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Harnessing the potential of AI in lifelong learning for medical undergraduates

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I. INTRODUCTION

Lifelong learning is an essential skill for a successful medical practitioner to keep pace with rapidly advancing medical knowledge and technologies. Artificial intelligence(AI) has a potential in developing and promoting the skill of lifelong learning among medical undergraduates. AI can facilitate adaptive learning, collaborative learning, coaching, and incorporating evidence-based learning in undergraduate education as measures promoting lifelong learning. Users should be aware of the capabilities and limitations of the technology to promote effective incorporation in education. Medical undergraduates should receive a basic AI education to harness its' potential in the best possible ways in lifelong learning.

Modern-day medical practice is rapidly revolutionising. The increasing content and complexity of medical knowledge are often beyond the human capacity to process and synthesise. A study in 2019 revealed there was an overall 2620% increase in the number of knowledge syntheses published over 20 years, from 1999 to 2019 (Maggio et al., 2020). Medical students and doctors struggle to stay updated with the expanding knowledge and find it difficult to cope with information overload. A successful practitioner should have excellent foundational knowledge, be up-to-date, know when and where to seek additional information, and understand optimal practices in the work environment. Such practitioners will adopt technologies to make their lifelong learning more effective and targeted toward improving patient care.

Artificial intelligence (AI) is at exponential growth, particularly in the field of medicine. AI inventions span across multiple dimensions such as AI-aided diagnostic systems, image interpretation, medical records, patient communication, and community-based care. Future practice environments are likely to be heavily AI-integrated. AI-based knowledge management systems and search engines will streamline the process of practitioners keeping themselves up to date with evolving medicine.

Developing lifelong learning among students is an important domain of medical education, that will them to keep abreast of rapid advances in medicine. Medical schools foster the development of lifelong learning habits through strategies such as (1) adaptive learning (2) collaborative learning (3) coaching and (4) incorporating evidence-based learning into the curriculum. This article focuses on how AI could be harnessed to facilitate and enhance these strategies to inculcate lifelong learning among medical undergraduates.

II. HOW COULD AI ENHANCE THE PROCESS OF ADAPTIVE LEARNING?

Adaptive learning is a process that customises individual learning experiences by determining an individual's strengths and weaknesses and specifically addressing them. The concept of adaptive learning has become popular in recent years. However, this concept was originally highlighted more than a century ago. In 1912, Edward Thorndike introduced the idea of the learning machine, where the machine could ask questions from the learner and suggest areas that need improvement.

With the rise of Generative AI, this concept is coming to reality. Generative AI, which produced content like text, videos and music in response to user prompts, powers adaptive learning tools that assess student knowledge, offer personalised feedback, and pinpoint areas for improvement to help guide their learning process toward mastery (Luke & Hooi, 2024).

Rapid advancements in generative AI have made this technology accessible to many users, allowing learning institutions to customise adaptive AI platforms at a relatively lower cost. Such tools may not only facilitate the learning journey of medical students but also make them strive for continuous feedback-driven improvement as practitioners. In the future, AI-driven adaptive learning may revolutionise continuous professional development (CPD) to pinpoint and address learning gaps, allowing efficient and relevant learning for busy clinicians.

III. WILL AI-DRIVEN LEARNING ENVIRONMENTS PROMOTE COLLABORATION?

Collaboration is defined as the mutual engagement of participants in a coordinated effort to solve the problem together (Roschelle & Teasley, 1995). Collaborative learning by means of peer learning, interdisciplinary learning, and interprofessional learning should be promoted to ensure students develop the skills and confidence to collaborate as clinicians in the future. In clinical environments, doctors learn from each other in both formal and informal ways. This type of learning is particularly important in learning new skills and encourages self-learning behaviours in individuals. In medical school, collaborative learning skills are enhanced through group work, simulations, and collaborative activities among students from different related streams such as medicine, nursing, and pharmacy. These approaches strengthen interprofessional communication, knowledge sharing, and enhance learning.

AI-based virtual reality simulated clinical environments are adopted by multiple medical schools to promote experiential learning. Promoting collaboration should be incorporated as a learning outcome when possible into such simulations. For example, simulations can focus on students' decision-making skills as what team members are to be activated in a simulated encounter and developing communication skills for effective collaboration. In addition, in the future, AI-based platforms may allow more widespread collaboration crossing boundaries, such as enabling clinicians to find the 'expert' to seek opinions on a particular condition, where AI-based systems can facilitate collaboration.

IV. COACHING FOR LIFE-LONG LEARNING – CAN AI DO THIS?

Coaching is a development process that enables a person to identify and enhance their own capabilities to reach personal and professional goals. This process has been demonstrated to be beneficial for students in educational settings (Breslin et al., 2023). How does coaching promote lifelong learning? Coaching, which allows the person to learn about self, enables one to identify own impediments towards learning. This will enhance behaviours facilitating learning. AI coaching or virtual coaching is now being explored. The advantages of AI coaching are accessibility, lack of bias, and convenience. Human coaching is still believed to be superior due to the aspects of the ability to express empathy, pick up non-verbal cues during conversation, and be more adaptive. Though the current technology of AI is unable to surpass an experienced human coach (Terblanche et al., 2022), these hurdles may be overcome with future advancements of the technology.

V. EMPHASISE EVIDENCE-BASED APPROACHES WITHIN THE CURRICULUM

Reading journals, critically appraising relevant publications, and adopting them in one's own practice are essential elements of the lifelong learning process for doctors, which should be developed from undergraduate days themselves. The main hurdle for such incorporations is the tight schedule within the curriculum and the content load. Despite traditional teaching being replaced by integrated teaching, the content load covered within the curriculum remains substantial. The depth and breadth of the content taught in medical school have not proportionately evolved over the years, despite major changes happening in clinical environments with AI integration. AI acts as an instant source of knowledge, aiding clinical decision-making and patient care. Bearing this in mind, educators should revise their curricula to reduce the depth of certain elements that could be easily retrieved digitally. However, students should have a sound knowledge on foundational principles on which advanced concepts can build on.

Re-evaluating the curriculum to reduce the content load would free more time in the schedule to promote critical appraisal of scientific literature, enabling students to wisely use scientific literature to stay up to date. A thoughtful and pragmatic approach to curriculum revaluation for lifelong learning involves embedding core competencies such as critical thinking, adaptability, self-directed learning, and interdisciplinary collaboration instead of overloading content.

VI. EQUIP UNDERGRADUATES WITH BASIC AI KNOWLEDGE AND SKILLS

Some medical schools, including NUS Medicine, have incorporated AI into the curricula. Exposing medical undergraduates to the foundations of AI technology can help them foresee the revolutionisation of future practice and equip themselves to embrace the technology. In addition, this will enable them to pursue new career pathways combining AI and Medicine. With regards to lifelong learning, clinicians may be equipped with AI-based tools to learn from real-time patient data for clinical decision-making, rather than waiting for prospective clinical trials or research. For example, students with foundational knowledge of AI will be able to use AI analytical skills to draw conclusions based on real-time and latest clinical data, as well as to detect trends of emerging diseases and antibiotic resistance, promoting early intervention.

Equipping future generations with AI knowledge will improve the quality of care and reduce diagnostic errors. Also, AI knowledge will guide practitioners to remain vigilant about data privacy and algorithmic bias when using AI. A future-ready curriculum will not only prepare students to use AI responsibly but also to question and enhance the tools.

AI comes with challenges and opportunities. The risk of bias, data quality and security issues, risk of over-reliance, AI relying on historical rather than real-time data, and lack of transparency in decision-making processes are some of the limitations. Still, AI has a vast potential to augment healthcare and health professions' education as discussed above. AI should augment clinical decision making, and not replace. Ethical considerations, including patient consent, data security, and accountability, must remain central to any AI integration in healthcare practice.

In summary, AI has huge potential to enhance the strategies implemented in medical education to promote lifelong learning in medical undergraduates. The users should be aware of the limitations of the technology, and incorporate it cautiously to harness the maximum benefit of the technology in the process of transforming our undergraduates to better clinicians and lifelong learners.

Notes on Contributors

NL conceptualised the article, created the first draft, and revised subsequent versions. In addition, approved the final version of the article for submission.

HSC conceptualised the article, revised the draft versions, and approved the final version of the article for submission.

CTY conceptualised the article, revised the draft versions, and approved the final version of the article for submission.

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