Making your own simulator(s)

Keeping it simple: An example
CAMES Masterclass, 2022

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Agenda

What I will use your time on

Who am I

Why

What

How

Garage

Take home messages

If nothing else, then please just

- Define the purpose of your simulator
- Start simple, and add features when necessary
- Everything is possible with a budget, but there often is not one
- Stop saying fidelity - use realism

MBS Svendsen

M.Sc.Eng, Ph.d.

- Master of Engineering
- Ph.d.
- Head of Engineering, CAMES RH
- Scientist, h: c: n:

Engineering

Core Services

Phantom Design Lab

CAMES

Phantom Design Lab

- Robotic Surgery
- Basic Skills
- Airway management
- Ultrasound

DataSW

- Data acquisition
- Data Management
- Data Analysis (stat/ml/ai)
- Programming
- XR

3D Lab

- Clin3DP
- PrintFarm
- Assistive devices

CAMES 3D

Start with why

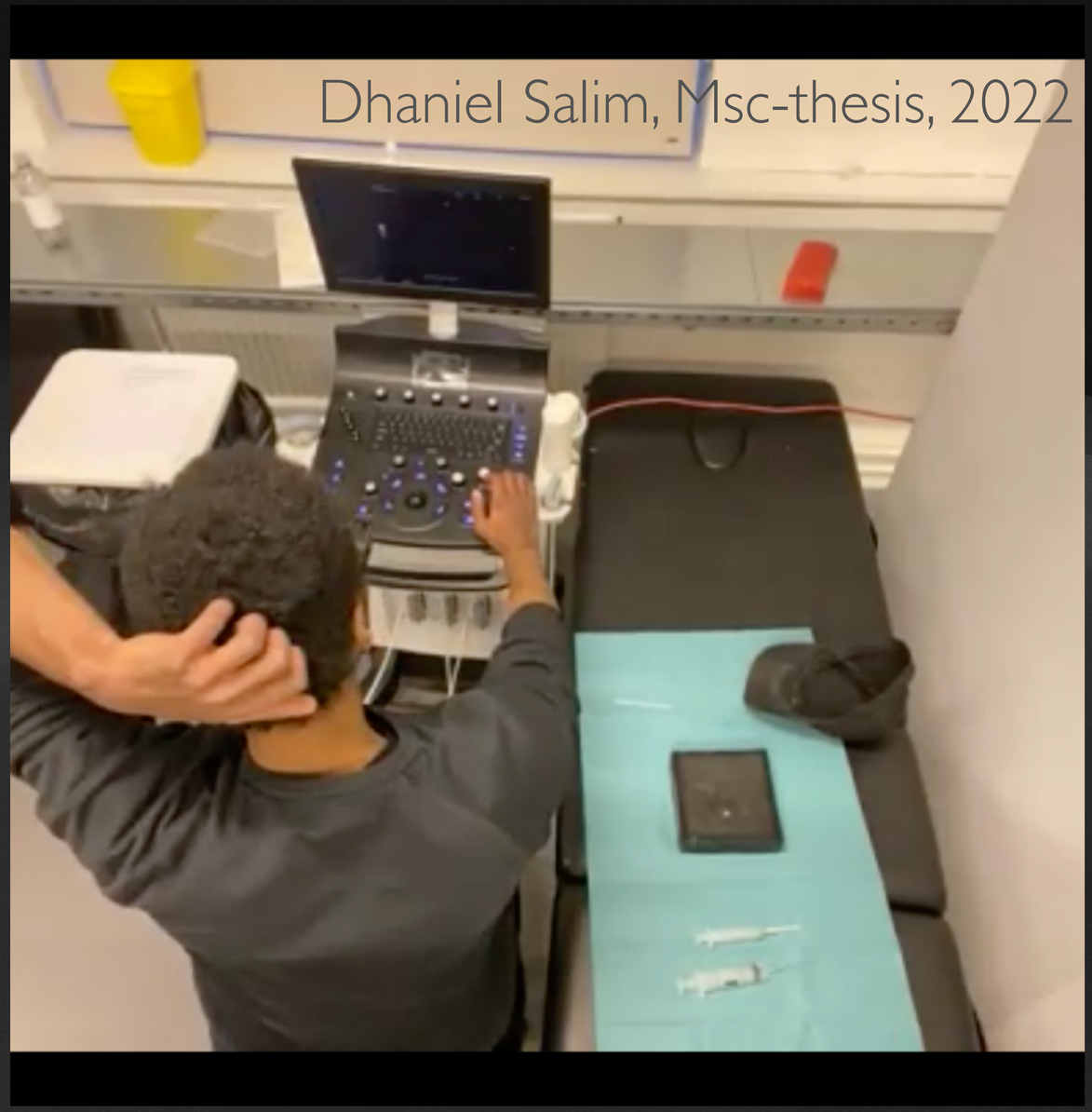
So, why ?

- Simon Sinek

Why medical simulators

Many solutions to many problems

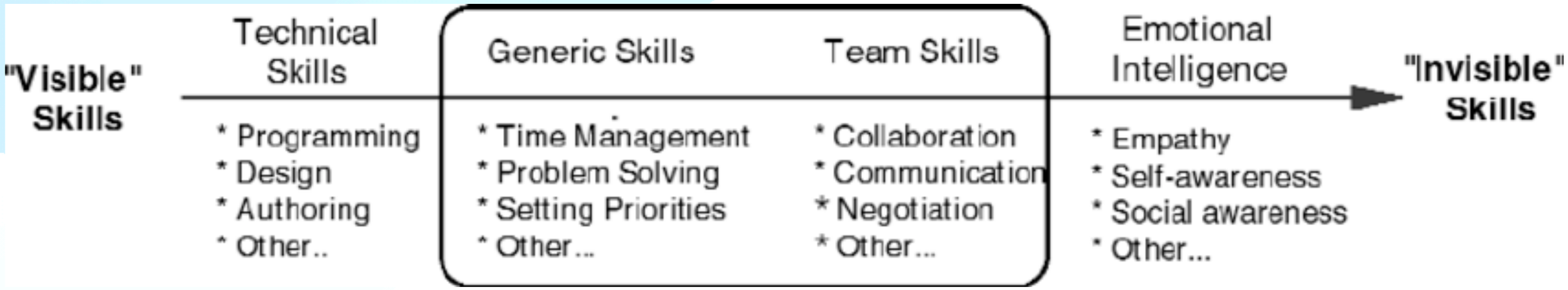
- Education and training
- Human factors
- Usability (Compliance)
- Test facility



Medical Simulation

Technical Skills

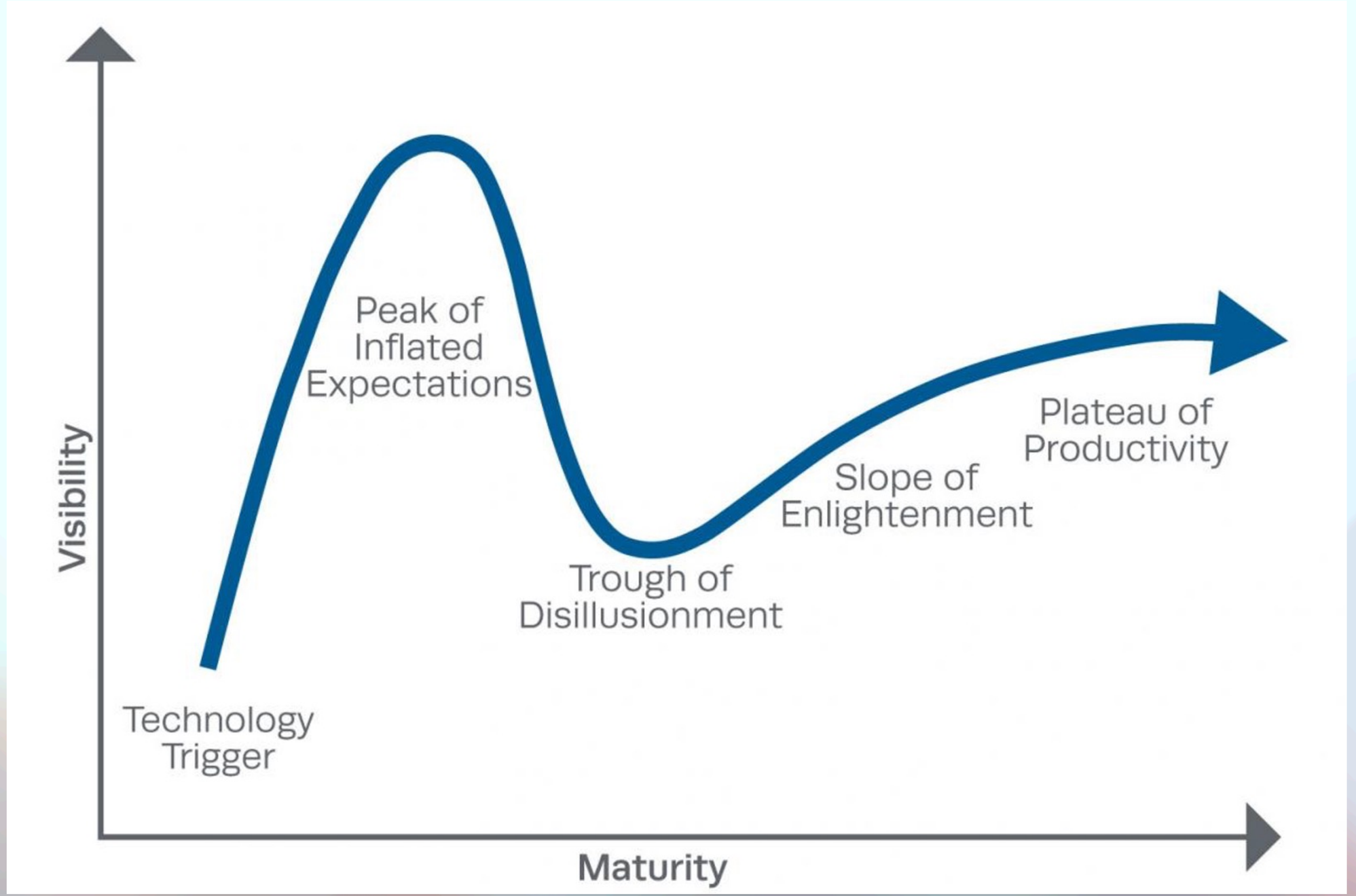
Non-technical skills



Learning objectives

Task

Write down your why


Visibility
Peak of
Inflated
Expectations
Plateau of
Productivity
Slope of
Enlightenment
Trough of
Disillusionment
Technology
Trigger
Maturity

What

Fidelity and realism

- Ref

- Start speaking a language that makes sense
- Fidelity is not a property

List 2

The Authors' Recommendations for Investigators in Simulation-Based Medical Education*

Recommendation #1: Abandon the term *fidelity.*

We recommend that the multidimensional and imprecise term *fidelity* be abandoned. More directly useful terms should be employed that reflect principles of effective training and transfer, such as physical resemblance and functional task alignment.

Recommendation #2: Shift emphasis from physical resemblance to functional task alignment.

The field of simulation should shift emphasis away from structural properties of the simulator (i.e., physical resemblance) to functional properties of the entire simulation context that align with learning objectives (i.e., functional task alignment). There is now plenty of evidence that physical resemblance can be reduced with minimal or no loss of educational effectiveness, provided there is appropriate correspondence between functional aspects of the simulator and the applied context.

Recommendation #3: Focus on methods to enhance transfer of learning.

The emphasis on designing physical resemblance into the simulator evolved as a means to promote transfer of learning to real-life settings. We recommend a refocus on specific methods for enhancing transfer of learning to the applied setting, supported by an evidence base for effective learner orientation, learner engagement, and the development of learning objectives to ensure functional task alignment.

*A more detailed version of these recommendations may be found in the "Recommendations" section of this Perspective.

instructional features. Consistent with recommendations in other fields, such

learning. Simulation scenarios should be designed to enhance transfer by whatever

Reconsidering Fidelity in Simulation-Based Training

Stanley J. Hamstra, PhD, Ryan Brydges, PhD, Rose Hatala, MD, MSc, Benjamin Zendejas, MD, MSc, and David A. Cook, MD, MHPE

Abstract

In simulation-based health professions education, the concept of simulator fidelity is usually understood as the degree to which a simulator looks, feels, and acts like a human patient. Although this can be a useful guide in designing simulators, this definition emphasizes technological advances and physical resemblance over principles of educational effectiveness. In fact, several empirical studies have shown

health professions education, and i Perspective they use their experienc conducting that review to examine concepts and assumptions surround the topic of fidelity in simulation.

Several concepts typically *associated* fidelity are more useful in explaining educational effectiveness, such as transfer of learning, learner engager and suspension of disbelief. Given th these concepts more directly influen

“It is product development”

Morten Bo

TECHNOLOGY READINESS LEVEL (TRL)

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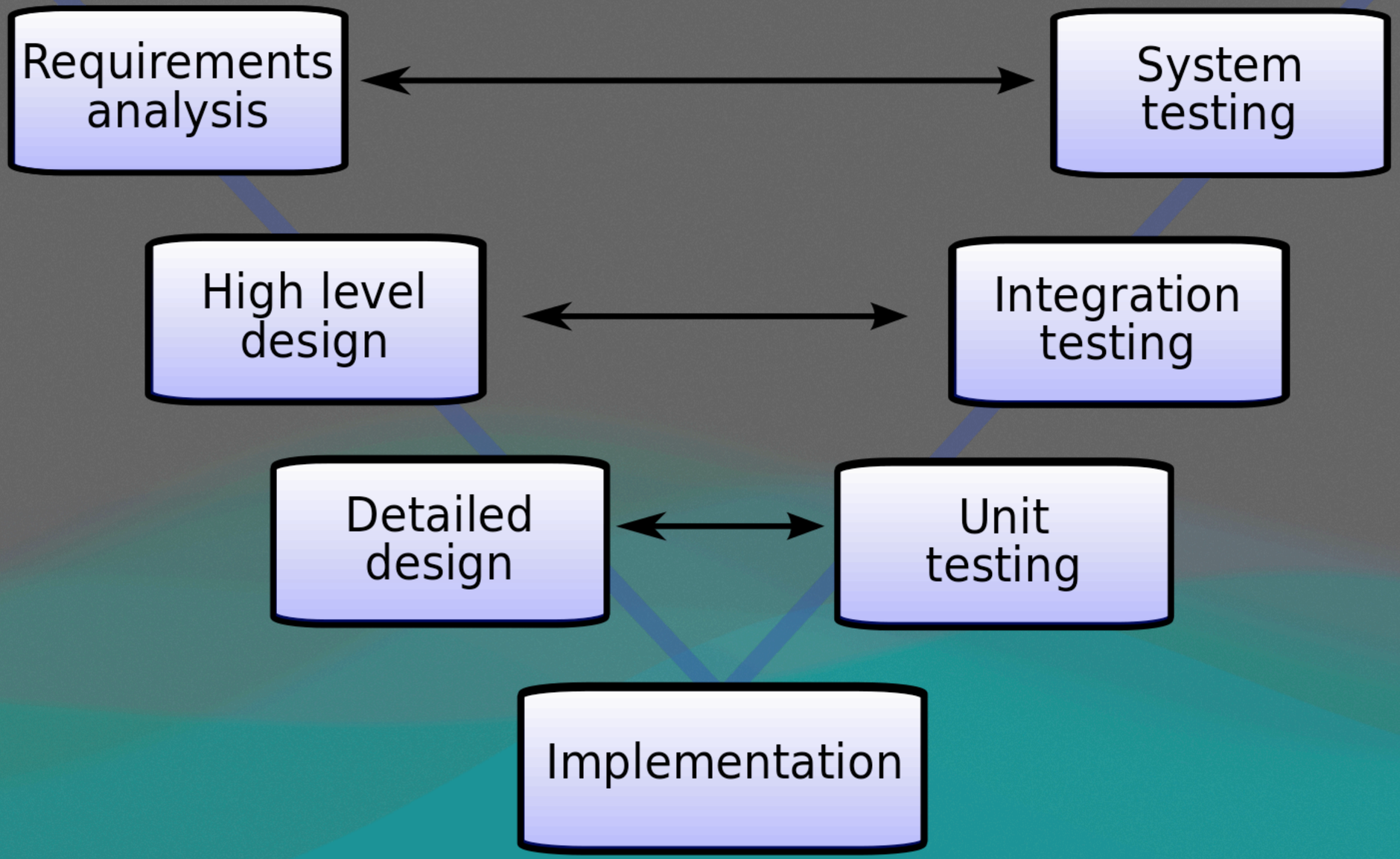
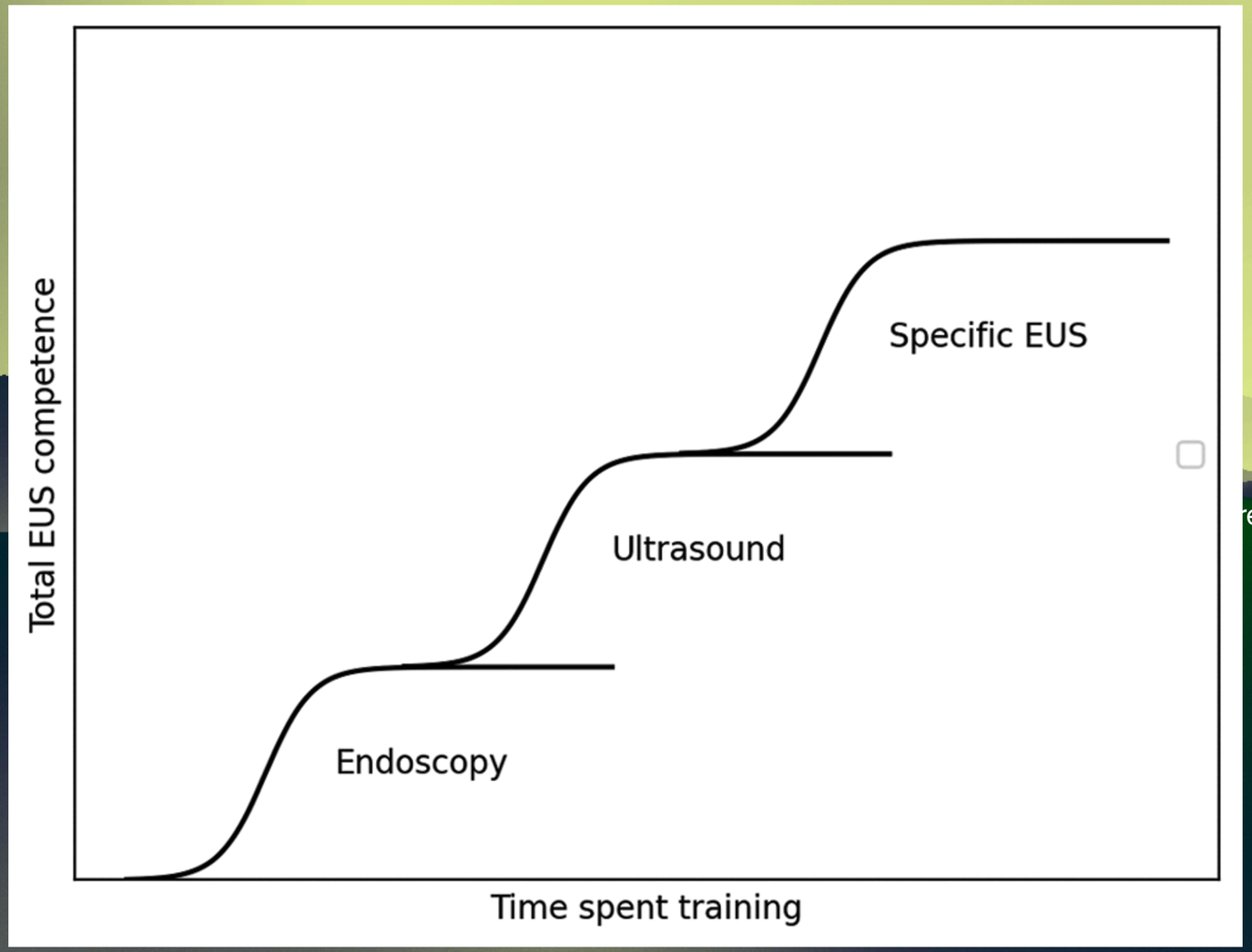
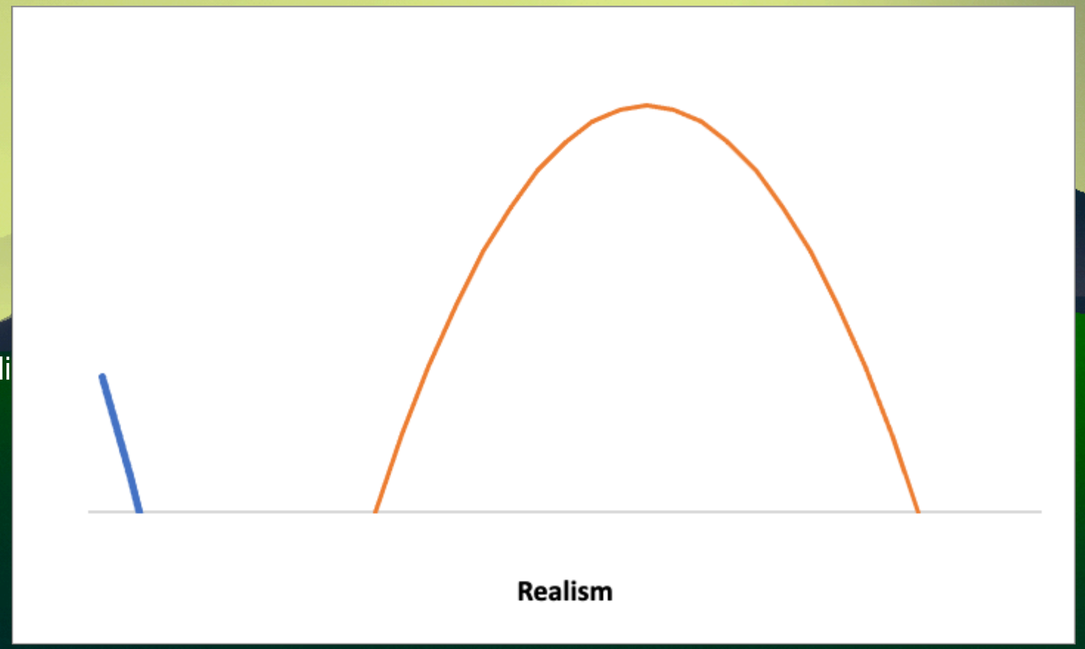

Requirements analysis
System testing
High level design
Integration testing
Detailed design
Unit testing
Implementation

Task

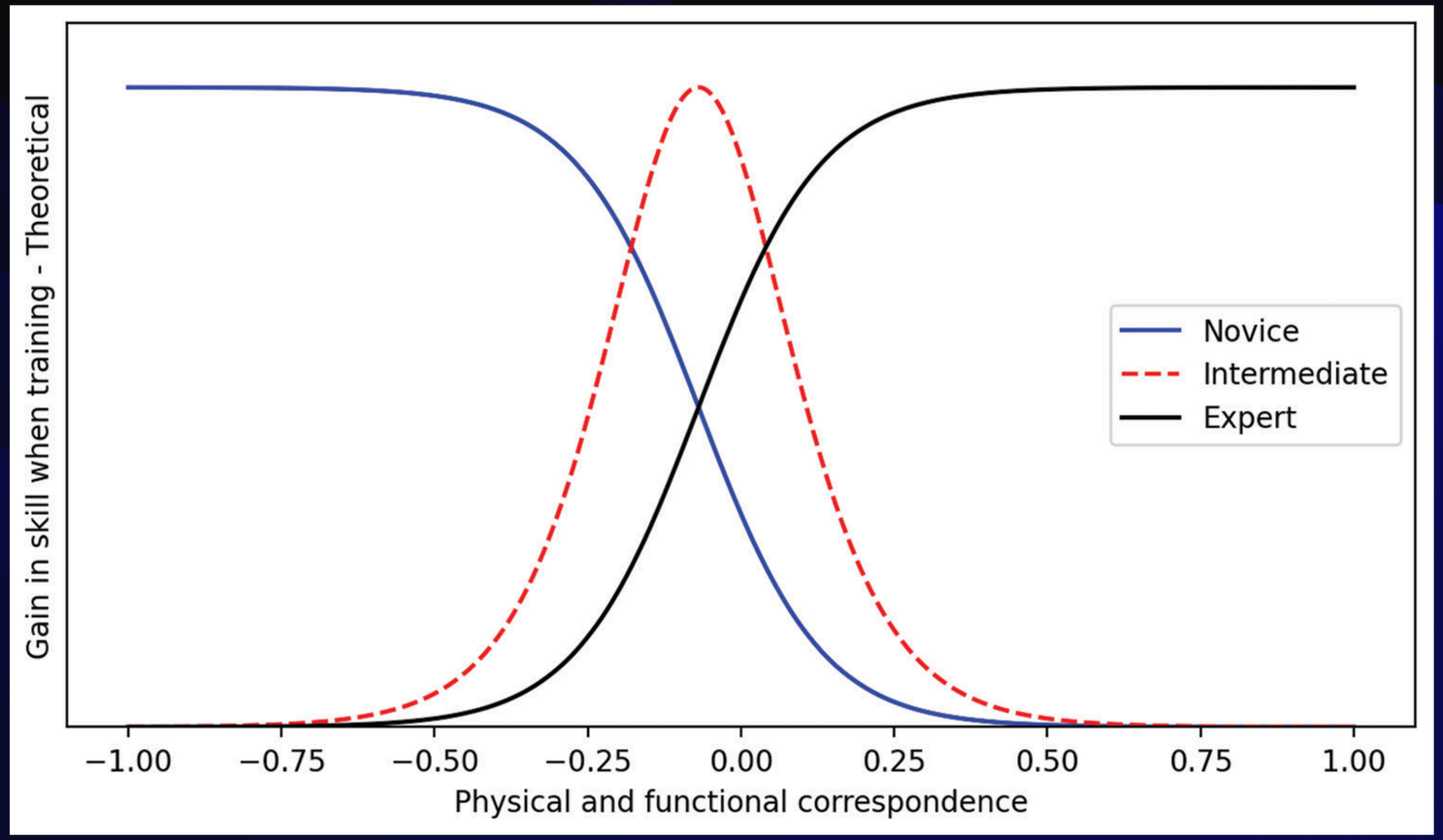
What will you make


Total EUS competence
Specific EUS
Ultrasound
Endoscopy
Time spent training


Realism

More advanced is not better

A review is still missing



Loss of resistance

A randomised controlled trial assessing four low-fidelity epidural puncture simulators

Tina H. Pedersen, Jonas Meuli, Eike J. Plazikowski, Maximilian Buttenberg, Maren Kleine-Brueggeney, Christian Seidl, Lorenz Theiler and Robert Greif

BACKGROUND Detecting loss of resistance (LOR) can either be taught with dedicated simulators, with a cost ranging from €1500 to 3000, or with the 'Greengrocer's Model', requiring simply a banana.

OBJECTIVES The purpose of this study was to compare three dedicated epidural puncture training simulators and a banana in their ability to simulate LOR. Our hypothesis was that there was a difference between the four simulators when comparing the detection of LOR.

DESIGN Single-blinded, randomised, controlled study.

SETTING Department of Anaesthesiology and Pain Therapy, Bern University Hospital, Switzerland.

PARTICIPANTS Fifty-five consultant anaesthesiologists.

INTERVENTIONS The participants were asked to insert an epidural catheter in four different epidural puncture training simulators: Lumbar Puncture Simulator II (Kyoto Kagaku, Kyoto, Japan), Lumbar Epidural Injection Trainer (Erler-Zimmer, Lauf, Germany), Normal Adult Lumbar Puncture/Epidural Tissue (Simulab Corp., Seattle, Washington, USA) and a banana. The simulators were placed in identical boxes to blind the participants.

MAIN OUTCOME MEASURES The primary outcome was the detection of LOR rated on a 100-mm visual analogue scale, in which 0 mm represented 'completely unrealistic' and 100 mm represented 'indistinguishable from a real patient'.

RESULTS The mean visual analogue scale scores for LOR in the four simulators were significantly different: 60 ± 25 mm [95% confidence interval (CI), 55 to 65 mm], 50 ± 29 mm (95% CI, 44 to 55 mm), 64 ± 24 mm (95% CI, 58 to 69 mm) and 49 ± 32 mm (95% CI, 44 to 54 mm); *P* less than 0.001, Friedman test.

CONCLUSION Two of the three dedicated epidural simulators were rated more realistic in detecting LOR than the banana, but some participants preferred the banana to the other three simulators. Given the relative cost of a banana compared with a dedicated simulator, we suggest that a banana be used to teach the technique of LOR for epidural puncture.

TRIAL REGISTRATION KEK Nr: Req-2015-z087.

Published online 21 April 2017

Simulator	Metric				
	Realism	**Performance**	**Features**	**Drawbacks**	**Ease of Use**
NIJMEGEN ECMO Simulator [1]	High	Low	• Simulates typical parameters • Wireless control • Portable and configurable	• Requires ECMO machine • No predefined scenarios • Does not simulate color change and line shattering	• Only specialists can operate and control the machine • Instructor can control training session passively
CLR [2]	High only for few parameters	High	• Displays parameters via screen • Wireless control • Available with cannulation	• Requires ECMO machine • No predefined scenarios • Limited number of parameters to control	• Easy control • Simple user interface • Easy connection to ECMO machine
Orpheus Perfusion Simulator [3]	High	Good	• Simulates the typical and critical scenarios	• Requires ECMO machine • Does not use real blood	• Simple and relatively easy to setup and control
ECMO Patient Simulator (EPS) [9]	High	High	• Simulates numerous parameters • Programmable scenarios	• Uses real blood • Requires ECMO machine	• Complicated user interface
3Dmed ECMO Simulation Kit [4]	Relatively low	Low	• Uses artificial blood • Used for surgical cannulation of and connection to ECMO machine	• Requires ECMO machine • Very limited simulation • No software side	• Overly simple
Puślecki et al. ECMO Mannequin. [5], [6]	High only for few parameters	Good	• Controllable hydraulic system, allowing for pressure manipulation • The mannequin can be cannulated • Low cost	• Requires ECMO machine • Wired control	• Mannequin requires manual setup • Simple and relatively easy controls
Modular ECMO Simulator	High	High	• Uses thermochromic ink for blood simulation • Simulates many ECMO emergencies	• Requires a relatively expensive priming fluid, which has to be replaced every 12 hours	• Easy to use through tablet application

10.1109/ACCESS.2021.3052145

How

Methods and Materials

Things we commonly sue

- 3D printing
- Silicone
- Hydrogels
- Ballistic gels

- Lets go to the garage and see instead

The end

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