AR VR Supply Chain Management Immersive Learning Solutions

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1. Introduction

Immersive learning has become a transformative element in education, utilizing advanced technologies like augmented reality (AR), virtual reality (VR), and mixed reality (MR) to generate dynamic and captivating learning atmospheres. Although this innovative approach provides numerous benefits, it also brings some barriers that must be tackled. In this session, we will examine the advantages and disadvantages of immersive learning, with a specific emphasis on the impact of advanced technologies, including glasses-free AR and VR video, on the field. Additionally, we will evaluate various immersive learning applications, ranging from digital design creation utilizing software such as Blender to the modification of training resources, in order to determine which approach exhibits the most potential for education's future.

a. Benefits of Immersive Learning:

Immersive learning has garnered substantial attention in the education sector due to several factors such as advancements in camera technology. The rapid progress in this technology has resulted in high-quality imaging, which is a key feature of AR/VR immersive learning. This feature enables learners to explore and interact with detailed virtual environments, leading to a more realistic and engaging experience.

Additionally, applications such as Blender can be used to create highly realistic 3D environments. Blender is a software that empowers educators to produce intricate and lifelike 3D environments. These virtual modules and environments can be smoothly integrated with VR, AR, or MR platforms for creating immersive and riveting educational experiences.

Platforms such as Unity and Unreal Engine offer educators and developers the necessary software development tools for crafting top-notch VR/AR/MR applications. These development kits facilitate the creation and execution of immersive educational experiences that align with pedagogical objectives.

Goggle-free technology: Though traditional goggles have long been a vital component of immersive experiences, their discomfort and potential adverse effects on eyesight have prompted the exploration of goggle-free AR/VR endeavours. Overcoming the limitations of cumbersome devices is crucial for broader adoption in academic contexts.

b. Challenges to overcome:

- Accessibility: Immersive technologies can be expensive and require specialized equipment, which can limit access for certain learners.
- Content development for high-quality immersive experiences can also be both time-consuming and resource intensive.
- Motion sickness is a potential concern for users. Some individuals may experience motion sickness or discomfort in virtual environments.

c. Advanced immersive technologies:

- Glasses-free learning: New technologies have paved the way for goggle-free immersive experiences, reducing the barriers to entry.
- Augmented Reality (AR): AR overlays digital information onto the real world, enriching the learning experience.

- Virtual Reality (VR): VR creates fully immersive virtual environments suitable for a variety of educational contexts.
- 360-degree videos: These videos provide a panoramic view of real or simulated environments, enhancing immersion.

d. Comparison of immersive learning modalities:

- Digital design and development (e.g. Blender): Immersive learning is particularly effective for teaching complex skills such as digital design and development.
- UI/UX Design: UI/UX training benefits from immersive experiences that mimic user interactions and feedback.
- Customize training materials: Personalizing learning content through immersive technologies enables adaptive and learner-centric training.

In conclusion, immersive learning through AR and VR technologies is transforming education by providing interactive and experiential learning opportunities. The selection of immersion learning activities, such as digital design exploration using Blender, UI/UX design, or customizing training materials, relies on the specific educational objectives and learner needs. As the industry evolves, it will be critical to address drawbacks and capitalize on advantages to shape the future of immersive education.

2. Immersive learning in Industry

Augmented Reality (AR) and Virtual reality (VR) immersive learning have gained significant usage in various industries due to their ability to enhance education training and further the industry.

1. Realistic simulation

- AR and VR provide realistic simulation to various industries using advanced technologies that can replicate real-world scenarios and environments to the learner. For instance, some specific simulations of work environments, machinery and processes can enable learners to learn through the immersive learning experience. Learners can develop more proficient skills and become more familiar with and understand the workflow, real-life equipment and situation on the job. For example, those manufacturing workers can practise their skill in operating the machinery before they directly go for the real-life machinery, which could compromise their safety. AR and VR systems can provide high-quality visual display and graphics rendering to create a more realistic environment by considering those visuals, texture, and lighting that is near to the realism of the simulations.
- For warehousing and inventory management, warehouse workers can use AR glasses or devices to get real-life information about inventory levels, goods location or order fulfilment. It can guide the workers to the specific items, provide more precise instructions for efficient picking and packing, and create a more realistic hands-on experience within the warehouse environment. At the same time, VR can replicate the warehouse layouts and inventory scenarios. Learners can practise tasks like organising storage, performing stock controls and optimising warehouse layout for efficient operations. These realistic simulations could improve worker's skills and reduce the risk in inventory management.

2. Hands-on experience

- AR and VR can provide a hands-on experience for the learners without needing physical equipment. Trainees can practise those complex tasks and learn the procedures in aviation, medicine, or heavy machinery industries in more secure and controlled virtual equipment. In terms of this, VR can virtually recreate real-like environments, allowing users to interact or manipulate objects in a 3D space. This could give learners a hands-on experience that closely mimics the working environment. For example, AR and VR can stimulate equipment operations in high-risk industries, such as aviation. For surgical training, trainee surgeons can use VR simulations to practise surgical procedures on virtual patients before going for the real one. VR can manipulate virtual organs, instruments and tissues or provide realistic hands-on practice before operating on patients.
- AR and VR can offer hands-on learning experiences in supply chain management and immersive learning solutions. For example, warehouse operations can use VR warehouse simulations to navigate and interact with the virtual warehouse environment. Practising high-risk equipment, such as a forklift that carries heavy goods, in a safe and controlled virtual environment is possible.

3. Cost-efficiency and rapid skill development

- Immersive learning experiences may require more upfront capital expenditure. It may cost more on the travel fee when the learner is doing their training on the expenditure. It can help save the organisation money in the longer term. Traditional training

methods often involve expenses like travel, accommodation and physical training material. For example, virtual simulations can substitute costly cadaver labs for medical students in the healthcare sector. At the same time, in the aviation industry, virtual flight simulators can reduce the cost of training pilots on the actual aircraft. AR and VR can replace or supplement these methods with a virtual training environment to reduce the need for physical resources and travel-related costs. This also accelerates the learning process by making it more engaging and interactive for the trainees. Learners may grasp complex concepts and skills more quickly and efficiently, reducing the time required for training and minimising the associated cost.

- Learners taking part in highly focused or high-intensity training sessions will experience more effective training than traditional training. It could be precious for an industry that needs rapid adaptation to technological changes and requirements.
- In the supply chain environment, downtime can be costly while AR and VR enable employees to learn new processes and systems without interrupting regular operations; it can minimise production disruption, improve cash flow, and ultimately save money,

4. Data and analytics

- AR VR immersive learning can provide valuable data and analytics to various industries, not only the medical healthcare sector or aviation sector, through collecting and analytic user interaction within the virtual environment. We can look through the performance metric as AR and VR systems are allowed to track user interaction, such as the time spent in the training module given, the completion percentage or rates, or the attempts to take the module. These metrics help the organisation keep track of learner's performance and effectiveness in the training program.
- In simulations and role-playing scenarios, AR and VR can capture the decisions we make and the outcomes that result from those decisions. These data could be used to analyse decision-making for the future and enhance the training program to reflect real-world scenarios more accurately.
- AR and VR systems can integrate with IoT (Internet of Things) devices and sensors placed throughout the supply chain. It could allow real-time tracking of goods, assets and vehicles. The immersive environment allows users to visualise information about the product's location, status, and condition. In this way, individuals or groups can identify areas where supplementary training or assistance may be necessary.

3. Empowering Immersive Learning: How IT Software and Hardware Enhance Industrial Training

In the rapidly evolving field of education and training, integrating immersive technologies has become a potent approach to enhance learning experiences. This article delves into supply chain management and investigates the utilization of Information Technology (IT) software and hardware for creating immersive learning environments. In particular, it focuses on Augmented Reality (AR) and Virtual Reality (VR) applications.

a) Hardware Advancements in Immersive Learning:

- Camera: They capture the real-world environment and allow for the integration of virtual elements without interruption. In immersive learning for AR and VR supply chain management, cameras allow students to overlay digital information onto physical objects, thereby improving their comprehension of real-world logistics and operations.
- Stylus Pen: Students are able to manipulate digital objects and make annotations, resulting in a more interactive and immersive learning experience. Within supply chain management, this translates to the ability to simulate inventory management or design efficient warehouse layouts.
- Sensor Technology: and accurate reflection of learners' actions in the virtual world. This is especially valuable in situations that require accurate movements and interactions, like operating machinery in a supply chain context.
- Laptop - ZenSpace: Laptops, particularly those with potent processors and graphics cards, such as the ZenSpace series, deliver the essential computing power to run immersive apps seamlessly. These gadgets are crucial in enabling learners to access and engage with immersive content without any technical limitations.

b) The Power of Software in Immersive Learning

- **Blender:** Blender is an open-source software that empowers educators and learners to create and import 3D models for animations. Its versatility allows for the design of objects, environments, and characters without limitations. Importantly, Blender-generated 3D objects are compatible with other software like Unity and Unreal Engine, making it an ideal tool for developing 3D assets used in AR supply chain simulations.
- **Unity:** Unity is a renowned platform in AR and VR for creating immersive and interactive learning experiences. It excels in the development of simulations, interactive games, and virtual environments. Unity XR offers specialized tools for AR creation, and its scripting capabilities using C# enable the creation of interactive behaviors for 3D objects. Additionally, Unity's physics engine ensures realistic interactions, vital for immersive learning in supply chain management.
- **AutoCAD:** AutoCAD, developed by Autodesk, is a leading software tool for computer-aided design (CAD). In immersive learning, AutoCAD shines by creating interactive 3D models of structures, machinery, and products. Its 3D modeling capabilities enable precise visualization, allowing students to explore architectural designs in virtual spaces, essential for understanding the complexities of supply chain management.
- **Oculus Rift and Oculus Quest:** Oculus Rift and Oculus Quest VR headsets, developed by Meta Platforms (formerly Facebook), are gaining traction in education. These

headsets facilitate immersive learning experiences, including virtual field trips, historical reenactments, and interactive science simulations. In supply chain management, students can virtually explore warehouses, simulate inventory management, and grasp logistics concepts with greater depth.

- **Unreal Engine:** Unreal Engine supports AR through plugins like ARCore and ARKit Support, simplifying development. Real-time rendering capabilities make it ideal for creating 3D visualizations in immersive learning. Whether designing supply chain processes or optimizing logistics, Unreal Engine provides a robust platform for educators and developers.

To conclude, the combination of IT software and hardware is revolutionizing industrial training through immersive learning. In the context of AR/VR-enabled immersive education for supply chain management, these technologies facilitate in-depth conceptual engagement, virtual exploration, and hands-on experience in a secure environment. As technology advances, the potential of immersive learning to transform training and education across multiple industries, including supply chain management, is endless.

4. The Digitalization of Immersive Learning: Pros and Cons in Supporting Modern Education

Immersive learning has significantly gained the attention of various industries, not only in the medical healthcare sector or aviation sector but also in supply chain management, when augmented by digitalization, augmented reality and virtual reality technologies. The computerization of immersive learning in supply chain management offers many advantages but also comes with specific challenges that can impact training, productivity and general operations.

Pros of digitalization in AR VR supply chain management immersive learning:

1. Realistic training environment.

- AR VR technologies can create highly immersive and real-world environments training services to let the learners or workers experience various aspects of the working environment, such as the surgery, the flight simulator, or the supply chain. For example, the supply chain aspect, from warehouse operations to distribution, can be operated in a lifelike setting. Realism can enhance the trainees' learning experience and prepare them for problem-solving in real-world uncertainties.
- The most important is to train the adaptability of the specific needs of the trainees. When organisations can customise realistic training environments to meet the supply chain management requirement, whether it is a complex distribution network or a highly automated warehouse, AR VR can be tailored to address the unique challenges of the supply chain to the trainees before they directly do the work while not understanding the workflow.

2. Cost saving

- Undoubtedly, traditional training methods often involve high costs, including physical simulations, travel expenses or in-person workshops. Digitized AR VR training can eliminate those extra costs and the associated overhead costs. It makes it a cost-effective alternative in the long run for the organisation. Scaling up the traditional methods causes costs to increase proportionally as the organisation grows. In contrast, AR VR training helps to scale without increasing the cost while making it cost-efficient for large and growing teams while delivering the training module that can ensure the consistency of the delivered content and experience across all trainees. The training modules can be reused and repurposed for different training needs while maximising the cost savings.

3. Enhanced safety

- Safety concerns are typical in those high-risk jobs such as aviation or supply chain, often dealing with heavy machinery or hazardous material. AR and VR simulations can reduce the risk of harm while offering the trainees a way to practise managing such situations, ensuring they are well-prepared to handle emergencies and safety protocols.
- For example, AR and VR simulations can recreate the hazardous situations commonly encountered in the supply chain, such as chemical spills, handling of dangerous chemical goods or forklift accidents. Trainees can then immerse themselves in the real-life environment, and the training module can test the trainee's performance on

how to respond to emergencies and whether they would still follow the safety protocol when the situation happens.

Cons of Digitalization in AR/VR Supply Chain Management Immersive learning

a) Adoption hurdles

- Implementing new technology like AR and VR technology immersive learning to train the employee might be difficult for the employee as some employees may be resistant to using the new technologies, or it is time-consuming to adapt to new immersive learning environments. Resistance to change may stem from the fear of the unknown field if the workers need to become more familiar with AR and VR technology. This issue will slow down the training process and may require extra effort from workers and the upper person in charge of change management.
- Some employees need to gain awareness of the potential benefits of AR and VR immersive learning in supply chain management. Organisations may need to invest in awareness campaigns and clearly explain how these technologies can enhance training and improve job performance. Ensuring that AR and VR training is accessible to all employees, including those with disabilities, can be challenging. The challenges given to organisations to ensure the consideration of making the technology accommodate the needs of all learners.

b) Initial investment cost

- Implementing Augmented reality(AR) and virtual Reality(VR) technology incurs significant expenses, it can be expensive. This is due to the circumstances involving purchasing the hardware, software development and content creation applications. This initial investment can financially burden an organisation, especially for a small company. It may find this requirement for implementing AR VR technology in the company.
- Look at the hardware costs that require specialised hardware, including expensive professional headsets, sensors and controllers. It mainly considers the need to purchase multiple units for a training program as it will involve many trainees. Nevertheless, creating a customised AR and VR training module for supply chain management training is complex and resource-intensive. Custom software development is costly and time-consuming, involving as many training modules as possible. Aside from that, organisations may face the uncertainty of Return on Investment(ROI) as many organisations hesitate to make a substantial upfront investment in AR and VR technology without a clear understanding or planning of the expected ROI. Many organisations may retreat when demonstrating the tangible benefits and calculating the cost of immersive learning in the early stages.

c) Limited realism

- There must be a potential gap between the virtual training environment and the actual complexities of real-world supply chain operations. AR and VR simulations may only capture some of the intricacies and complexities of fundamental supply chain management. For instance, the virtual warehouse operations or the manufacturing facilities may lack the dynamic nature of the real one or any expected events, such as sudden equipment breakdown or supply chain disruption. The AR and VR technologies may simplify all the sudden accidents, but they still could not bring excellent momentum to the learners.
- When organisations try to enhance their safety protocol when following the trainer's feedback, there is limited physical feedback, as in AR and VR simulations. The

absence of physical objects and tactile feedback could reduce the sense of realism. For instance, a trainee might feel differently than the actual weight and texture of the product they are handling, which may impact the learning experience, especially in scenarios that require manual dexterity. It could improve workers' skills and reduce the risk in inventory management.

5. Exploring the World of Immersive Learning: Goggles vs. Goggleless

When it comes to immersive learning, a fundamental distinction arises between goggle-based and goggleless approaches, each offering unique advantages and drawbacks that impact the realm of AR VR supply chain management immersive education.

Goggle-based immersive learning typically employs Virtual Reality (VR) headsets as its primary hardware. VR completely submerges learners into alternate digital realities, creating a profound sense of immersion. Learners wear VR headsets such as the HTC Vive or Oculus Quest, often paired with headphones and hand controllers, enabling them to navigate and interact within their virtual environments. This approach is characterized by the creation of entirely synthetic, digitally crafted content and environments that faithfully replicate real-life scenarios. Furthermore, it provides a safe and risk-free space for learning, enabling repeated practice and accurate measurement of success, ultimately enhancing the retention of information.

On the other hand, goggleless immersive learning predominantly utilizes Augmented Reality (AR) technology. Unlike VR, AR does not seek to block out the real world; instead, it blends digital content seamlessly with the physical environment. Digital assets in AR can take various forms, from flat and 2D instructional information to complex and 'real' 3D objects. AR content is often triggered by specific objects or geographical locations, allowing learners to access information and simulations through mobile devices like smartphones and tablets, ensuring accessibility.

Goggle-based Immersive Learning (Virtual Reality):

Pros:

a) Complete Immersion: VR offers learners a fully immersive experience in digital worlds, enhancing engagement and experiential learning.
b) Realistic Replication: Digitally created content and environments in VR accurately simulate real-life scenarios, ensuring authentic learning experiences.
c) Safety and Repeatability: VR provides a risk-free space for learners to practice and repeat activities, allowing for accurate measurement of success and improved retention.
d) Enhanced Retention: The immersive nature of VR can support students in retaining information for longer periods.

Cons:

a) Isolation: Goggle-based immersive learning can lead to isolation, as learners are cut off from the physical world and human interaction, which is crucial for successful learning environments.
b) Hardware Dependency: VR requires specific hardware like VR headsets, which may not be easily accessible or affordable for all learners.
c) Comfort Issues: Extended use of VR headsets can be uncomfortable, especially during long learning sessions.

Goggleless Immersive Learning (Augmented Reality):

Pros:

a) Real-World Integration: AR seamlessly blends the real world with digital content, enhancing contextual learning and relevance.

b) Object and Location-Based: AR content can be triggered by specific objects or geographical locations, providing dynamic learning experiences.
c) Accessibility: Goggleless immersive learning is easily accessible through common mobile devices like smartphones and tablets.
d) Enhanced Retention: The interactive and contextual nature of AR can support students in retaining information for longer periods.

Cons:

a) Isolation Concerns: Goggleless immersive learning may also lead to isolation as learners focus on digital content, potentially undermining the importance of human interaction in the learning process.
b) Design Complexity: Creating effective 3D interfaces for goggleless immersive learning can be challenging, requiring specific design skills to provide a complex and engaging virtual experience.

In conclusion, the choice between goggle-based and goggleless immersive learning in AR VR supply chain management education depends on various factors, including the learning objectives, accessibility of hardware, and the desired level of immersion. Both approaches offer unique advantages and challenges, and educators must carefully consider these factors when designing immersive learning experiences to ensure they align with the specific needs and goals of their learners.

6. Flowchart

Start

1. Define Learning Objectives
- Identify Key Concepts
- AR VR Supply Chain Management Immersive Learning Solutions

- Determine Target Audience
- Lecturer, students

2. Content Creation
- Develop 3D Models of Supply Chain Components
- Create Interactive VR/AR Simulations

3. Platform Selection
- Choose AR/VR Hardware
- Select Development Tools (e.g., Unity, Blender)

4. Integration
- Integrate 3D Models and Simulations with the Platform
- Ensure Compatibility and Optimization

5. User Interaction Design
- Design User Interfaces
- Implement User Controls (e.g., Gestures, Controllers)

6. Testing and Quality Assurance
- Conduct User Testing
- Debug and Refine

7. Monitoring and Updates
- Gather Feedback
- Make Improvements and Updates

End

7. Algorithm

1. Define Learning Objectives:
    - Identify the specific supply chain management topics and concepts to be taught.
2. Content Creation:
    - Develop 3D models of supply chain components (e.g., warehouses, transportation, inventory).
    - Create interactive VR/AR simulations that illustrate supply chain processes.
    - Incorporate realistic scenarios and challenges.
3. Platform Selection:
    - Choose appropriate AR/VR hardware and devices
    - Select development tools and software (e.g., Unity, Blender) for content creation.
4. Integration:
    - Integrate 3D models and simulations with the chosen AR/VR platform.
    - Ensure compatibility and optimise performance for smooth user experiences.
5. User Interaction Design:
    - Design user interfaces that are intuitive and user-friendly.
    - Implement user controls, such as gestures or handheld controllers, for interaction.
6. Testing and Quality Assurance:
    - Conduct thorough testing, including user testing with students.
    - Debug and refine the AR/VR modules based on user feedback.
7. Monitoring and Updates:
    - Gather feedback from students and educators.
    - Make necessary improvements and updates to enhance the learning experience.
8. End:
    - Continue monitoring, updating, and expanding the AR/VR supply chain management immersive learning program as needed.