

Design of a training curriculum

Pritam Singh MA MRCS
Clinical Research Fellow
Division of Surgery
Department of Surgery & Cancer
Imperial College London

Learning Objectives

- Definitions of terms used within the surgical education literature
- Outline the difference between proficiency – versus time-based learning schedules
- Defend a curricular approach to acquisition of surgical skills
- Examples of surgical training curriculums
 - » National specialty based
 - » Technical skills

Definition of a curriculum

- A statement of the intended
 - Aims and objectives
 - Content
 - Experiences
 - Outcomes and
 - Processes of a programme,
- Including a description of the structure and expected methods of
 - Learning
 - Teaching
 - Feedback and
 - Supervision.
- The curriculum should set out what
 - Knowledge
 - Skills and
 - Behaviours the trainee will achieve.

Definition of a syllabus

- Details the content and outcomes of learning to be achieved at each stage of training:
 - What trainees are expected to know
 - What trainees are expected to be able to do
 - Expectations are matched to points of training

Definition of an assessment

- A systematic procedure for measuring a trainee's progress or level of achievement
- Measured against defined criteria to make a judgement about a trainee.

Definition of an assessment system

- Integrated set of assessments
 - in place for the entire postgraduate training programme
 - Blueprinted against, and supports, the approved curriculum.
- Can use different methods
- Can be implemented as national examinations or workplace based assessments
- Competence v Performance
- Performance based assessment becomes more important as trainees' experience increases

Definition of competence

- Competence is a complex structuring of attributes needed for intelligent performance in specific situations
- It incorporates the ideas of professional judgement

Examples of surgical curricula

- High profile national training curricula
 - Canada: CanMEDS
 - UK: The Intercollegiate Surgical Curriculum Programme (ISCP)
 - USA: Surgical Council on Resident Education (SCORE)
- Technical skills curricula

Original article

Development of a virtual reality training curriculum for laparoscopic cholecystectomy

R. Aggarwal, P. Crochet, A. Dias, A. Misra, P. Ziprin and A. Darzi



Excerpta Medica

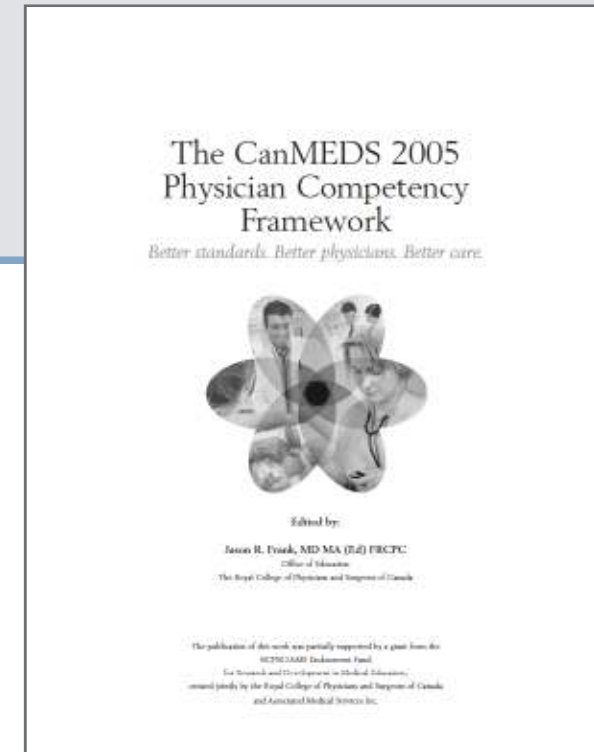
The American Journal of Surgery 191 (2006) 128–133
Laparoscopy

The American
Journal of Surgery

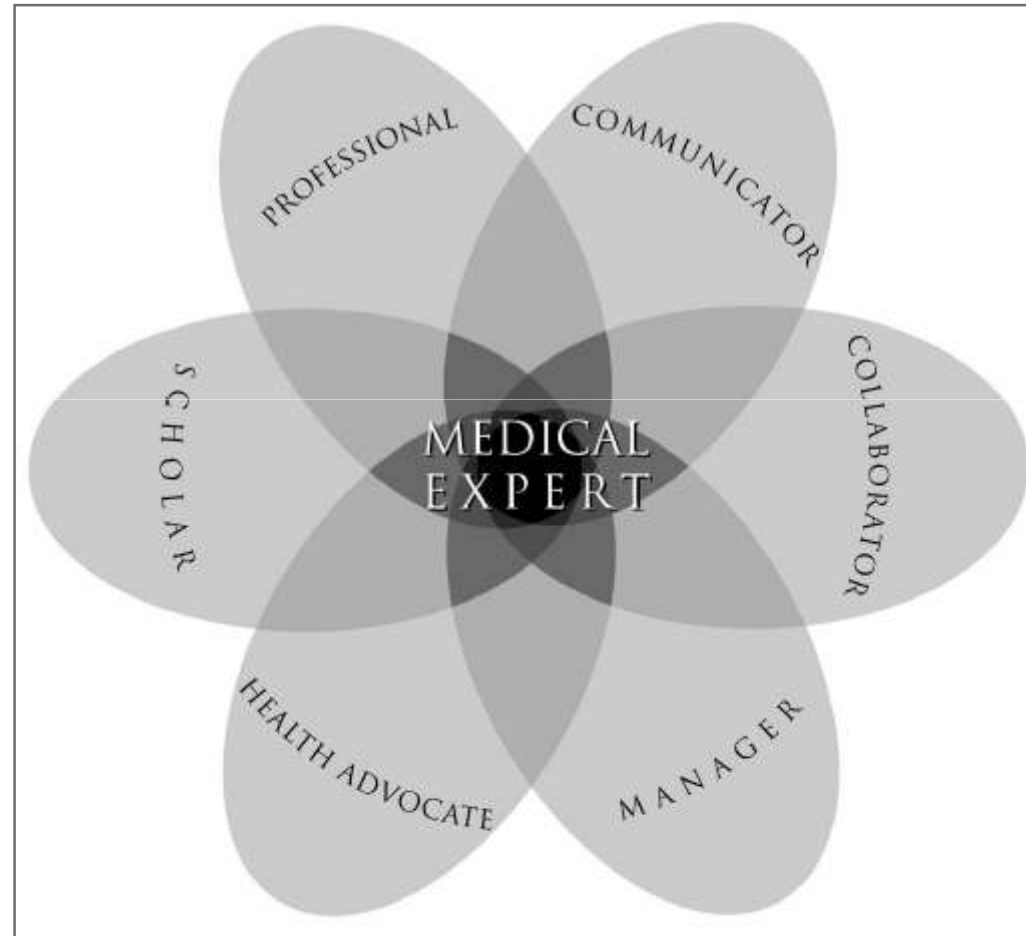
A competency-based virtual reality training curriculum for the acquisition of laparoscopic psychomotor skill

Rajesh Aggarwal, M.B.B.S.^{a,*}, Teodor Grantcharov, Ph.D.^b, Krishna Moorthy, M.D.^a,
Julian Hance, M.B.B.S.^a, Ara Darzi, M.D.^a

- Developed by the Royal College of Physicians and Surgeons of Canada
- Multiple Stakeholders
 - Educators
 - Teachers
 - Trainees
 - Practising Physicians
 - Researchers
 - Other Health Care Professionals
 - Public Officials
 - Public/Patients



CanMEDS Physician Roles Framework



Source: Frank, JR. (Ed). 2005. The CanMEDS 2005 physician competency framework. Better standards. Better physicians. Better care. Ottawa: The Royal College of Physicians and Surgeons of Canada.

CanMEDS Development

- Phase I: Framework Development (1993-1996)

Table 1. The CanMEDS Project Methodology for the Development of the Competency Framework in Phase I

Systematic educational planning model adopted

Consultation with Fellows from many specialties
Expert input (e.g., MD-patient communications)
Consultation with other healthcare organizations (e.g., Canadian Medical Protective Association)
Systematic literature search (incorporating the extensive EFPO bibliography)
Input from public focus groups done in Ontario (EFPO)

Qualitative analysis of themes in the data
CanMEDS Roles Working Groups (including hundreds of Fellows)

Modified Delphi Process
Identification of the core competencies
Assembly into the CanMEDS Roles Framework

Survey of two cohorts of RC Fellows: validation of the framework
Adoption by Council

CanMEDS Development (2)

- Phase II: Pilot Projects (1996-1997)
- Phase III: Implementation (1997-2002)

Table 2. Standards revised during CanMEDS Phase III

General accreditation Specialty-specific accreditation standards Specialty-specific credentials standards Objectives of training Final in-training evaluation reports (FITERs) Exam blueprints

- Phase IV: Faculty Development (2002-2005)

UK Standards to be met

- The 1983 Medical Act
 - General Medical Council (GMC) to set the standards for training and the end-point to be achieved to enter GMC's Specialist Register
 - to establish standards and requirements relating to postgraduate medical education and training
 - to maintain the standards and requirements established through quality assurance
 - to develop and promote postgraduate medical education and training in the UK.



GMC Standards for a curriculum

- Planning: Standards 1 & 2
 - Curriculum purpose and development
 - The assessment system must be fit for purpose
- Content: Standards 3 & 4
 - Content of the curriculum
 - Assessment and curricula referenced to all areas of *Good Medical Practice*
- Delivery: Standards 5, 6, 7 and 8
 - Managing curriculum implementation
 - Model of learning
 - Learning experiences
 - Assessment system methods

GMC Standards for a curriculum (2)

- Outcomes: Standards 9, 10, 11, 12, and 13
 - Supervision of the trainee
 - Role of the assessor
 - Assessment feedback to the trainees
 - Standards for classification of trainees' performance/competence
 - Documentation will be standardised and accessible nationally
- Review: Standards 14, 15, 16 and 17
 - Curriculum review and updating
 - Resources
 - Lay and patient involvement
 - Equality and diversity

Intercollegiate Surgical Curriculum Programme (ISCP)

- Framework for systematic progression to consultant level
 - Implemented from August 1 2007
- Approved by the Postgraduate Medical Education and Training Board
- Syllabus provides explicit standards in specialty based:
 - Knowledge
 - Clinical judgement
 - Technical and operative skills
 - Professional skills
- Aiming to go beyond technical expertise
 - CanMEDS
 - Good Medical Practice from GMC

ISCP: Curriculum development

- Via the Intercollegiate Surgical Curriculum Project of the Joint Committee on Higher Surgical Training (JCHST)
- Involving the:
 - Royal College of Surgeons of England
 - Royal College of Surgeons of Edinburgh
 - Royal College of Physicians and Surgeons of Glasgow
 - Royal College of Surgeons in Ireland
 - Specialty associations
- Led by Chairman of the JCHST and Chairs of the Specialist Advisory Committee (SAC) and their delegated editors
- Practicing surgeons
- Trainees
- Educationalists
- Other specialists

ISCP: Curriculum development (2)

- Managed by the Intercollegiate Surgical Curriculum Project
- Phase I – Initial Development (March 2003 to September 2004)
- Phase II – Pre-Pilot (December 2004 to March 2005)
- Phase III – Pilot (September 2005 to July 2007)
- Phase IV – Review and Evaluation (April 2007 to March 2008)
- Contributing funders for Phases II and III
 - UK Department of Health
 - Irish Department of Health and Children
 - Royal Colleges

ISCP: Key Principles

- Format and framework common to all surgical specialties
- Systematic progression
 - Foundation years to exit from surgical specialist training
- Competence based outcomes
 - Rather than time based
- Progression determined by achieving competency based outcomes specified by specialty curricula
- Curriculum standards underpinned by robust assessment processes which conform to PMETB standards
- Delivered by appropriately qualified surgeons
- MDT environment
- Collaboration with health service providers and trainers at all levels

ISCP: Components

- Syllabus content
- Teaching and Learning
- Assessment
- Systems and Resources

SCORE Curriculum

- SCORE developed in 2006
 - aim to develop a standardised national curriculum for General Surgery
- Member organisations:
 - American Board of Surgery (ABS)
 - American College of Surgeons (ACS)
 - American Surgical Association (ASA)
 - Association of Program Directors in Surgery (APDS)
 - Association for Surgical Education (ASE)
 - Residency Review Committee for Surgery (RRC-Surgery)
 - Society of American Gastrointestinal and Endoscopic Surgeons (SAGES)
- All funding provided by member organisations
- Competency based:
 - Patient care and procedural skills
 - Medical Knowledge
 - Professionalism
 - Communication
 - Practice based learning
 - Systems based practice

SCORE: Current state of development

- Syllabus content
 - Started with patient care component
 - Surgical technical skills curriculum being developed by the ACS and APDS
- Teaching and Learning
 - Endorsed the ACS Fundamentals of Surgery program
 - Examining issues related to surgical training
 - Assessment of technical competency
 - Teaching and assessment of professional behaviours
 - Faculty development
- Assessment
 - Supporting an operative performance rating system in development at Southern Illinois University
- Systems and Resources
 - SCORE Portal

SCORE Portal

- Web based learning system
- Selected educational reading material
- Radiology & Anatomy images
- Operative videos
- ABSITE practice questions

The screenshot shows the SCORE Portal interface. At the top is the SCORE logo with navigation links for Home and About. Below is a 'Search Information' section with a 'General Search' input field and a 'SEARCH' button. There are four main search categories: Patient Care, Medical Knowledge, Systems Based Practice, and Other Resources, each with a 'Search by Category' link. A 'Self Assessment' section offers 'Multiple Choice Questions'. On the right, a 'GENERAL S' menu lists various medical categories such as Abdomen - General, Alimentary Tract - Esophagus, and Surgical Critical Care.

The screenshot shows a detailed page for 'Dysphagia'. It includes a reference number (100140), category (Alimentary Tract - Esophagus), type (Disease/Condition), and level (Broad). A legend indicates 'Text Resource' and 'STATdx'. The page features tabs for 'LEARNING OBJECTIVES', 'STUDY QUESTIONS', 'TEXT RESOURCES', and 'VIDEOS'. Under 'LEARNING OBJECTIVES', there are two main sections: '1. Pertinent Anatomy/Histology' and '2. Pertinent Physiology'. Each section contains a question (a) and associated resources like 'STATdx: Esophagus (Anatomy)', 'ACSS, 4:1: Workup and Management of Specific Causes of Dysphagia - Disorders Producing Fixed Mechanisms', and 'Greenfield, 66: Disorders Affecting Specific Organs - Esophagus'.

- Evidence based reviews in Surgery
- Ability for faculty to create and give assignments

ISCP v SCORE

ISCP

- Development started in 2003, in use since 2007
- Full syllabus available
- Web based
- Faculty can use to assign learning objectives
- Does not incorporate teaching material
- Well developed workplace base assessments - online

SCORE

- Started development in 2006, still being developed
- Syllabus for patient care available
- Web based
- Faculty can assign learning objectives
- SCORE Portal has multimedia teaching material
- Assessments not currently available

Why do we need a competency based curriculum?

- Traditionally time-based
- Assumption:
 - After a certain number of years of training competency will be achieved
 - With enough time, trainees will gain enough experience to gain a broad training
- Volume based
 - Logbook numbers
- Assumption:
 - Volume of cases seen/performed will act as a surrogate marker of competency
 - Number of cases is proportional to ability
- Stands to reason 'practice makes perfect'

Why do we need a competency based curriculum?(2)

- Time based
- Problems with assumptions:
 - Does not account for variations in workload – numbers can still be low
 - Without targeted training to the trainees needs there is no guarantee that all conditions will be seen, especially rarer conditions
- Volume based
- Problems with assumptions:
 - Numbers do not inform about the quality of training received
 - Does not account for different rates of learning and learning curves
- Time is a surrogate marker of volume and breadth of experience.
- Volume is a surrogate marker for competence

'Tailor made' training: Competency based

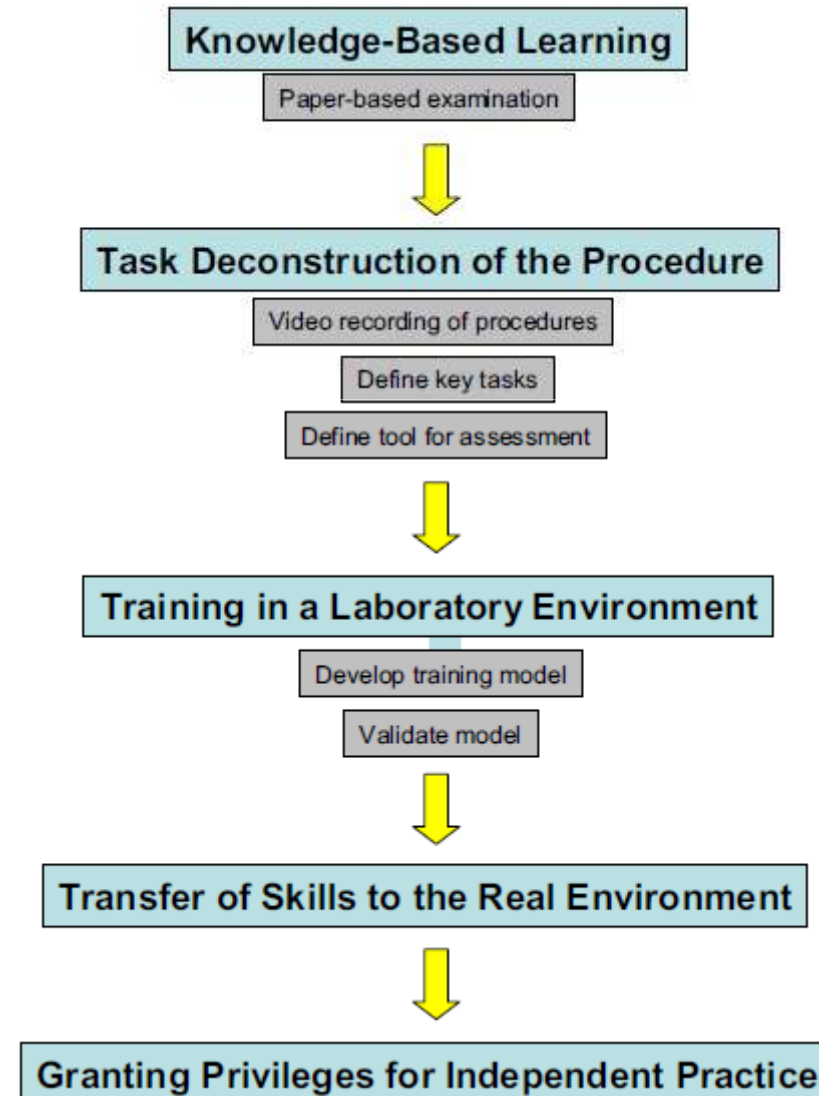
- Ideal solution is to personalise training to each individual trainee
 - Difficult to deliver in the setting of a nationally standardised training curriculum
- A pragmatic solution is a competency based training curriculum where progression is only possible after competency has been achieved
- This is the new paradigm for all mentioned training curricula
 - ISCP
 - SCORE
 - CanMEDS
- Assessment of competency is the new challenge

Competency based technical skills curriculum development

- Demonstration of proficiency in technical skills is not a uniquely surgical problem
 - Cardiology
 - Anaesthetics
 - Gastroenterology
 - Respiratory
 - Interventional radiology
- Hierarchic task-based approach to deconstruct the procedure into its constituents
- Develop a systematic strategy for learning the required skills
- Identify the key tasks that are integral to the procedure and form the basis of an assessment process.

Framework for Systematic Training and Assessment of Technical Skills

Rajesh Aggarwal, MA, MRCS, Teodor P Grantcharov, MD, PhD, Ara Darzi, KBE, MD, FACS, HonFREng, FMedSci



Validation: Some more definitions

- Face validity: Extent to which the examination resembles real life situations
- Content validity: Extent to which the domain that is being measured is being measured by the assessment tool
 - e.g. when attempting to assess technical skills we may in fact be testing knowledge
- Construct validity: Extent to which a test measures the trait it purports to measure
 - e.g. extent to which a test discriminates between various levels of expertise
- Concurrent validity: Extent to which the results of the assessment tool correlate with the gold standard for that domain
- Predictive validity: Ability of the examination to predict future performance

Reliability:

- Test-retest: Measure of a test to generate similar results when applied at two different points
- Inter-rater: Measure of the extent of agreement between two or more observers when rating the performance of an individual

Sources:

Moorthy K, Munz Y, Sarker SK, Darzi A. Objective assessment of technical skills in surgery. *BMJ*. 2003;327:1032-1037.

Aggarwal R, Grantcharov T, Moorthy K, Milland T, Papasavas P, Dosis A, Bello F, Darzi A. An evaluation of the feasibility, validity, and reliability of laparoscopic skills assessment in the operating room. *Ann Surg*. 2007 Jun;245(6):992-9.

VR training curriculum development

- Task deconstruction

Skill or task	Description
Basic skills	
Camera manipulation 0°	Using a 0° camera, locate and snap photographs of ten balls, in an abstract environment
Camera manipulation 30°	Using a 30° angled camera, locate and snap photographs of ten balls, in an abstract environment
Eye–hand coordination	Locate each flashing ball and touch with the tool of the appropriate colour
Clip application	Clip leaking ducts within a specified segment, before the pool fills
Clipping and grasping	Safely grasp and clip leaking ducts within a specified segment, before the pool fills
Two-handed manoeuvres	Use two graspers to locate the balls within the jelly mass and then place them in the endobag
Cutting	Safely cut and separate a circular form using one tool to retract and the scissors to cut accurately
Electrocautery	Use a hook to burn the highlighted band, while retracting other bands with an accessory instrument
Translocation of objects	Manipulate object with two graspers and, with a minimum number of translocations, place the object into the orientation of the matching transparent object
Procedural tasks	
Clipping and cutting—retracted gallbladder	Gallbladder already exposed with Hartmann's pouch retracted by a static tool. Clip the cystic artery and duct within a specified area and then cut safely between the clips
Clipping and cutting—two hands	With the gallbladder already exposed use a blunt grasper to retract Hartmann's pouch. Once correct retraction is achieved, clip the cystic artery and duct within a specified area and then cut safely between the clips
Calot's triangle dissection	Grasp the infundibulum of the gallbladder, retract away from the liver, and dissect the peritoneal coverings to expose the cystic duct and artery
Gallbladder separation	Separate the gallbladder from the liver bed with appropriate retraction and dissection of the peritoneal adhesions to the liver bed. Continue dissection until the gallbladder is free from the liver
Full procedure	Virtual complete cholecystectomy procedures, based on anatomies created from CT/MRI real patient data. Practise a complete cholecystectomy procedure, with a range of appropriate instruments

VR training curriculum development (2)

- Validation of the tasks

Fig. 2 Total number of movements for two-handed manoeuvres skill. Horizontal lines within boxes, boxes and whiskers represent median, interquartile range and range respectively. Circle represents an outlier ($P = 0.007$, Kruskal–Wallis test)

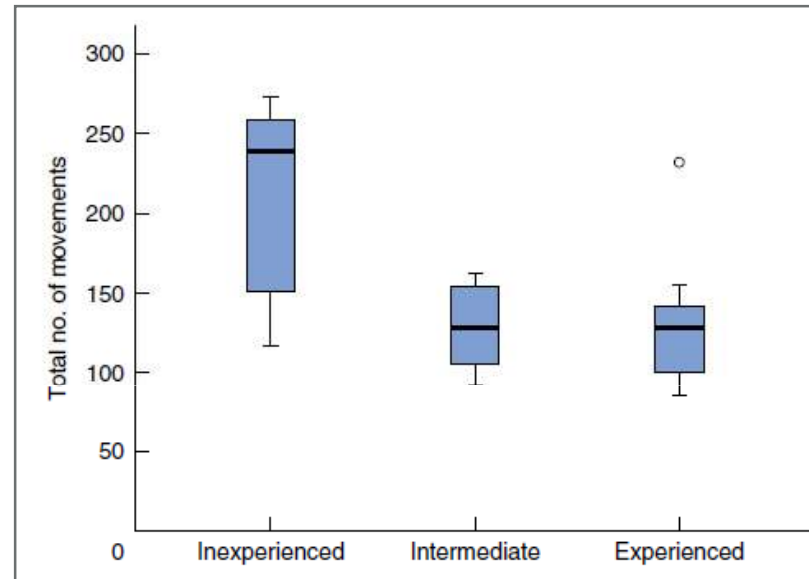


Table 2 Construct valid metrics for basic skills

Task	Time taken (s)	Accuracy rate (%)	Total speed (cm/s)	Total no. of movements	Total path length (cm)
Camera manipulation 0°	✓	✓			
Camera manipulation 30°	✓				
Eye–hand coordination					
Clip application			✓		
Clipping and grasping	✓		✓		
Two-handed manoeuvres	✓		✓	✓	✓
Cutting	✓				
Electrocautery	✓				
Translocation of objects			✓		

VR training curriculum development (3)

- Learning curve

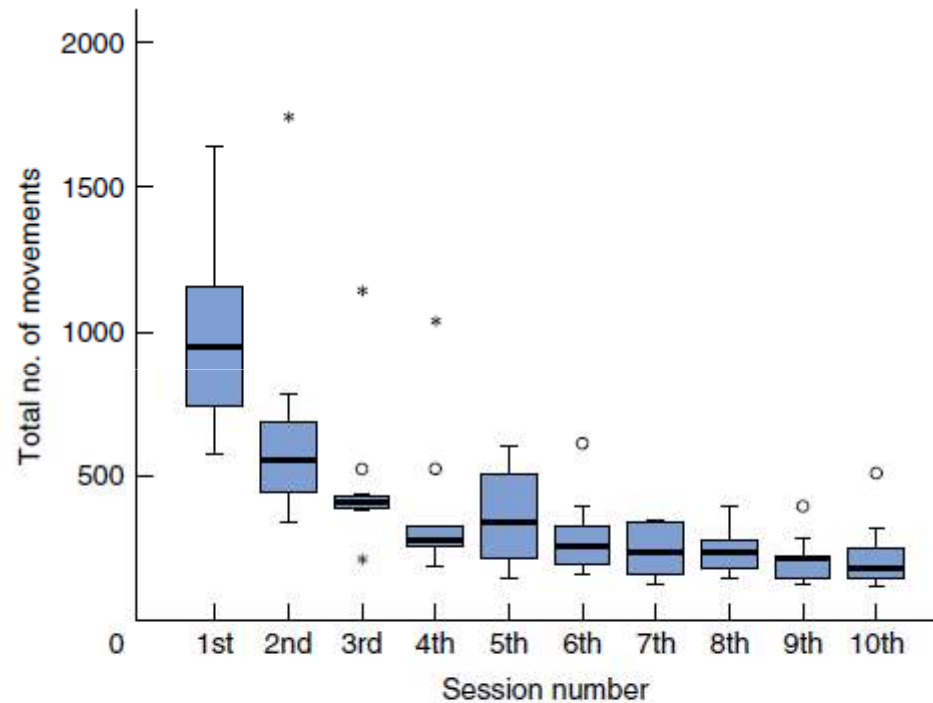


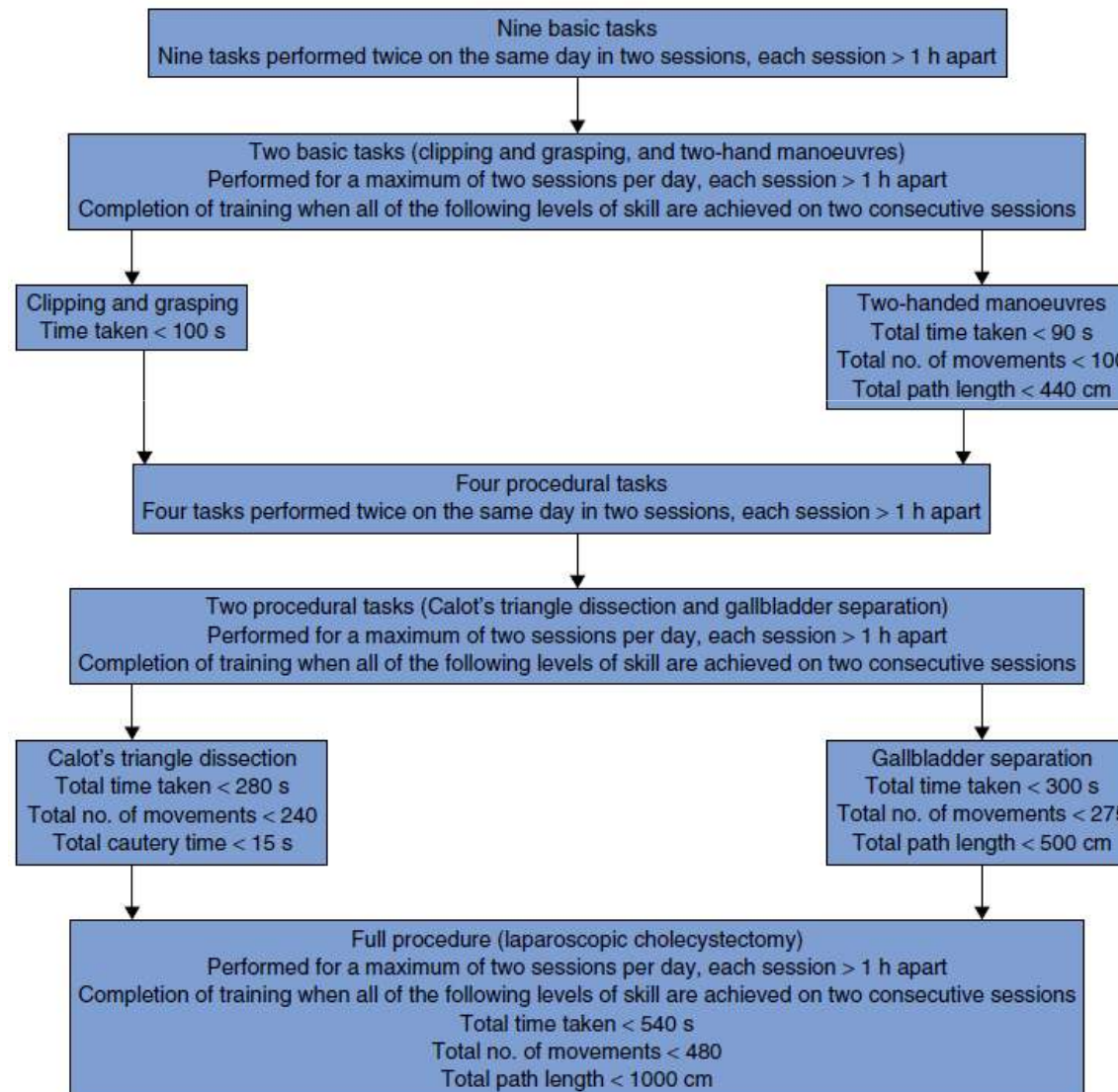
Fig. 3 Learning curve for total number of movements for gallbladder separation. Horizontal lines within boxes, boxes and whiskers represent median, interquartile range and range respectively. Circles and asterisks represent outliers and extreme cases respectively

VR training curriculum development (4)

- Combine construct validity and learning curve data
- → Metrics for development of the training curriculum

Task	Metric	Construct valid	Learning curve	Plateau session	Benchmark level
Skills					
Clipping and grasping	Time taken (s)	✓	✓	9th	104
	Total speed (cm/s)	✓	✓	2nd	8.3*
Two-handed manoeuvres	Time taken (s)	✓	✓	6th	89
	Total no. of movements	✓	✓	8th	106
	Total path length (cm)	✓	✓	8th	440
Tasks					
Calot's triangle dissection	Time taken (s)	✓	✓	7th	278
	Total no. of movements	✓	✓	7th	241
	Total cautery time (s)	✓	✓	7th	15
Gallbladder separation	Time taken (s)	✓	✓	4th	312
	Time to extract gallbladder (s)	✓	✓	4th	219*
	Total no. of movements	✓	✓	4th	274
	Total path length (cm)	✓	✓	4th	511
Full procedure	Time taken (s)	✓	✓	2nd	548
	Time to extract gallbladder (s)	✓	✓	2nd	521*
	Total no. of movements	✓	✓	3rd	481
	Total path length (cm)	✓	✓	3rd	1012

An Evidence Based Training Curriculum



Summary

- Definitions of terms used within the surgical education literature
- Outline the difference between proficiency – versus time-based learning schedules
- Defend a curricular approach to acquisition of surgical skills
- Examples of surgical training curriculums
 - » National specialty based
 - » Technical skills

QUESTIONS & DISCUSSION