has become a viral sensation, with users taking the device out into the world and sharing their experiences on social media. People have been seen wearing the headset while running errands, working out, and even driving.

The device can transform any room into your personal theatre, expanding your movies, shows, and games to your perfect size and experience them in Spatial Audio. It also features Apple’s first 3D camera, enabling you to capture magical spatial photos and spatial videos in 3D. The device’s interface, which relies on tracking your eye and hand movements to navigate, is being hailed as a revolution in AR/VR interfaces. It has been described as a generational leap in mixed reality interface design.

Despite its high price tag and lower battery life, the Vision Pro has seen a pre-order boom, with up to 180,000 units sold during the pre-order weekend. This shows that there is a significant demand for high-quality AR/VR devices, and Apple is leading the way in meeting this demand. The return rate has also dropped to just 1%, suggesting that those buying the product today have a good idea of what they are buying and why.

The future scope of Apple Vision Pro is immense. As AR and VR technologies continue to evolve, the device is expected to offer even more immersive and intuitive experiences. It could revolutionize various sectors, including education, healthcare, entertainment, and more, by providing more interactive and engaging ways to learn, work, and play.

**Future Scope:**



The graph titled “The Diverse Potential of VR & AR Applications” provides predictions for the market size of Virtual Reality (VR) and Augmented Reality (AR) software across different sectors in 2025. The total predicted market size is $35 billion, divided into the Enterprise and Public Sector ($16.1 billion) and the Consumer sector ($18.9 billion). The Enterprise and Public Sector is further broken down into Healthcare ($5.1 billion), Engineering ($4.7 billion), Real Estate ($2.6 billion), Retail ($1.6 billion), Military ($1.4 billion), and Education ($0.7 billion).

In the Consumer sector, the market is segmented into Videogames ($11.6 billion), Live Events ($4 billion), and Video Entertainment ($3 billion). The graph highlights the diverse potential of VR and AR applications, with healthcare and video games predicted to have the largest shares in their respective sectors. These predictions, sourced from Goldman Sachs Global Investment Research, represent a base case scenario, indicating that actual outcomes could be higher or lower depending on various factors.

**5. Conclusion**

The Usage and implementation of AR/VR is projected to keep increasing with the same boom as more implementations are added so will sales and market size of AR/VR will increase. This increase in implementations will bring positive impacts to user, companies, the field AR/VR. With the increasing performance from implementations, more convenient and well implemented devices will come to the commercial AR/VR products market, it’s a given these products will do well in said market. It is noted, that all three hypotheses converge and affect each other with various points of connection.

Reference

https://financesonline.com/virtual-reality-statistics/.