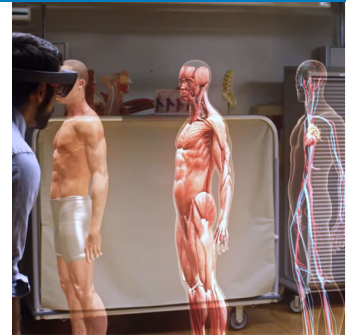


## Technology Enhanced Learning for Student-Centred, Active Learning in the Medical Sciences

*Seminar: Innovating Microscopy Education in Pathology  
Amsterdam, May 19-20, 2022*

Peter GM de Jong, PhD  
Center for Innovation in Medical Education  
LEIDEN UNIVERSITY MEDICAL CENTER



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### Peter GM de Jong, PhD

Senior Advisor/Educational Researcher  
Technology Enhanced Learning  
Leiden University Medical Center



Editor-in-Chief Medical Science Educator  
President-Elect 2022-2023  
International Association of Medical Science Educators (IAMSE)



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## Technology Enhanced Learning

*The application of technology to teaching and learning*

*Any technology that enhances the learning experience*

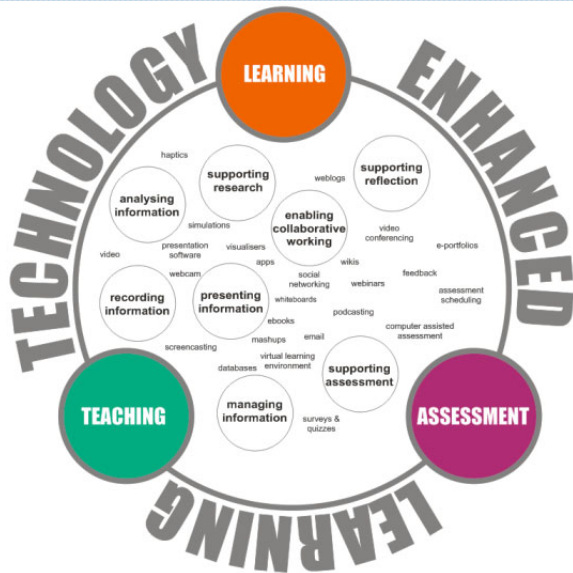
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## Technology Enhanced Learning



1. Administrative systems
2. Teaching tools
3. Learning resources
4. E-learning and simulators
5. Collaboration tools
6. Digital testing
7. Distance learning

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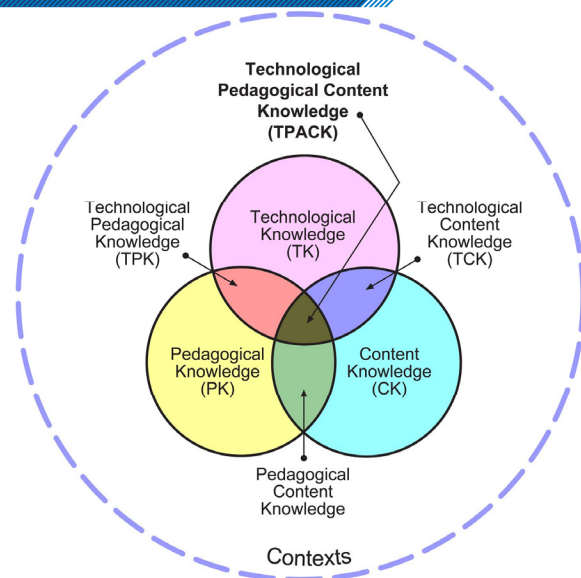
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## Technology Enhanced Learning

Multiple disciplines involved  
TPACK model



*Mishra, P., & Koehler, M. J. (2006). Technological pedagogical content knowledge: A framework for integrating technology in teachers' knowledge. Teachers College Record, 108 (6), 1017–1054*

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# Technology Enhanced Learning

## Advantages

- To make teaching and learning time and place independent
- To make teaching and learning more active
- To make teaching and learning adaptive/personal tailored
- To create options for distance education
- To teach in new ways impossible without technology

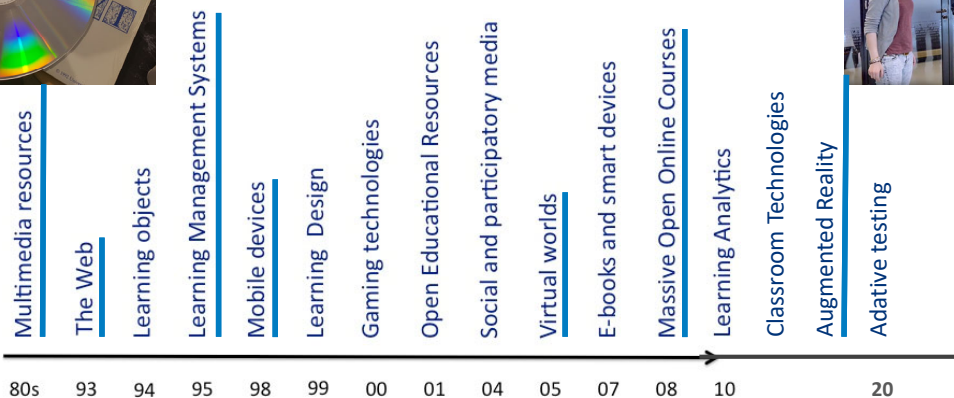
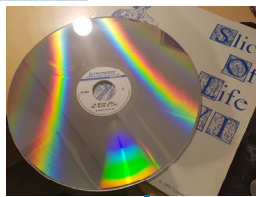
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# Technology Enhanced Learning Timeline



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Adapted from Gráinne Conole and Wilfred Rubens (2014, blog)  
<https://www.te-learning.nl/blog/de-geschiedenis-van-ict-in-het-onderwijs/>

# Theoretical backgrounds on transformation

## THE SAMR MODEL

Dr. Ruben R. Puentedura

**S**

### SUBSTITUTION

Technology acts as a direct substitute, with no functional change

Source: Wikimedia, creative Commons

## Technology as Substitution

Was:	Becomes:
Lecture	Recorded lecture on demand
Book	PDF file for download
Slides on paper	Slides as PowerPoint file
MCQ Exam on paper	MCQ Exam on the computer
Interview/presentation	Video clip



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## THE SAMR MODEL

Dr. Ruben R. Puentedura

**S**

### SUBSTITUTION

Technology acts as a direct substitute, with no functional change

**A**

### AUGMENTATION

Technology acts as a direct substitute, with functional improvement

Source: Wikimedia, creative Commons

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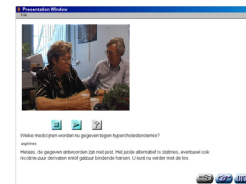
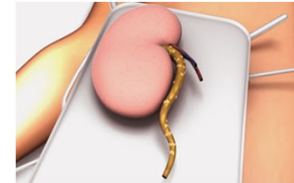
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# Technology as Augmentation

Significant enhancements to the student experience

Was:	Becomes:
Book	eBook with multimedia
Slides on paper	Recorded PowerPoint with multimedia and voice over
Exam on paper	Adaptive computer exam with multimedia and feedback
Illustration	Animation
Paper patient case	Computer patient simulation



## THE SAMR MODEL

Dr. Ruben R. Puentedura

**A**

### AUGMENTATION

Technology acts as a direct substitute, with functional improvement

**S**

### SUBSTITUTION

Technology acts as a direct substitute, with no functional change

ENHANCEMENT

# THE SAMR MODEL

Dr. Ruben R. Puentedura

## S

### SUBSTITUTION

Technology acts as a direct substitute, with no functional change

## A

### AUGMENTATION

Technology acts as a direct substitute, with functional improvement

## M

### MODIFICATION

Technology allows for significant task redesign

ENHANCEMENT

Source: Wikimedia, creative Commons

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## Technology as Modification

Actual change to the design of the lesson and its learning outcome

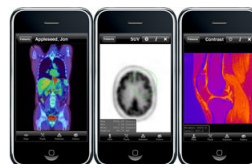
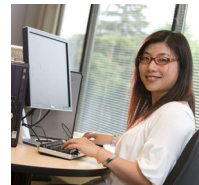
### New:

eModule at own pace/time/ place/level with assignments

Discussion board place/time independent

Online collaboration with peer feedback

Authentic testing



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# THE SAMR MODEL

Dr. Ruben R. Puentedura

## S

### SUBSTITUTION

Technology acts as a direct substitute, with no functional change

## A

### AUGMENTATION

Technology acts as a direct substitute, with functional improvement

## M

### MODIFICATION

Technology allows for significant task redesign

## R

### REDEFINITION

Technology allows for the creation of new tasks, previously inconceivable

ENHANCEMENT

Source: Wikimedia, creative Commons

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## Technology as Redefinition

Creating a learning experience not possible without technology

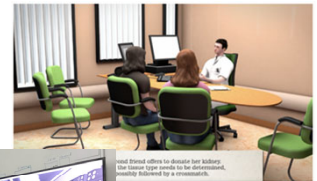
New:

Serious game

Virtual Reality

Augmented Reality

3D/360-degree video

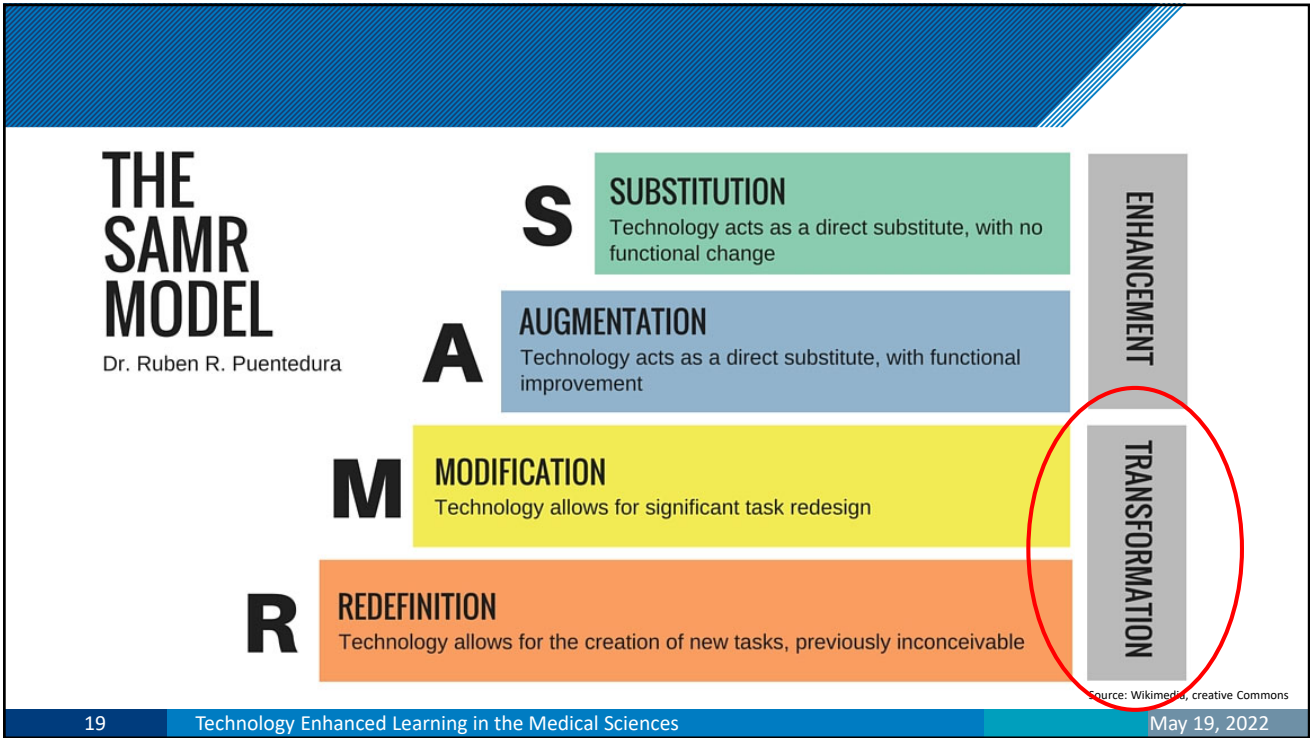


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**How to use it?**

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# Examples of Technology Enhanced Learning in Medical Education

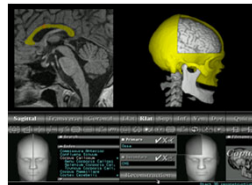
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## E-learning Modules



E-Learning modules

Simulations & serious games



Laboratory simulations

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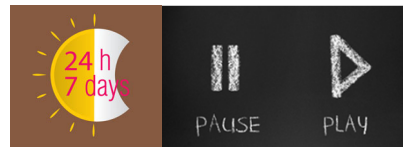
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## The use of MOOC's in the Curriculum

MOOC's have originally been designed for the general public "outside of university" (Downes, 2005/2008, connectivism)

Characteristics:

- **Online** only
- **Open** – free – no requirements
- Often structured as a classroom course
- **Large number** of participants worldwide
- Study place and time independent
- Study at your own pace



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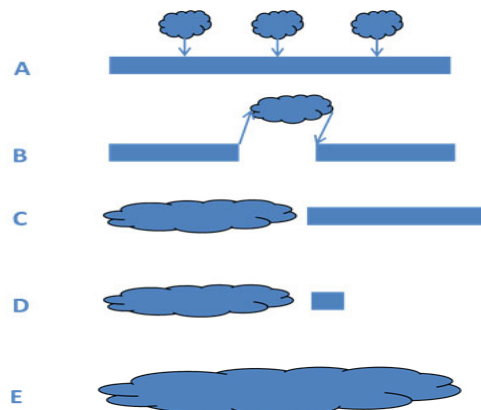
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## The use of MOOC's in the Curriculum

### Integration designs in Campus

- A: use as **learning objects**
- B: use as **replacement**
- C: **required preparation** for a course
- D: use as **stand-alone course with assignment**
- E: use as **stand-alone online with credits on completion**



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## Hybrid Classroom

Synchronous education with students in the classroom and on a distance at the same time

- Technically complex
- Didactical challenging
  - *Attention*
  - *Engagement*
  - *Motivation*



Leuven University, Belgium

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## Proctoring for Digital Testing



From: <https://www.ncarb.org/blog/exam-evolution-when-can-we-expect-remote-proctoring>

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## Basic Sciences Podcasts

Use audio recordings to explain anatomy and pathology



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## Virtual Reality

**Virtual reality (VR)** is an interactive computer-generated experience taking place within a simulated environment, that incorporates mainly auditory and visual, but also other types of sensory feedback like haptic.



- look around in an artificial world
- move around in an artificial world
- interact with virtual features or items
- transmission of vibrations
- VR headset screen in front of the eyes
- VR room with multiple large screens



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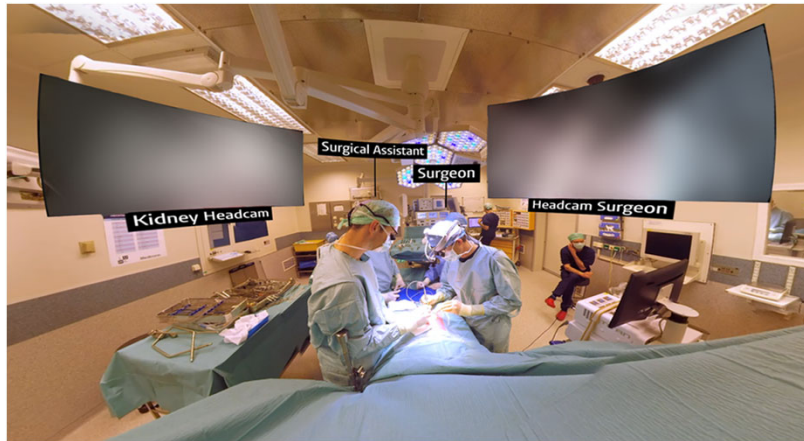
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# Virtual Reality

## Clinical teaching



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# Augmented Reality

**Augmented Reality (AR)** is an interactive experience of a real-world environment whereby the real-world is "augmented" by computer-generated perceptual information as a layer on top of the real world.

- digital components into a person's perception of the real world
- enhance natural environments
- offer perceptually enriched experiences



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## Mixed Reality

**Mixed Reality (MR)** is an interactive experience of a real-world environment where the real-world is "augmented" with computer-generated perceptual information, including visual, auditory and haptic feedback.



- digital components into a person's perception of the real world
- integration of immersive sensations that are perceived as natural
- enhance natural environments
- real world becomes interactive and manipulatable



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## Mixed Reality

### *Augmedicine: Lung cases*



Pieterse et al. Design and Implementation of "AugMedicine: Lung Cases," an Augmented Reality Application for the Medical Curriculum on the Presentation of Dyspnea. (2020) *Front. Virtual Real.* 1:577534. doi: 10.3389/frvir.2020.577534

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## Why to use it? Or why not?

> *Only if it is useful!*

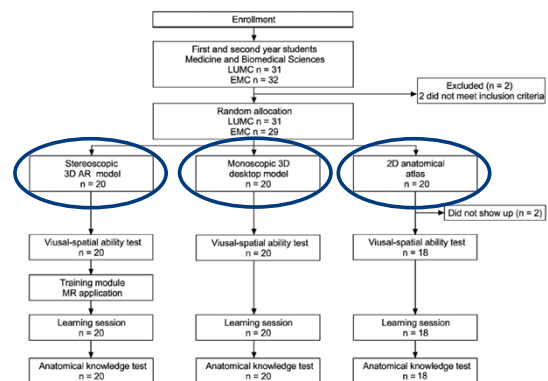
## Visual Spatial Ability and 3D learning

MR application *DynamicAnatomy*

- Visual Spatial Ability was measured with Mental Rotation Test (Vandenberg and Kuse, 1978)

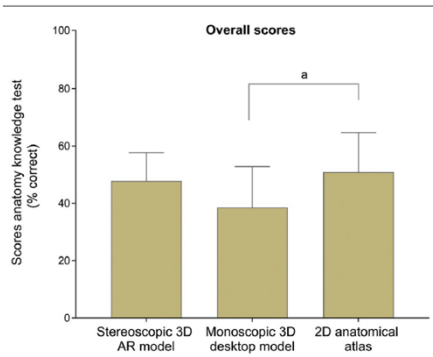
58 students, 3 conditions:

- learning from 2D anatomical atlas
- learning from monoscopic 3D desktop model
- learning from 3D MR model with HoloLens



Katerina Bogomolova et al. *The Effect of Stereoscopic Augmented Reality Visualization on Learning Anatomy and the Modifying Effect of Visual-Spatial Abilities: A Double-Center Randomized Controlled Trial, Anat Sci Educ 0:1–10 (2020)*

## Visual Spatial Ability and 3D learning



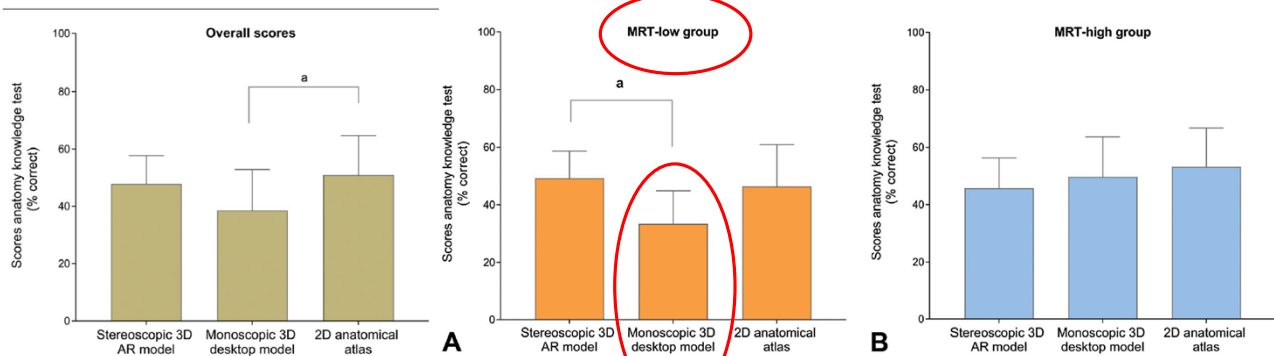
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## Visual Spatial Ability and 3D learning



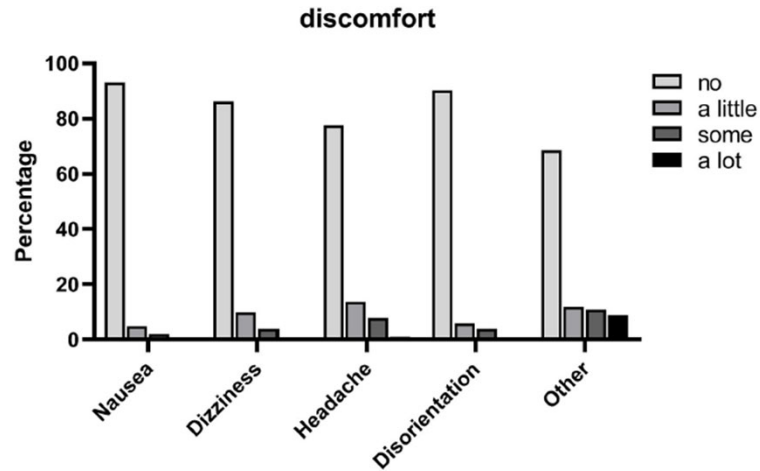
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## Side effects of Virtual Reality



44.2% no physical discomfort at all; 50% a little to some physical discomfort; 3.8% (4 students) a lot of physical discomfort. Most commonly reported: headache, weight of the headset, dizziness

## Pathology Education: GRIPE@IAMSE

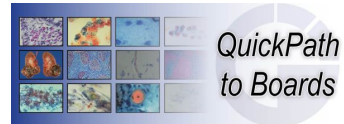
## GRIFE@IAMSE

### Group for Research in Pathology Education (GRIFE)

- Founded in 1971 as a society of educators involved in educating pathology
- Goal: to discuss educational approaches and to exchange pathology learning materials
- Merged within IAMSE in 2020

### Shared teaching resources

- Image Bank with over 4,000 indexed digital images covering clinical, gross, and microscopic pathology
- Multiple Choice Item Bank
- Image Item Bank - multiple choice questions related to the images in the Image Bank.
- Clinical Cases Item Bank - multiple choice questions related to patient case histories and laboratory information
- Faculty development materials
- *QuickPath to Boards* Facebook group for students



**Thank you for your attention**

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@pgmdejongnl



Slice of Life <https://library.med.utah.edu/publishing/slice/sol/index.html>

From 1985 to 2007, the Slice of Life Project served as a nonprofit, cooperative venture creating and sharing educational materials using computers, multimedia, and new media in health care, health sciences, and medical education.

