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Enjy Abouzeid, Inas Zakaria, Mohammed Alshobaily, Mohamed H. Shehata & Hany Atwa

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AI-assisted case builder: Making PBL more scalable and adaptable

Enjy Abouzeid[a], Inas Zakaria[b,c], Mohammed Alshobaily[d], Mohamed H. Shehata[e,f] and Hany Atwa[e,g]

[a]School of Medicine, Ulster University, Londonderry, UK; [b]Kasr Al-Ainy School of Medicine, Cairo University, Cairo, Egypt; [c]College of Medicine, Suleiman AlRajhi University, AL Qassim, KSA; [d]Research and Innovation, Saudi Patient Safety Centre, Riyadh, KSA; [e]College of Medicine and Health Sciences, Arabian Gulf University, Manama, Bahrain; [f]Faculty of Medicine, Capital University, Cairo, Egypt; [g]Faculty of Medicine, Suez Canal University, Ismailia, Egypt

ABSTRACT

Developing high-quality problem-based learning (PBL) cases remains a significant challenge in medical education. It is resource-intensive and competes with faculty responsibilities in teaching, clinical care, research, and administration. As a result, many institutions struggle to generate sufficient cases to sustain active learning. The emergence of artificial intelligence (AI) and large language models (LLMs) offers a potential solution. We introduced the PBL Case Builder, a customised ChatGPT application designed to guide educators through structured case creation. The builder enforces four input parameters: target audience, curriculum context, core topic, and desired complexity, before generating content, ensuring contextualisation, and pedagogical alignment. Cases are produced in a consistent format, including progressive triggers, mapped learning objectives, and tutor prompts, which educators can then refine. This shifts their role from author to reviewer, reducing workload while enhancing efficiency and consistency. This innovative solution demonstrates that AI-assisted case building can streamline development, promote adaptability, and improve transparency in pedagogical design. Future work should evaluate the educational impact of AI-generated versus human-generated (traditional) cases, explore student and faculty perceptions, and create peer-reviewed repositories to scale this innovation globally.

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What was the educational challenge?

Developing high-quality PBL cases is a major challenge for curriculum developers. Effective cases must be clinically authentic, contextually relevant, inclusive, and aligned with curricular outcomes, yet their development is resource-intensive and requires subject expertise, pedagogical skill, iterative revision, and regular updating. At the same time, academic staff face competing demands across teaching, clinical work, assessment, research, and administration, limiting capacity for case development [1,2]. Given the central role of PBL in undergraduate health professions education, where cases structure inquiry and foster self-directed learning, teamwork, and clinical reasoning, declines in case quality undermine the effectiveness of the entire PBL process [3,4]. Case construction remains complex and time-consuming even in well-resourced institutions, and purchased cases still require substantial local adaptation, further increasing faculty workload [5].

Over time, these pressures contribute to 'PBL fatigue', characterised by superficial problem analysis, ritualised student engagement, and reduced fidelity to PBL principles, driven by static case libraries and the manual bottleneck of case renewal [6,7]. Against this backdrop, artificial intelligence (AI) and large language models (LLMs) offer a potential solution. In medical education, tools such as ChatGPT can reduce the burden of case development by shifting educators' roles from primary authors to reviewers, enabling faster production while maintaining quality [8]. However, integration of AI into educational frameworks requires careful evaluation to ensure pedagogical soundness and alignment with learning outcomes [9,10].

What was the solution?

We hypothesised that AI could enhance the PBL learning experience by directly addressing one of its greatest barriers: case writing. By leveraging customised tools such as the **ChatGPT PBL Case Builder** (https://chatgpt.com/g/g-681a09f297f88191b7133405cbc2a9e3-pbl-case-builder) as shown in Figure 1, medical educators can generate draft cases

CONTACT Enjy Abouzeid enjyabouzeid@yahoo.com School of Medicine, Ulster University, Londonderry, UK.
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efficiently, focus their expertise on review and refinement, and ensure alignment with curricular objectives. While early studies demonstrated the feasibility of using ChatGPT for case generation [8], our work builds on this foundation to explore how customisation can systematise and scale PBL case development, offering a practical solution to a long-standing challenge.

The PBL Case Builder is designed to guide educators through a structured case creation process. The tool prompts for key elements, patient demographics, presenting complaint, medical history, examination findings, investigations, and evolving scenario, while highlighting natural triggering points for small-group discussion. By parameterising learner level, cultural context, and inclusivity, the builder produces rapid draft cases which educators can refine to ensure clinical accuracy and pedagogical alignment.

Recent literature demonstrates increasing use of large language models (LLMs) for clinical case generation in health professions education, largely focusing on feasibility, efficiency, and specific formats such as clinical vignettes or virtual patients [8,11]. Generative AI, powered by LLMs, substantially reduces the cognitive and temporal burden of case development by enabling rapid prototype generation and iterative refinement. Evidence demonstrates that AI accelerates faculty case development from weeks to hours, while enabling systematic incorporation of patient diversity, constructive alignment with curriculum objectives, and rapid updates reflecting current evidence—all within a quality-assurance framework wherein clinical teachers verify accuracy and relevance [12,13]. Meta-analytic evidence from six randomised controlled trials demonstrates that AI-powered PBL improves knowledge acquisition by 46% and learner satisfaction, positioning AI-customised case builders as a transformative mechanism to transition medical education from periodic curricular renewal to dynamic, continuously evolving case libraries that sustain pedagogical engagement and clinical relevance [14].

While AI-generated cases are perceived as educationally valuable, studies consistently highlight the need for expert oversight to ensure appropriate learner level, realism, and pedagogical coherence. More recent work has emphasised scalability through template-driven case libraries, diversity-focused prompt optimisation, and low-cost, globally accessible LLM-based virtual patients framed as a disruptive innovation [15–17]. The PBL Case Builder aligns with these scalable approaches but differs by enforcing structured pedagogical inputs prior to generation, producing PBL-specific outputs (progressive triggers, mapped learning objectives, tutor prompts), and embedding educator oversight as a core design principle.

How was the solution implemented?

The Case Builder guides educators through stepwise case development, ensuring both structure and alignment with curricular needs. Case development begins with blueprinting, where educators define the ‘case domain’ (body system/Core clinical condition), learner level, and intended learning outcomes. The builder then scaffolds the case by prompting for patient demographics, presenting complaint, past medical history, and relevant social context.

Next, the builder generates information in stages through progressive disclosure, producing examination findings, investigation results, and evolving scenarios that create natural ‘triggers’ for discussion. Once the draft is produced, educators engage in refinement and alignment, reviewing for plausibility, contextual relevance, and mapping to frameworks such as the GMC (General Medical Council), MLA (Medical Licensing Assessment), or institutional graduate attributes. Cases can then be packaged and exported into formats suitable for use in PBL tutorial sessions, with the option of piloting to adjust complexity or adapt cases for different learner groups.

Importantly, the builder is configured to enforce structured inputs before case generation. This prevents vague prompts and ensures contextualisation. The four required parameters are:

1. Target Audience—e.g. Year 1 pre-clinical students.
2. Curriculum Context—e.g. cardiovascular system.
3. Core Topic or Condition—e.g. asthma.
4. Desired Complexity or Focus (Optional)—e.g. emphasis on physiology, professionalism, ethics …

Only when all inputs are provided can the builder proceed. This subsequently generates cases in a consistent format, as shown in Supplementary Files:

- A title and patient-story-based scenario presented in four progressive triggers.
- A learning objectives table (10–12 objectives) with rationale and trigger mapping.
- Tutor discussion prompts (2–3 per trigger).
- A mapping of learning objectives to case triggers, ensuring transparency between narrative and objectives.

By combining enforced parameters with a structured case format, the builder shifts the educator’s role from author to reviewer. Instead of drafting from scratch, faculty focus on refinement, accuracy,

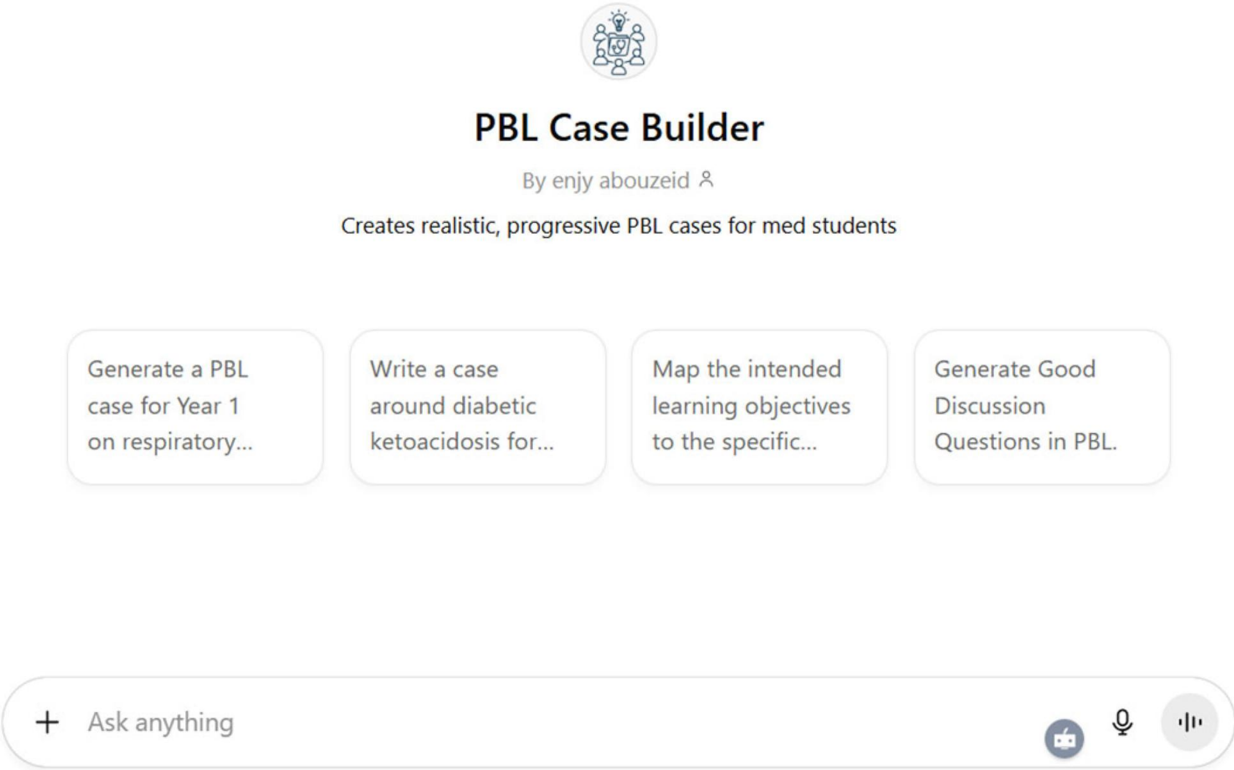

Figure 1. Interface of the customised ChatGPT.

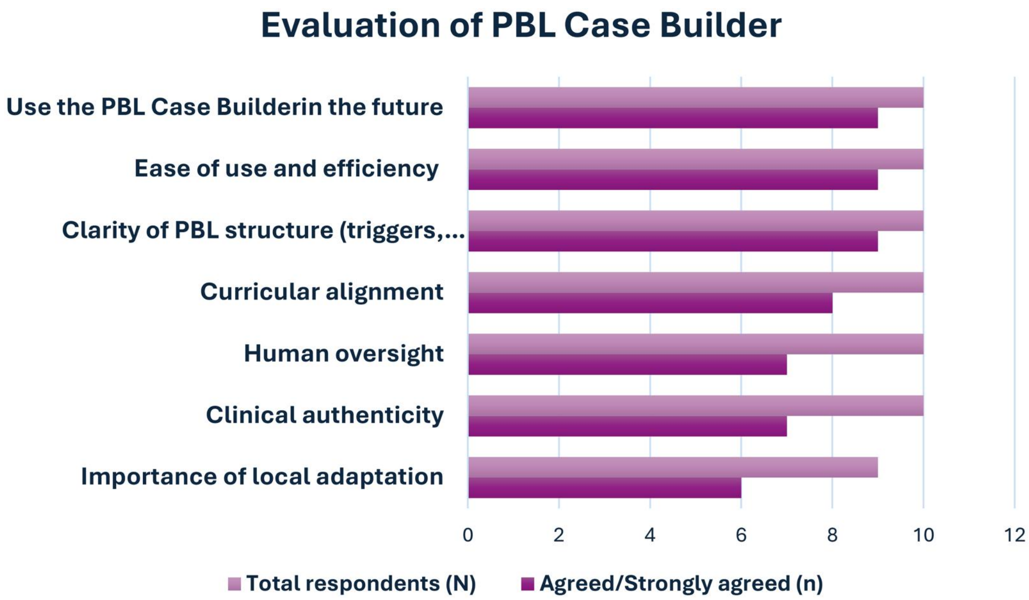

Figure 2. Evaluation of the PBL case builder.

and contextualisation. This approach enhances efficiency while embedding quality control at the earliest stage of case development.

While AI accelerates case drafting and enforces structural consistency, only educators can safeguard accuracy, inclusivity, and educational value. Faculty oversight remains indispensable to ensure that cases reflect clinical reality and avoid bias. Accordingly, we asked 10 experts to evaluate the Case Builder and the developed case using an MS form https://forms.office.com/e/tXfkUXKCBn. Participants reported holding diverse and overlapping roles, including medical educators, PBL tutors/facilitators, clinicians, and curriculum designers. Most respondents selected more than one role, reflecting the multidisciplinary nature of PBL case development in medical education. All respondents reported at least some prior exposure to AI tools in education, with experience ranging from minimal to moderate; none identified as advanced or expert users of AI for PBL case construction.

Figure 2 summarises participants' responses to key evaluation statements and shows consistently positive perceptions of the PBL Case Builder across domains of structure, usability, and future adoption. The strongest endorsement related to clarity of PBL structure and ease of use, with participants describing the tool as providing a clear and organised framework that supported triggers, learning needs, and tutor prompts (e.g. 'Helpful in putting a general frame', 'Very easy, smooth, quick with a realistic case scenario', 'Organised work'). These comments suggest that the builder enhanced coherence and reduced uncertainty during case construction.

High agreement was also reported for curricular alignment, with participants noting that the generated cases aligned with intended learning outcomes while still allowing educator-led refinement ('It gives you the base that you can start to modify'). Clinical authenticity was positively perceived, although respondents emphasised the continued need for expert review to ensure accuracy and realism. Consistent with this, strong agreement was observed for the importance of human oversight, with participants cautioning against uncritical reliance on AI output ('You cannot depend on AI totally'; 'User needs to modify according to the agreed intended learning outcomes').

Perceptions of local adaptation were positive but comparatively lower, reflecting recognition that cultural, institutional, and curricular tailoring is required beyond the initial AI-generated draft ('Ensure the content is culturally and religiously appropriate'; 'To be customisable according to the course specifications'). Qualitative feedback highlighted both strengths (framework, templates) and areas for improvement, particularly the need for richer interaction questions and greater flexibility in prompts (e.g. number of triggers, learning needs per trigger).

Participants also identified opportunities for further enhancement, including improvements in aesthetic presentation and formatting (4/10), greater consistency across repeated outputs (3/10), and increased curricular customisation (3/10). Collectively, these findings inform iterative development and underscore the importance of aligning AI-supported tools with local educational contexts and educator expectations.

What lessons were learned that are relevant to a wider global audience?

Our experience with the customised ChatGPT PBL Case Builder highlights several lessons relevant to medical educators globally. High agreement regarding future use indicates strong acceptability and perceived practical value, particularly when the tool is used as a co-creation aid rather than a replacement for educator expertise. By shifting educators' roles from case authors to reviewers, AI can meaningfully reduce workload while supporting clinical accuracy and pedagogical alignment.

Structured input parameters are critical to producing contextualised, curriculum-aligned outputs and avoiding generic content. The ability to rapidly adapt cases for different learner levels and teaching contexts supports efficient expansion of PBL case banks, especially in resource-constrained settings. Embedding evaluation rubrics and integrating tutor and student feedback enables iterative prompt refinement and continuous quality improvement. Finally, explicit mapping of learning objectives to case triggers and inclusion of tutor prompts enhance pedagogical transparency, supporting scalability and consistency across facilitators and cohorts.

What are the next steps?

A key limitation of the PBL Case Builder is that it generates a structured first draft rather than a fully ready-to-use case. Although this reduces the cognitive and time burden of case development, expert refinement remains necessary to enhance clinical nuance, narrative flow, and contextual authenticity. Future work will focus on iterative prompt optimisation and feedback-informed enhancements to produce more developmentally complete outputs, while preserving essential human oversight.

The next step is to evaluate its educational impact through comparative studies of AI-generated versus human-generated (traditional) cases, and to explore student and tutor perceptions. At a global level, creating repositories of peer-reviewed AI-generated cases and linking the builder with curriculum mapping and assessment systems could reduce duplication, adaptation across contexts, and embed this innovation into the next wave of medical education.

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Notes on contributors

Enjy Abouzeid, MBChB, MSc, PhD, FAcadMEd, SFHEA, AFAMEE, is a Lecturer of Medical Education and the PBL lead at the School of Medicine, Ulster University, UK. She is a Faculty at the Diploma of Health Professions Education (DHPE). She has served as Vice President of the Assessment and Evaluation Unit at the Faculty of Medicine, Suez Canal University, Egypt, where she was promoted to Associate Professor of Medical Education.

Inas Zakaria, MBChB, MSc, MD, PhD, Dip HPE, is a Full Professor of Medical Microbiology, Parasitology, & Immunology at Sulieman Al Rajhi University, KSA, and at the Faculty of Medicine, Cairo University, Egypt. She holds an honoured Diploma from Suez Canal & Maastricht Universities as a certified specialist in Health Professions. Prof. Abdelaziz led faculty development initiatives, PBL, electronic learning programs, and innovative assessment practices in LCME-accredited.

Mohammed Alshobaily, MSc. MedEd, PhD, is a Head of Research and Innovation at the Saudi Patient Safety Centre, KSA. Previously a director of a university teaching and learning centre and a medical program reviewer for the Saudi Commission for Health Specialities. His expertise includes CBME, assessment, faculty development, and innovation. He is certified in e-learning and academic quality practice.

Mohamed H. Shehata, MBBCH, MSc, MD, MHPE, MRCGP (Int), FAIMER Fellow, is a Professor of Family Medicine and Chairperson of the Family and Community Medicine Department at the College of Medicine and Medical Sciences, Arabian Gulf University, Bahrain. His expertise includes curriculum reform, designing Problem-Based Learning (PBL) scenarios, and faculty development in technology-enhanced learning.

Hany Atwa, MBChB, MSc, PhD, DipPED, AFAMEE, IFI FAIMER Fellow, is a professor of Medical Education at both the College of Medicine and Health Sciences, Arabian Gulf University, Bahrain and the Faculty of Medicine, Suez Canal University, Egypt. He is a faculty and project adviser at the IFI FAIMER Institute (Philadelphia, USA) and the Regional FAIMER Institute ASU-MENA-FRI (Cairo, Egypt). He is a faculty and unit planner at the Joint Master of Health Professions Education (JMHPE) between Maastricht and Suez Canal Universities and the Diploma of Health Professions Education (DHPE) in Suez Canal University, Egypt.

ORCID

Enjy Abouzeid http://orcid.org/0000-0002-9431-6019
Inas Zakaria http://orcid.org/0000-0003-3722-238X
Mohammed Alshobaily http://orcid.org/0000-0002-3409-8961
Mohamed H. Shehata http://orcid.org/0000-0002-9156-931X
Hany Atwa http://orcid.org/0000-0002-0099-4100

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