

# Transforming Medical Education and Training with VR using M.A.G.E.S.

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## The problem

### Expensive training Model



Master: Educates while working  
Apprentice: Builds career & learns while operating  
(Estimated Costs: \$48,000 per apprentice per year in OR time alone)

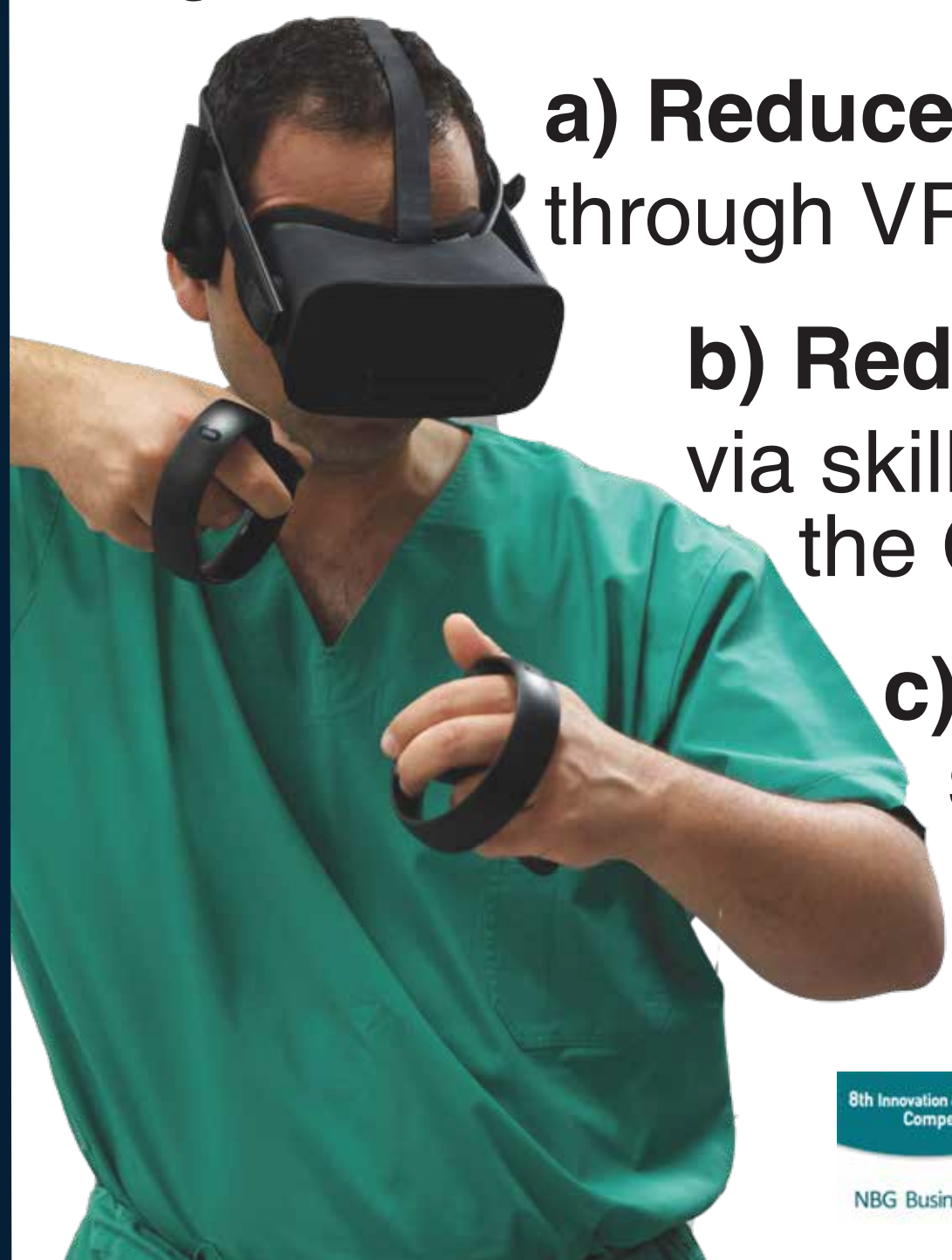
### Limited Surgical Simulation



Robotic simulators: expensive, anchored, not for open surgery  
(Estimated costs: \$ 150,000 per robotic simulator)

## Our solution

The most advanced Virtual Reality (VR) software simulation platform that builds surgical skills based on M.A.G.E.S.

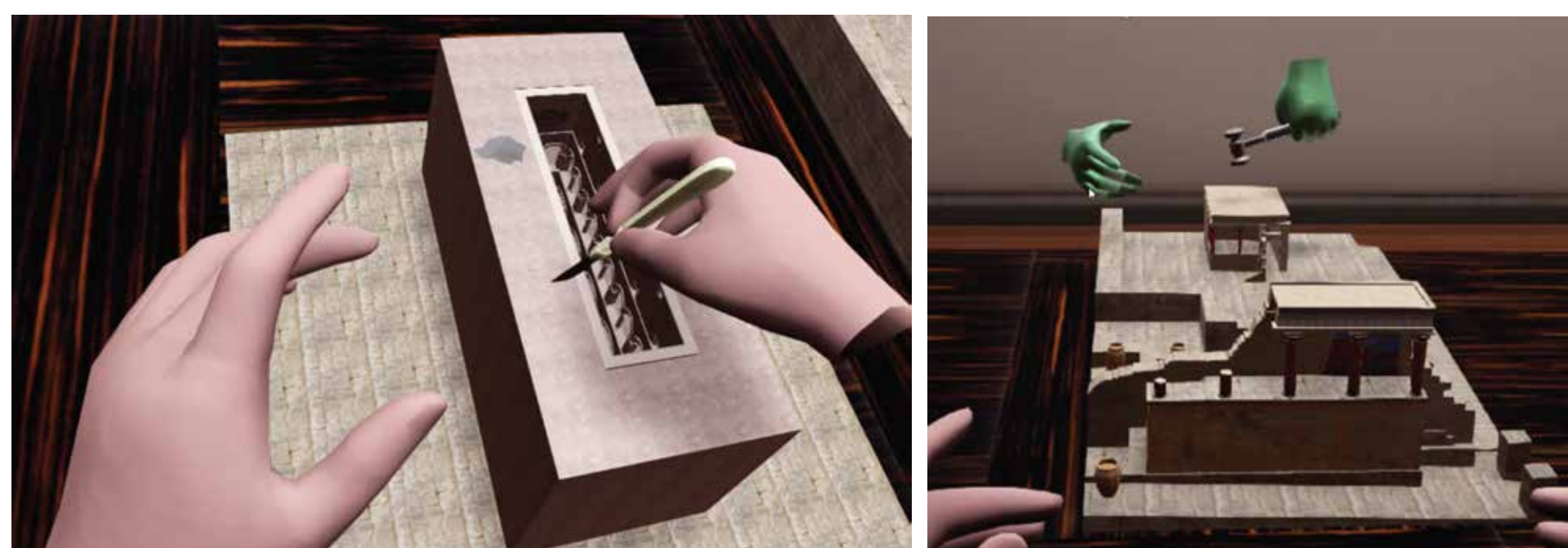


- a) Reduces surgical errors through VR psychomotor training
- b) Reduces training costs via skill transfer from VR to the Operating Room
- c) Democratizes and scales up training



## Platform SDK exposing M.A.G.E.S.

Applicable to any gamified, psychomotor training need (e.g. cultural heritage restoration)



## References

George Papagiannakis. 2013. Geometric Algebra Rotors for Skinned Character Animation Blending. In SIGGRAPH Asia 2013 Technical Briefs (SA '13). ACM

George Papagiannakis, Panos Trahanias, Eustathios Kenanidis, and Eleftherios Tsiroidis. 2018. Psychomotor Surgical Training in Virtual Reality. Springer International Publishing, Cham, 827–830.

Margarita Papaefthymiou, Dietmar Hildenbrand, and George Papagiannakis. 2016. An inclusive Conformal Geometric Algebra GPU animation interpolation and deformation algorithm. The Visual Computer 32, 6 (01 Jun 2016), 751–759.

## Our novel technology: M.A.G.E.S.

### Multi-player, shared virtual collaborative operating room

Our innovative networking layer, allows cooperative operations.

Our Custom **Conformal Geometric Algebra** (CGA) GPU interpolation engine groups transformations under a single mathematical framework:

$$T = 1 - \frac{1}{2}te_{\infty} \quad R = e^{-b\frac{\phi}{2}} \quad D = 1 + \frac{1-d}{1+d}e_{\infty}^{\wedge}e_0$$

New character vertex position =  $T * R * D$

- ✓ Network data transfer
- ✓ Interpolation quality
- ✓ 7+ simultaneous users



### Analytics engine with cloud-based assessment



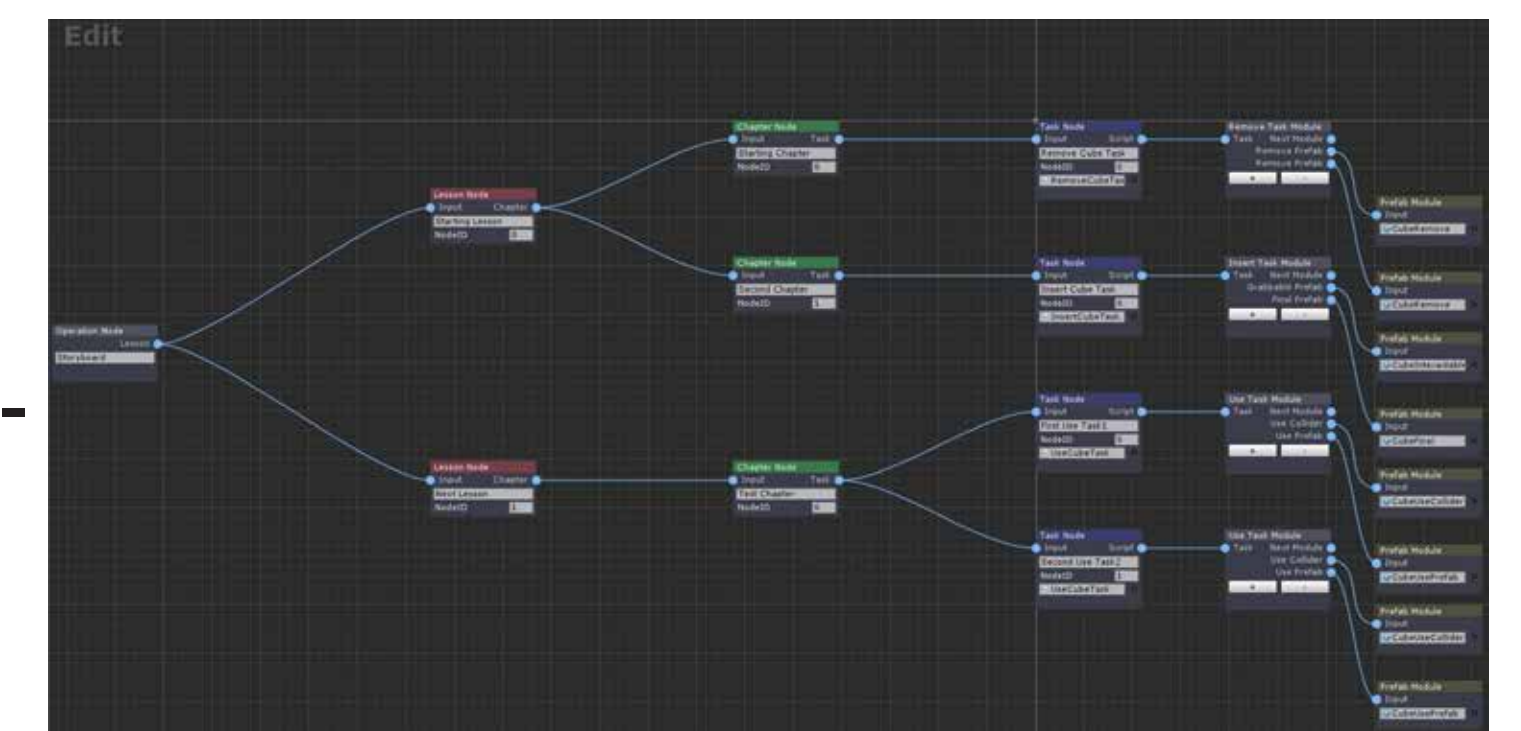
Another novelty is our own Analytics engine with **cloud-based user assessment** to track, monitor and present important feedback regarding each gamified operation.

- ✓ Unlimited user event tracking and analysis

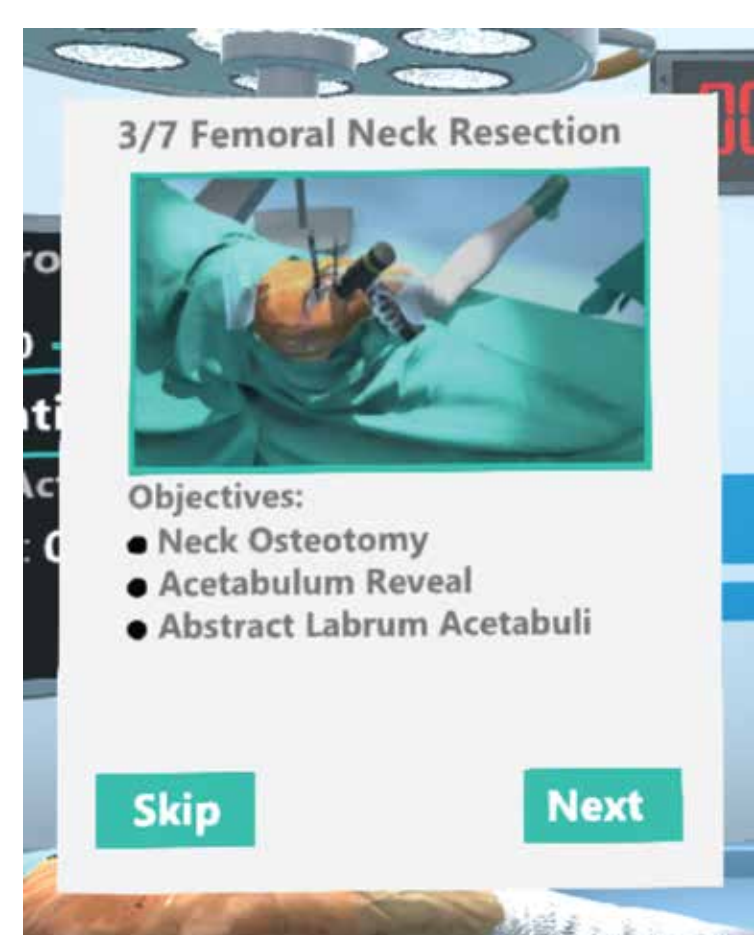
### Gamified rapid prototyping

Medical operations can be **modeled, modified** and **generated** through scriptable nodes using our custom visual scripting editor.

- ✓ Coding-free SDK
- ✓ Content creation



### Educational Curriculum



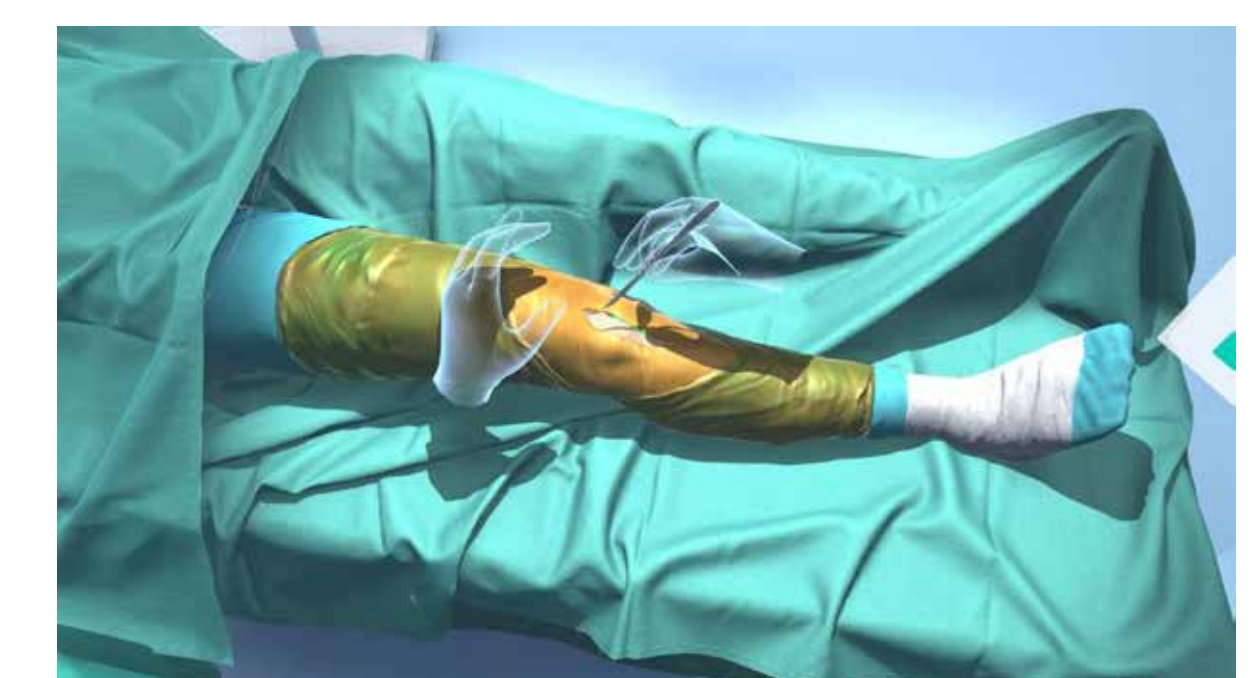
Our products integrate an educational curriculum to **enhance knowledge and skills**.

- ✓ Adaptive visual guidance
- ✓ Gamification elements
- ✓ Curriculum Objectives
- ✓ Live webinar support
- ✓ Scoring system

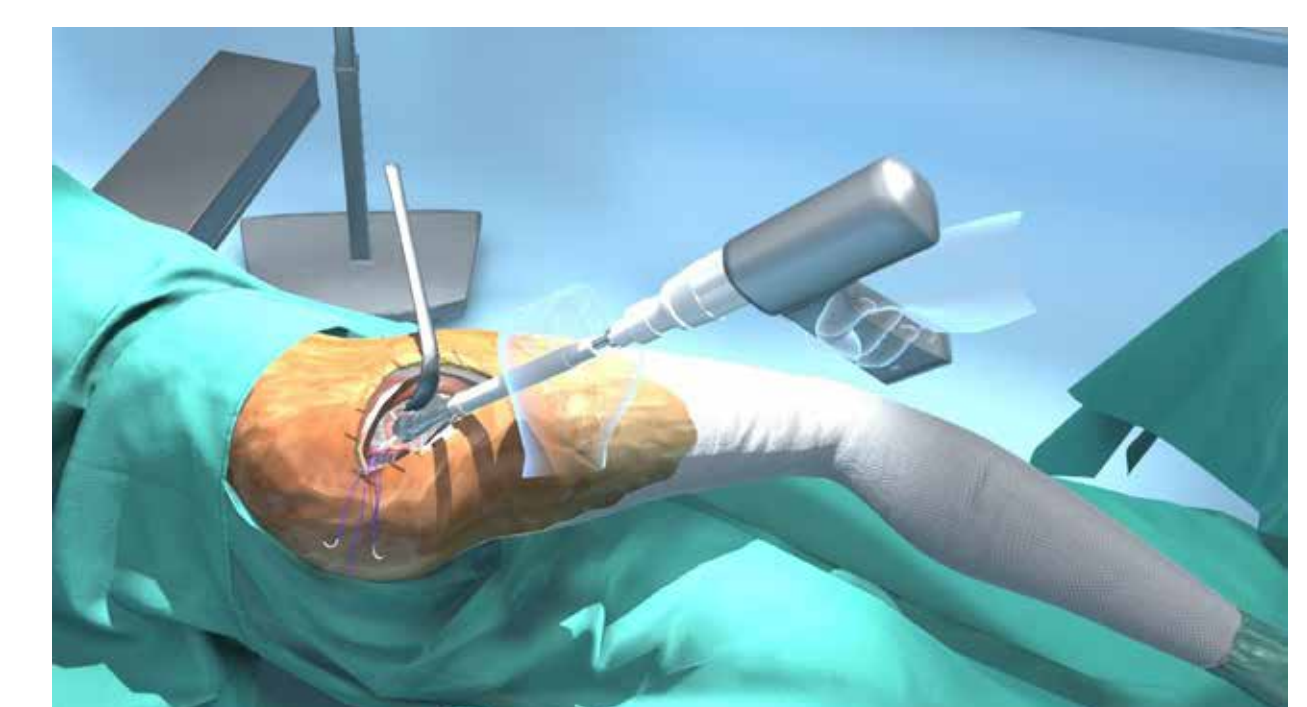


### Semantic Representation of Medical Operations

By **prototyping commonly used patterns** and surgical techniques we managed to create a **customizable platform** able to populate new content with minimal changes.



Total Knee Arthroplasty



Total Hip Arthroplasty