HKU Med
School of Clinical Medicine
Department of Paediatrics
& Adolescent Medicine
香港大學兒童及青少年科學系

DIGITAL TECHNOLOGIES IN PAEDIATRIC MEDICAL EDUCATION

Artificial Intelligence, Extended Reality and Beyond

Department of Paediatrics and Adolescent Medicine
School of Clinical Medicine
LKS Faculty of Medicine
The University of Hong Kong.
May 2026

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INTRODUCTION

Those were the days in paediatric education when learning was tethered to textbooks, hand drawn diagrams, clinical photos, and limited duration of clinical exposure of medical undergraduates. Conditions like congenital heart defects, respiratory distress with noisy breathing, or developmental delay were reduced to descriptive text and two-dimensional black-and-white diagrams. Mastery of the tools of the trade was not only a matter of accessing information, but also of slowly accumulating a depth of clinical experience.

The pedagogical foundations of clinical medicine including paediatrics were, for generations, built upon a triad of print, physical presence in the lecture hall and clinical wards, and apprenticeship. The textbook is nonetheless a static repository of knowledge, becoming possibly outdated at the time of its printing. Didactic lectures, lasting for at least an hour each in the past, were delivered with the assistance of slide projectors and overhead transparencies, often in a standard textbook format with a lack of interactivity. Clinical skills were acquired through direct apprenticeship, where students shadowed seasoned clinicians on ward rounds, their learning contingent only on the specific cases that presented themselves during their clinical rotation.

Today, digital technologies have transformed this landscape, offering immersive, readily accessible, and dynamic tools that bring the education of paediatric medicine to life in ways once unimaginable. This transformation is being ushered in by artificial intelligence, extended reality, and other digital technologies. These technologies are evolving from exploratory tools into core components of medical education. This paradigm shift transcends mere digitization. It introduces an era of personalized and adaptive learning and signifies a shift from time-based, one-size-fits-all education to a competency-based, learner-centric model beyond the boundaries of time and space. This is not merely a change in pedagogical tools, but a fundamental evolution in the learning ecosystem of medicine. This new ecosystem should groom a new generation of medical graduates who are not only clinically proficient, but also skilled in digital literacy and technology-augmented patient care, and importantly with preserved essential human skills.

Students of today are adept at multitasking across digital platforms and thrive in collaborative, technology-mediated environments. Their cognitive frameworks are shaped by interactivity, connectivity between the physical and digital worlds, and visual-spatial learning. Learning becomes an active, engaging process rather than passive reception of facts. This generational shift demands inevitably a new paradigm in paediatric education.

For professoriates in paediatric education, being trained in the pre-artificial intelligence era, challenges are expected when tasked with the need to integrate digital tools while simultaneously undergoing their own rapid, often self-directed, digital upskilling. Their challenge is not merely technical but also philosophical, which necessitates reconciliation between experience-based clinical heuristics and technology-driven pedagogical approaches. Furthermore, the role of professoriates being sole repository of knowledge and experience needs to be redefined.

Our Department has responded proactively to the paradigm shift in medical education with ongoing integration of digital technologies into the paediatric undergraduate curriculum. This document provides an overview of our current approach in three key areas: 1) the application of artificial intelligence, extended reality, and other digital platforms within our educational framework, 2) the preparation and professional development of educators to effectively utilize these technologies, and 3) the ongoing challenges and considerations that require attention to ensure evidence-based and sustainable integration and implementation of artificial intelligence and other digital technologies into our undergraduate paediatric curriculum.

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Byran Lin Professor in Paediatric Cardiology
Chairperson
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School of Clinical Medicine
LKS Faculty of Medicine
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ARTIFICAL INTELLIGENCE, EXTENDED REALITY, AND OTHER DIGITAL TECHNOLOGIES IN PAEDIATRICS

For Medical Students

Medical students are increasingly using artificial intelligence to support their learning, preparation for examinations, and development of clinical skills. Our Department has embarked on the "Paediatric Education for Generation Z and α (PEGZα) initiative" and developed three digital technology-based platforms to cater for the needs of students of today, to personalize their learning, to move beyond static curricula, and to create dynamic simulations of paediatric critical scenarios.

1. AISPEC (AI-Simulated Paediatric Engagement and Communication)

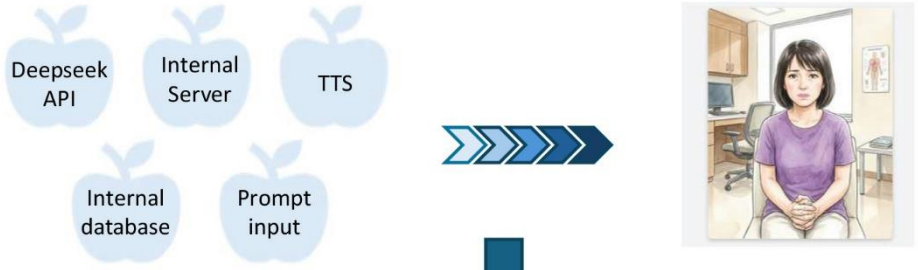
Our Department has developed this innovative AISPEC paediatric chatbot platform dedicated to the training paediatric history-taking and communication skills. This platform capitalizes on natural language processing to create specialized, multilingual chatbots that operate in English, Cantonese, and Mandarin.

Designed to serve three distinct educational roles, the chatbot functions as

1) a parent or caregiver providing the history of the child
2) an examiner asking the students to
    a. summarize the history
    b. provide a problem list
    c. provide the next steps in targeted physical examination
    d. reason the probable diagnosis and differential diagnoses
    e. order appropriate investigations
    f. devise a management plan
3) an evaluator offering structured feedback on
    a. communications skills and demonstration of empathy
    b. the gathering of information from parents or caretaker
    c. clinical reasoning to reach a diagnosis
    d. the ability to perform relevant physical examination and ordering of appropriate investigations
    e. the appropriateness of the management plan

AISPEC Platform

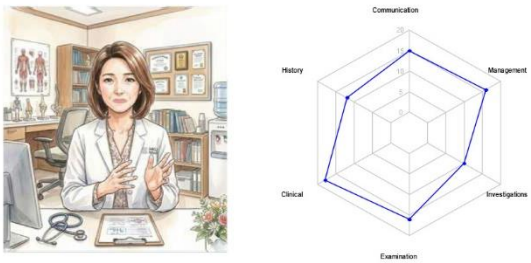
AI-stimulated parent



History taking from AI chatbot

AI chatbot to examine the student based on the history obtained

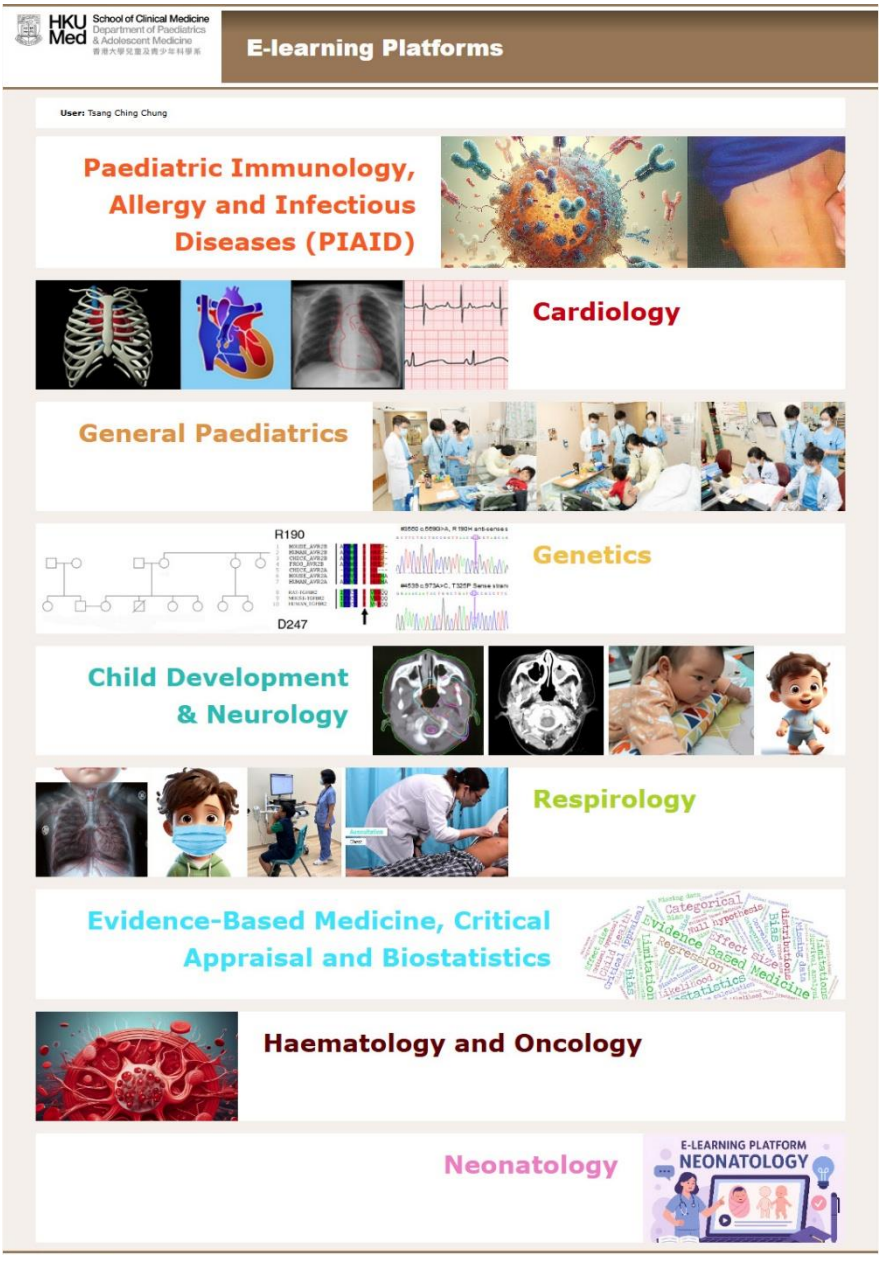
Evaluation and scoring based on rubrics



2. E-SPARK (E-Specialty Paediatric Academic Resource and Knowledge)

Our Department has developed comprehensive E-learning platforms tailored specifically for paediatric education, designed to provide structured, accessible, and interactive learning resources across different paediatric domains. This platform enables students to study anywhere, anytime, and at their own pace, offering flexibility that accommodates diverse learning schedules and preferences.

It features nine dedicated modules, including general paediatrics, cardiology, child development and neurology, respirology, evidence-based medicine and biostatistics, haematology and oncology, neonatology, and immunology, allergy and infectious diseases. Each of the modules incorporates recorded lectures, multimedia resources that illustrate physical examination skills and clinical signs, case-based scenarios, compilations of radiographic images and electrocardiograms, and guides to essential clinical procedures and clinical management.



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E-learning Platform in General Paediatrics

/ General Paediatrics

User:

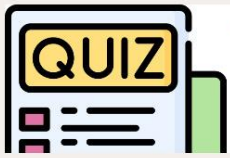
Clinical Examination Skills

Physical Signs

Lectures and Presentations

Guidelines and Reviews

Education Leaflets



Clinical Quiz

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E-learning Platform in Respirology

/ Respirology

User: Tsang Ching Chung

Clinical Examination Skills

Physical Signs

Paediatric Imaging

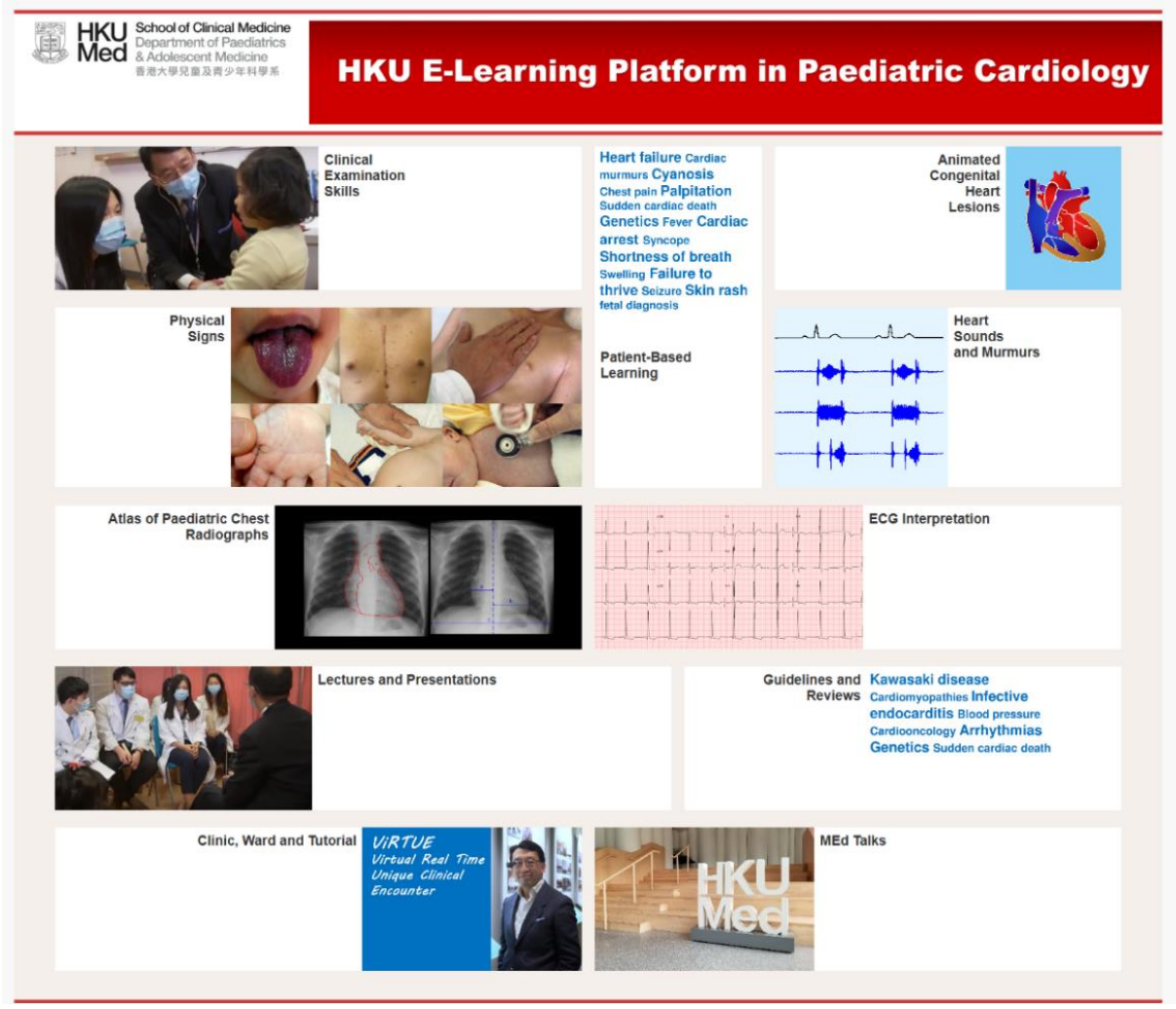
Pulmonary Function Tests

Lectures and Presentations

Guidelines and Reviews

Paediatric Asthma Essentials

Patient Education Library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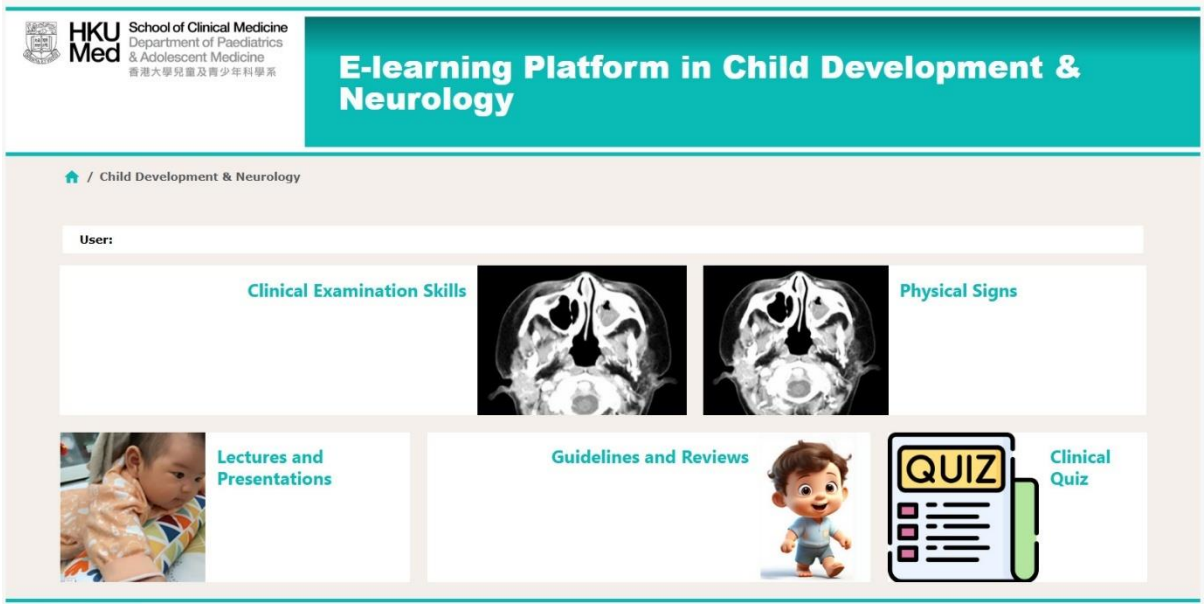
HKU E-Learning Platform in Paediatric Cardiology
Clinical Examination Skills
Heart failure Cardiac murmurs Cyanosis Chest pain Palpitation Sudden cardiac death Genetics Fever Cardiac arrest Syncope Shortness of breath Swelling Failure to thrive Seizure Skin rash fetal diagnosis
Patient-Based Learning
Animated Congenital Heart Lesions
Physical Signs
Heart Sounds and Murmurs
Atlas of Paediatric Chest Radiographs
ECG Interpretation
Lectures and Presentations
Guidelines and Reviews
Kawasaki disease Cardiomyopathies Infective endocarditis Blood pressure Cardiooncology Arrhythmias Genetics Sudden cardiac death
Clinic, Ward and Tutorial
ViRTUE
Virtual Real Time Unique Clinical Encounter
MEd Talks
HKU Med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E-learning Platform in Child Development & Neurology
/ Child Development & Neurology
User:
Clinical Examination Skills
Physical Signs
Lectures and Presentations
Guidelines and Reviews
QUIZ
Clinical Quiz

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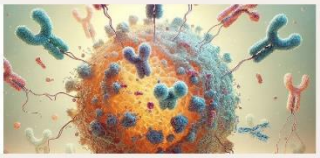
E-learning Platform in Paediatric Immunology, Allergy and Infectious Diseases (PIAID)

User:

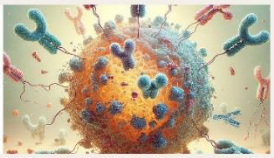
Allergy Skin Testing



Physical Signs

Lectures and Presentations

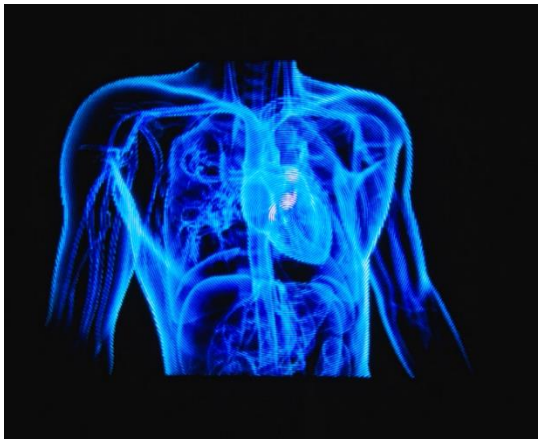
Guidelines and Reviews

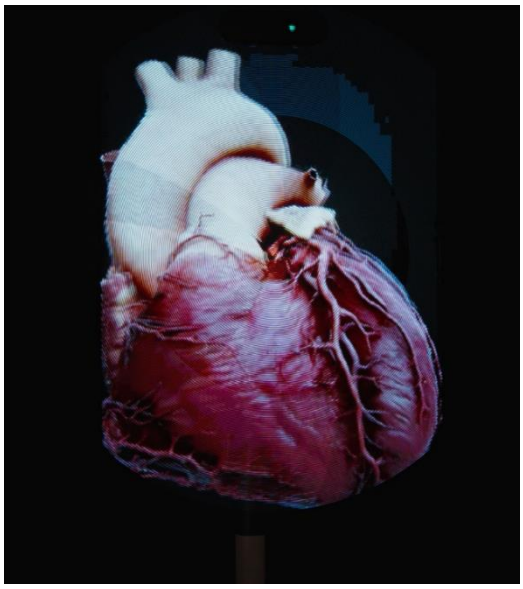


3. PIXR (Paediatric Immersive eXtended Reality)

Virtual reality and holography-based teaching of paediatric cardiology

Our Department has integrated innovative virtual reality and holographic technologies into undergraduate paediatric teaching of paediatric cardiology to create immersive, interactive learning experiences that enhance understanding of complex anatomical and clinical concepts of structural congenital heart disease and paediatric acquired heart disease. With the use of these technologies, students would appreciate the anatomy of cardiac lesions in three dimensions and in a dynamic and scalable learning environment.





360-degree videos of clinical procedures

Our Department has begun using 360-degree camera to record the performance of bedside clinical procedures to enrich the digital resources for teaching and learning purposes.

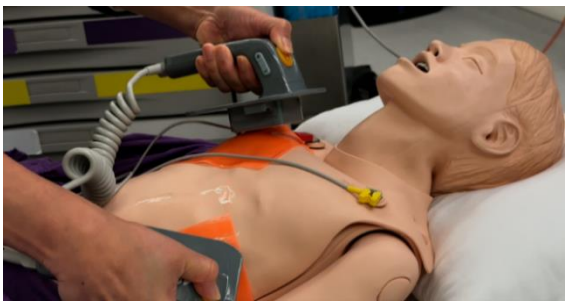
Recognising that clinical placements may offer limited opportunities to observe a wide range of procedures, these video recordings capture techniques in an immersive manner. The first-person perspective allows learners to observe clinical skills from different angles, enhancing their engagement and understanding.

To further enrich the learning experience, the videos include annotated tags and prompts that guide students through key steps and essential concepts throughout the procedure. These videos are accessible via the E-learning platforms of our Department, and the immersive experience can be enhanced with the use of virtual reality headsets.

Simulation-based teaching

Our Department prepares students for the acute management of critical paediatric conditions including anaphylaxis, seizures, and supraventricular tachycardia using simulation-based teachings.

Simulation-based teaching is conducted in the Paediatric Simulation Laboratory at the Hong Kong Children's Hospital. Each scenario uses realistic manikins, standardized scenarios, and immersive environments to replicate real-world clinical emergencies. This hands-on, scenario-driven approach helps to build competence, teamwork, and confidence of students and ensures that they are better equipped with the ability to manage these important paediatric emergency situations safely and effectively.



For Medical Educators

1. Lecture preparation

Teachers can harness artificial intelligence to enhance the efficiency and quality of their lecture and presentation preparation. The available artificial intelligence-powered tools can help to generate structured outlines, draft evidence-based content, and curate up-to-date clinical guidelines relevant to different paediatric topics. The tools can also assist in designing visually engaging PowerPoint slides.

Examples of practical use of available artificial intelligence-powered tools are provided below:

Content generation

- *ChatGPT, Gemini*: draft lecture outlines, structure content, explain concepts, generate case studies, create quiz questions
- *Perplexity AI*: summarizes medical research content with cited references
- *Consensus*: extracts insights from scientific papers

Slide creation and design

- *Gamma*: generates slides from a prompt
- *Beautiful.AI, Canva AI*: designs slides with medical diagrams, icons, and layouts
- *Microsoft Copilot (in PowerPoint)*: helps to generate slide content and suggest designs

Visual and interactive content creation

- *DALL·E, Midjourney, or Stable Diffusion*: Generate medical diagrams

Voice transcription

- *Otter.ai*: transcribes lectures and generate summaries for students

It is imperative to review the artificial intelligence-generated medical content for correctness, alignment with most recent evidence and guidelines, and absence of hallucination and ethical issues. These tools are meant to facilitate educators to create updated and engaging lectures while saving time on content creation and design.

2. Question setting

Teachers can leverage artificial intelligence to efficiently generate a diverse bank of assessment questions tailored to medical students.

Our Department has designed effective prompts for the generation of banks of multiple-choice questions (MCQs) and extended matching questions (EMQs):

1. For MCQs, the artificial intelligence can rapidly produce clinically relevant stems, plausible distractors based on common misconceptions, and clear explanations for correct answers, all aligned with specific learning objectives.
2. For EMQs, the prompts have been designed to first outline a coherent theme (e.g. chest pain in children, skin rash), generate a list of options, and finally a series of unique patient vignettes that test differential diagnosis and pattern recognition.

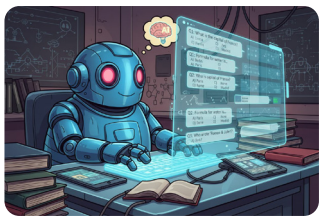
For the writing of effective prompts:

1. Be specific: Define patient demographics, clinical setting, elements to be included in the stem, answer options
2. State the question type: Ask for diagnosis, next step of management, investigation, data interpretation of treatment aligned with undergraduate medical curriculum level
3. Request plausible distractors: Ask for "common misconceptions" or "similar conditions to be included in the differential diagnosis."
4. Ask for explanations: This helps with the verification of the accuracy of the answer options.
5. Iterate: If the initial output is not satisfactory, refine the prompt (e.g., “elaborate on the symptoms”, “add vital signs” or “make the scenario more complex”).

It remains essential for the teacher to vet all questions for clinical accuracy, contextual appropriateness, and alignment with the intended cognitive level, ensuring the final assessment is both rigorous and pedagogically sound.

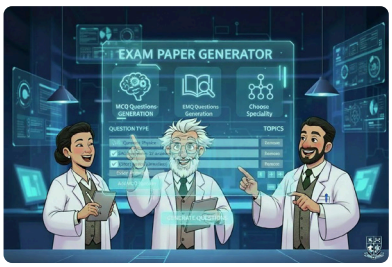
Paediatric QBank Platform

AI-Generated Questions Based on Expert-Created Prompts

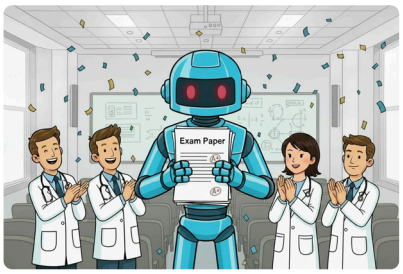


Two-Level Expert Vetting to Ensure Accuracy and Quality

Flexible Control Over Generation Settings and Preference



Automatic Exam Paper Generation For Review and Iteration

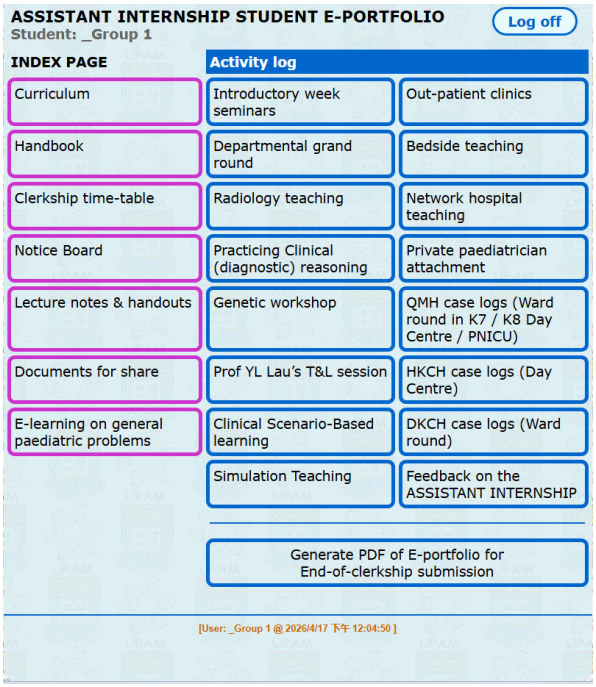


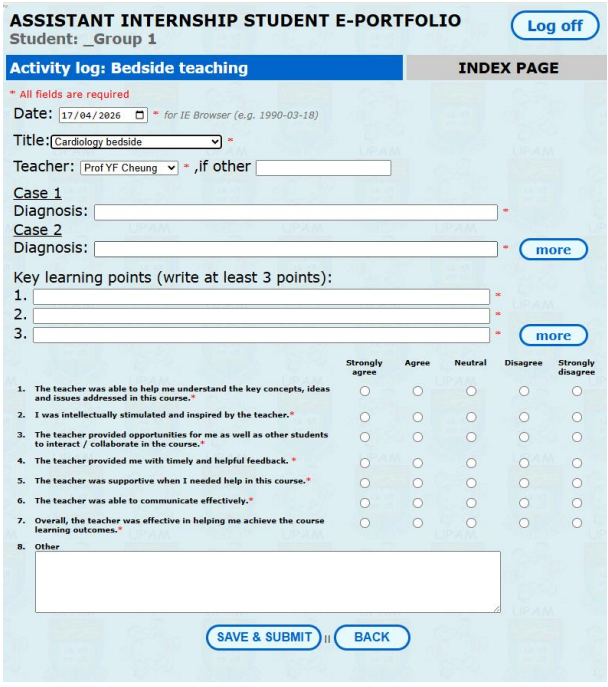
Strong Security With 2FA Authentication and Access Control

3. E-logbook

The E-logbook platform is an online tool that supports MBBS students to systematically record their clinical and lecture-based learning experiences. Students are encouraged to document key elements of lectures, patient encounters and clinical observations during ward attachment and clinic teaching sessions. To ensure consistency and reinforce effective learning practice, students are advised to complete entries promptly following each teaching activity. In addition to providing structured record-keeping, the platform enables students to evaluate teaching staff and submit feedback.

Overall, the E-logbook platform functions as a comprehensive educational resource by integrating self-directed learning materials, the Department handbook, and an electronic timetable system. This integrated approach enhances the learning experience through promoting well-organized documentation, encouraging active engagement, and ensuring convenient access to essential academic resources.



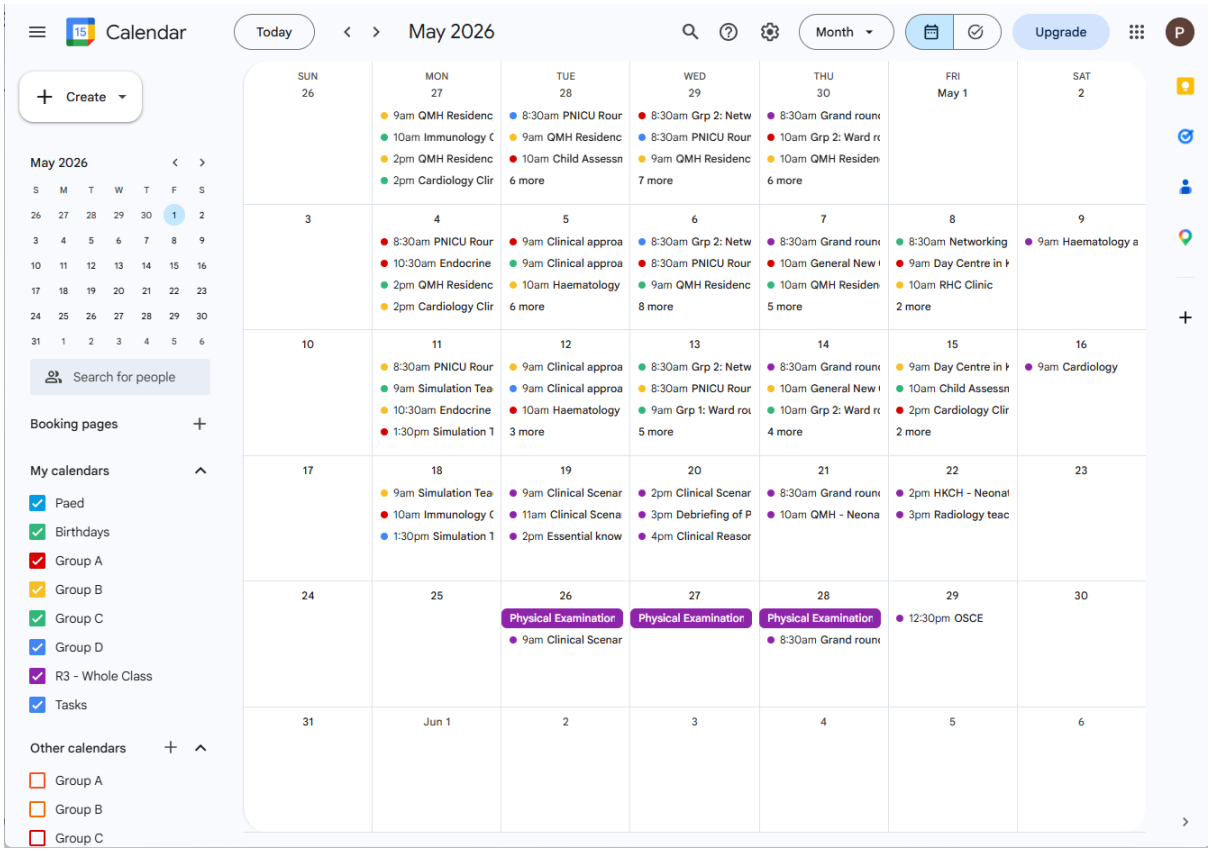


For Administrators and Office Staff

1. E-Calendar System

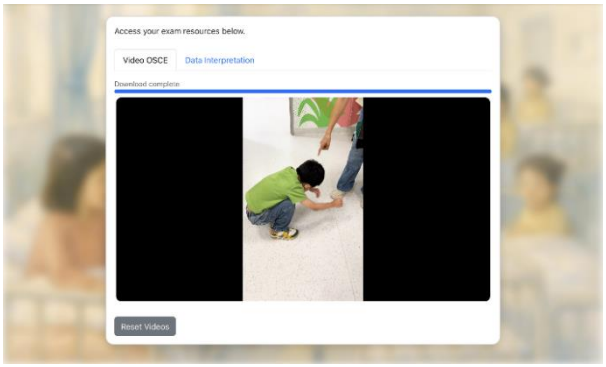
The E-Calendar system of our Department has replaced traditional paper-based schedules, offering a dynamic, accessible, and easily searchable timetable platform. Students can synchronize their group-specific schedules directly onto their personal calendars, facilitating efficient time management. Real-time updates implemented by administrative staff are instantly reflected, minimizing the risk of students relying on outdated information. The intuitive interface promotes quick adoption and ensures students always access the most current timetable data.

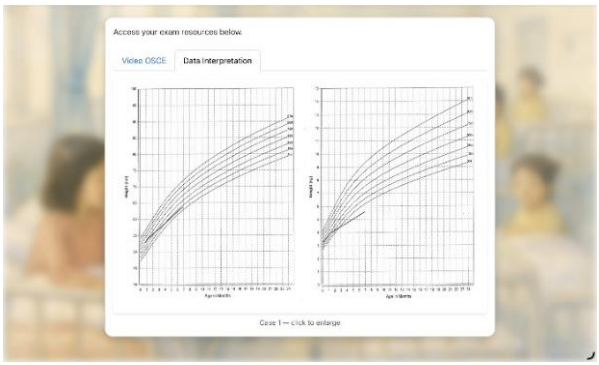
This system enhances communication efficiency, reduces administrative workload, and supports proactive planning. By providing a centralized, up-to-date scheduling solution, the E-Calendar system fosters organizational transparency and helps students manage their academic commitments more effectively, contributing to a more streamlined educational environment.

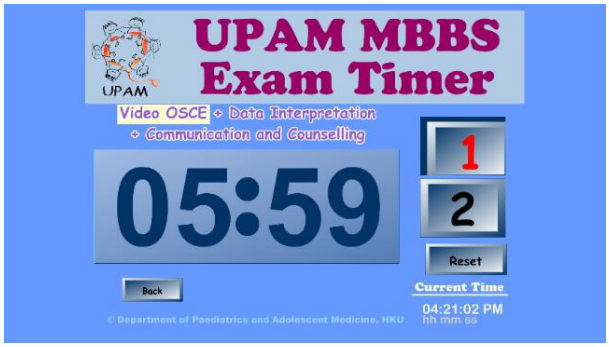


2. E-Examination System

The E-Examination System of our Department features centralized time management and digital presentation of examination materials. Synchronized countdown timers with auditory alerts monitor examination duration across multiple stations, ensuring precise timing and fairness. Alerts at 5-minutes and 1-minute before the end of examination assist examiners and candidates to manage time effectively and reduce disruption of examination flow. The system utilizes computers and iPads connected via Zoom. Additionally, iPads are used to display examination videos and datasets such as growth charts, chest radiographs, computed tomography scans to examine students in the Clinical Competency Test (Objective Structured Clinical Examination) stations.

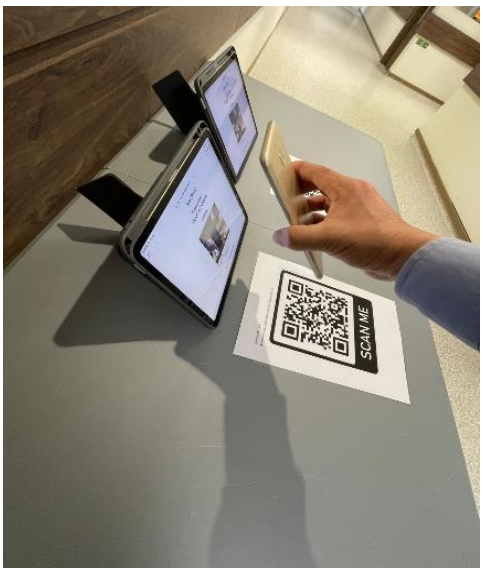






3. QR Code-based E-Attendance System

The QR Code-based E-Attendance system of our Department is a secure, contactless digital solution. Students authenticate via their HKU portal accounts to generate unique QR codes, which they present to scanners at the venue for immediate verification. The system provides an overview of the attendance and punctuality of students. Each QR code is deactivated after 15 minutes post-generation, preventing its misuse or sharing.



PREPARATION OF FACULTY MEMBERS

Understanding of Challenges to Teaching Professoriates

The paradigm shift necessitates faculty members to reconsider the roles and to become co-learners with students, exploring the innovative digital technologies together. The role of being sole repository of knowledge and experience needs to be redefined, and key new responsibilities need to be recognized. Teaching professoriates should instil in students the wisdom to know when to trust and how to ensure the accuracy of information derived from technologies, how to rely on human intuition and empathy, and how to establish the irreplaceable doctor-patient relationship.

Key Challenges

- Changes in mindset
- Gaps in skill set
- Digital presence
- Technological fluidity
- Resistance to change

Our Roles

- To impart and transfer knowledge?
- To continue with only the Socratic approach to teaching?
- As enablers? But how?
- Copiloting with human-machine interaction? But how?
- Being taken over by robot?

Key New Responsibilities

- Integrating AI into medical curriculum
- Teaching on the critical evaluation of AI and its ethical use
- Illustrating the clinical applications of AI
- Emphasizing the humanistic skills

Training in Artificial Intelligence Literacy

Artificial intelligence literacy involves the knowledge and skills of using artificial intelligence and the ability to understand, critically evaluate, and responsibly and ethically use artificial intelligence in real-world contexts. It encompasses not only a grasp of how it works and its capabilities, but also the limitations related to biases, errors, hallucinations and unintended consequences.

Developing AI literacy among medical professoriate, who were trained in the pre-artificial intelligence era, is crucial to ensure that we can safely and effectively leverage emerging technologies in undergraduate education apart from patient care, research, and health systems management.

Effective education would be achieved through sharing of relevant webpages, workshops and hands-on demonstrations of commonly used AI tools; and grand rounds and journal clubs that critically appraise AI-focused research.

HKU webpages on artificial intelligence literacy
https://libguides.lib.hku.hk/AI-literacy
https://aied.talic.hku.hk/ai-literacy
https://www.med.hku.hk/en/teaching-and-learning/edtech/resource-hub

Supporting the Integration of Digital Technologies in Curriculum Design

Our Department recognizes that supporting medical faculty to integrate digital technologies into curriculum design requires strategic, technical, and pedagogical resources. To this end, the former Information Technology Team has been restructured into the Information Technology and Multimedia Production Team, expanding its capacity to support the development of high-quality digital learning materials and platforms.

Faculty members are encouraged to build on the existing infrastructures to enhance their teaching. Clinical professoriates are encouraged to interact with information technology and multimedia production team members to translate educational ideas into feasible and engaging digital learning experiences. We strive to further strengthen this integration by providing support for development of other digital tools, including virtual patients and ward scenarios, simulation platforms, and learning management and evaluation systems.

Ongoing evaluation through learner feedback, analytics, and outcomes should inform iterative improvements so that the digital technologies would enhance, rather than simply digitize, existing teaching practices.

Awareness of the Pitfalls of Artificial Intelligence in Medical Education

As artificial intelligence tools become more embedded in medical education, it is essential that professoriates are aware of their pitfalls, limitations and potential risks.

1. Overreliance on artificial intelligence with erosion of human essential skills

Learners may default to artificial intelligence-generated answers made available within seconds after entering the prompts rather than engaging in the slower but essential pathways of association, reasoning, and appraisal and synthesis of evidence. Reflective practice and feedback from teachers would be hampered by such habitual practice.

Overreliance on artificial intelligence for retrieval of medical information, reasoning of diagnosis, and planning of clinical management with little human interaction and feedback may further potentially erode the human skills of communication, empathy, critical thinking, creativity, and problem-solving skills.

The questions of how to prevent overreliance on artificial intelligence and how to balance the integration of artificial intelligence with preservation of human essential skills, in the clinical setting communication and counselling skills, reasoning and association, empathy and ethical decision in particular, are timely and crucial.

While solutions may not be immediately clear, the importance of ensuring that the next generation is not only proficient with use of digital technologies to augment patient care but retains essential human skills cannot be overemphasized and has been discussed in our Departmental retreat. What is clear, however, is the need to proactively address the issue with designing of the paediatric undergraduate curriculum with strong emphasis on humanity, ethics, communication and clinical reasoning skills while embracing and integrating artificial intelligence and other digital technologies. How to adopt a balanced approach requires continuous evaluation and adaptation of both the learners and the teaching professoriates.

2. Ethical and privacy concerns

The integration of artificial intelligence raises important ethical and privacy concerns.

The black box nature of many artificial intelligence algorithms renders it difficult to understand what datasets are used, how the algorithms are trained, how reasoning is done, and how the conclusions are reached. The lack of this information begs for legitimate concerns on transparency, equity, and accountability.

The integration of artificial intelligence use of artificial intelligence in medical education may involve the use of student data and patient information. The importance of the adherence to the institutional guidelines on the consent process for data collection, data protection, data ownership, and the ethical use of data cannot be overemphasized.

The teaching professoriates should be aware of these concerns, address potential pitfalls, and educate students on how to preserve and apply human professional judgement when integrating artificial intelligence into their learning and future clinical practice while taking account of these concerns.

3. Limitations of artificial intelligence

There is no doubt that artificial intelligence has introduced unimaginable transformative possibilities in medical education. Nonetheless, to date it still harbours significant limitations that constrain its full capabilities and reliability.

Artificial intelligence systems can produce or amplify biases in training data related to misrepresentation of certain patient ethnic groups among other factors, leading to inequitable recommendations. While the outputs may appear authoritative, being presented with a high level of confidence, incorrect or even completely "hallucinated" outputs remain a distinct possibility, risking the uncritical acceptance of the generated outputs. The black box nature of artificial intelligence models and the ensuant issues have been described above.

The current artificial intelligence-driven tools, while can simulate clinical scenarios, lacks the nuanced understanding, empathy, ethical reasoning, cultural sensitivity and contextual judgment inherent to human educators. These human skills remain essential in ambiguous or complex clinical presentations that require holistic patient assessment. The consequences of overreliance on artificial intelligence have also been alluded earlier.

EPILOGUE

"It was the best of times, it was the worst of times, it was the age of wisdom, it was the age of foolishness, it was the epoch of belief, it was the epoch of incredulity, it was the season of Light, it was the season of Darkness, it was the spring of hope, it was the winter of despair" open the seminal historic novel of Charles Dickens. It cannot be truer using this to depict what is happening in the fifth industrial revolution, in which integration of artificial intelligence and other digital technologies into medical education and beyond is happening in light speed.

It is not merely a change in pedagogical tools amid this shift in paradigm, but a fundamental evolution in the learning ecosystem of clinical medicine. The outcomes of this new ecosystem should be new generations of medical graduates who are proficient in human, clinical, and technological skills. In this new ecosystem, the human expertise will be evolving in symbiosis with digital technologies. How to ensure that essential human elements will continue at the forefront of medical education is the crux of the matter for the medical educators of today.

We can only harness the full power of artificial intelligence and other digital technologies to create a new paradigm in medical education through understanding their potential applications and pitfalls, proactively addressing the challenges, fostering a symbiotic relationship, and designing human-centred curricula. As evidence-based guidelines on the integration of artificial intelligence and other digital technologies into the current paediatric medical curriculum remain limited to date, we shall make concerted efforts to contribute to the know-how, the governance of their ethical use, the generation of new data on their impact on student learning and assessment, and the incorporation of these technologies into existing competency-based frameworks of learning and assessment.

As we navigate this complex transformation together, the core values of medicine shall ensure that we are heading in the right direction!

ACKNOWLEDGEMENT

The integration of artificial Intelligence and other digital technologies into the paediatric undergraduate curriculum of our Department is a complex and multifaceted endeavour. This initiative would not have been possible without the expertise, dedication, and support of all of you!

On behalf of the Department, I extend my deepest gratitude to all faculty members and honorary teachers, whose clinical wisdom and educational commitment have provided the essential foundation for this curricular transformation. I am grateful to the directors and staff of the Paediatric Simulation Centre at the Hong Kong Children's Hospital for their collaborative support and provision of immersive learning environments for our students. Sincere thanks are also due to the Teaching and Learning team of our office for the strong administrative support and to our Information Technology and Multimedia Production Team for the creative solutions and technical execution.

While it is not possible to name every one of you who have contributed, to all of you, I wish like to express my sincerest and heartfelt appreciation. This initiative stands as a testament to a shared vision of the future of paediatric education, a future what we are just beginning to shape together as we embark on an exciting journey of transformation.