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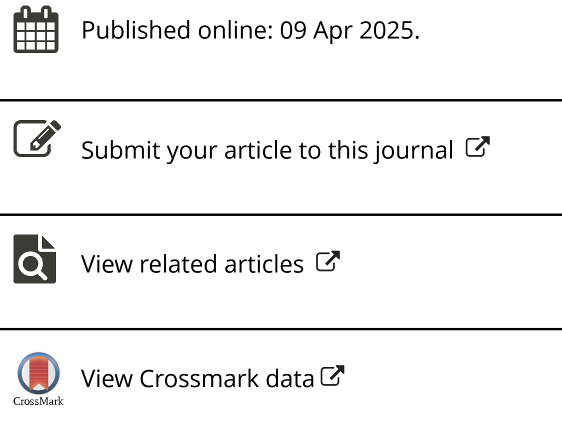

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NEW WAVE

From technology adopters to creators: Leveraging AI-assisted vibe coding to transform clinical teaching and learning

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ABSTRACT

Integrating theoretical knowledge with the practical skills essential for clinical practice remains a significant challenge in clinical education. Conventional teaching strategies often fall short in preparing clinicians to navigate the unpredictable, urgent, and multifaceted nature of clinical decision-making, while also providing limited support for the development of cognitive heuristics essential to forming independent clinical judgment. To address these challenges, we introduce vibe coding, a novel AI-assisted, no-code development approach that enables educators to create interactive, customisable learning simulations without programming expertise. By prioritising rapid prototyping and iterative refinement, vibe coding shifts the focus from technical constraints to pedagogical goals, allowing educators to generate code through intuitive, conversational prompts. We applied this approach to develop two distinct applications: the Differential Diagnosis Trainer (DDT), which enhances diagnostic reasoning through randomised clinical scenarios and AI-generated feedback, and the Insulin and Blood Sugar Simulation (IBSS), which offers real-time exploration of metabolic dynamics. Both tools were built using AI-powered no-code platforms, demonstrating significant improvements in accessibility, cost-effectiveness, and scalability. We encourage educators to transition from technology adopters to creators, leveraging AI-driven platforms to develop innovative, scalable, and personalised clinical simulations that transform learning experiences and ultimately enhance patient care.

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What is the educational challenge?

A persistent challenge in clinical education is bridging the gap between theoretical knowledge and practical application.

Traditional pedagogical approaches – such as didactic lectures and textbook-based learning often fall short in preparing healthcare professionals for the complex, unpredictable, and time-sensitive nature of real-world clinical decision-making [1]. Although high-fidelity simulations offer a valuable means of experiential learning, they are often costly, logistically demanding, and difficult to scale. Moreover, conventional approaches do not always equip clinicians with the cognitive flexibility needed for effective clinical reasoning. While heuristics – simple, experience-based decision-making strategies are essential in real-world practice, they are frequently overlooked in favour of rigid, formal logic [2].

Despite AI's potential to enhance simulation-based education [3], a significant barrier remains: most AI-driven learning tools require coding expertise, limiting their accessibility to educators who lack programming knowledge. Given that clinicians and educators already face significant time constraints, engaging in extensive coding or troubleshooting is impractical. This bottleneck restricts AI's impact in medical education, keeping it in the domain of technically proficient developers rather than frontline educators.

What was the solution?

To address this gap, we explore how AI-assisted agents and AI-powered code assistants can democratise the creation of simulations to enhance teaching and learning, by enabling clinical educators to develop customisable learning environments without programming expertise.

Here, we introduce vibe coding [4], an intuitive approach that empowers medical educators to create personalised, interactive learning experiences without coding skills. Vibe coding prioritises rapid prototyping and experimentation over rigid coding structures, using AI-powered tools to generate code while educators focus on problem-solving, user experience, and instructional design. By collaborating with AI, even those without a technical background can turn ideas into functional applications, making software development more accessible, efficient, and user driven. This signifies a shift towards a fluid, creative coding experience, where educational goals take precedence over technical barriers.

Applying this approach, we developed two applications using AI-driven tools through intuitive, user-friendly development processes.

1. *The DDT* (https://ddxchallenge.aine.education) – an AI-powered clinical reasoning application designed to enhance diagnostic skills. Users begin by generating randomised clinical scenarios that combine various clinical abnormalities. Under time pressure, they

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formulate and prioritise differential diagnoses and articulate their reasoning. Once submitted, the tool delivers comprehensive AI-driven feedback – including AI's ranked potential diagnoses, detailed explanations, and clinical likelihood assessments – to evaluate the user's differentials. This reflective learning process broadens clinical perspectives, sharpens diagnostic precision, and reinforces metacognitive skills.

2. The IBSS (https://sugar.aine.education) – an interactive, real-time platform that empowers learners to explore the dynamic relationships among insulin administration, dietary intake, insulin sensitivity, and glycaemic control. Users can adjust key parameters – including insulin type, dosage, frequency, meal timing, insulin sensitivity, and carbohydrate content – to visualise real-time blood glucose trends. This scenario-based learning approach deepens understanding of metabolic interactions and enhances clinical decision-making in diabetes management.

How was the solution implemented?

The development process followed an intuitive vibe coding approach, where a medical educator iteratively refined AI-generated code using structured prompts in conversational language. This method lowered technical barriers, making AI-assisted development more accessible to educators.

Remarkably, a medical educator with no formal programming training completed the entire process – from defining the project scope to deployment – in just two hours. This highlights the efficiency of AI-assisted workflows, enabling rapid prototyping and deployment without requiring coding expertise. Both applications were built using AI-assisted no-code platforms, leveraging OpenAI (o1, o3-mini) and Anthropic (Claude 3.5 and 3.7 Sonnet) models and deployed via Replit.

The development process followed these key steps:

1. *Defining the Project Scope* – Educators provided structured prompts to outline the learning objectives and desired features.
   - *Example prompt for DDT*: 'Build an interactive differential diagnosis trainer that randomly generates two medical conditions (with options for customisation), allows users to write and label their differential diagnoses with supporting reasoning under timed pressure, and then provides ranked AI feedback with detailed explanations and learning tips.'
   - *Example prompt for IBSS*: 'Build a web-based insulin and blood sugar simulator that allows users to input baseline blood glucose, insulin injections (type, dose, time), meals, sugar events, and personal insulin sensitivity factors/carbohydrate ratios, then calculates and displays blood glucose changes over time in a chart, factoring in both injected and natural insulin effects.'
2. *Reviewing the AI-generated plan* – AI generated a structured development outline, detailing key features, components, and implementation steps. Educators refined these plans to align with pedagogical goals.
3. *Building and refining the application* – AI generated an initial codebase, which was iteratively refined through continuous educator–AI interactions, including debugging, feature enhancements, and user interface improvements.

   Using vibe coding effectively does require some understanding of how the tool works – particularly its interaction with the underlying language model, basic principles of prompt design, and simple program logic. Based on our experience, it is unlikely that users will be able to generate a complete and functional module using a single prompt. Instead, the development process typically involves multiple iterations of creation and refinement.
4. *Deployment and testing* – The final applications were tested and deployed on Replit. The environment facilitated testing and deployment of the application, ensuring that the platform functioned as intended before integration into clinical education settings.

   It is also noteworthy that the accuracy of each program is closely tied to its specific design and purpose, especially within an educational setting. For example, programs developed to simulate deterministic algorithms (e.g. IBSS) will produce outputs based on the accuracy and robustness of the underlying algorithm. In these cases, the error rate directly reflects the quality of that algorithm. In contrast, educational tools that incorporate generative AI (e.g. DDT) rely on the capabilities of the LLM used. Here, the error rate is influenced by the performance characteristics of the specific LLM model. This distinction is crucial when evaluating the reliability of AI-driven educational tools and understanding how learners might interact with or interpret their outputs.

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

Through this process, we identified three key lessons.

1. *Accessibility*. AI-assisted code generation can transform medical education by making sophisticated clinical simulations accessible to educators without programming expertise. In the past, developing digital learning tools required specialised technical knowledge and collaboration with software developers – an approach that was both costly and time-consuming. AI-powered no-code platforms now allow educators to create customised, interactive learning environments using conversational language instead of code, enabling greater accessibility and flexibility in medical training.
2. *Cost-effectiveness and scalability*. AI-powered development provides a cost-effective and scalable alternative to traditional software creation, significantly reducing financial and logistical barriers to implementing advanced clinical simulations. Hiring professional developers to build bespoke medical education tools is often prohibitively expensive, limiting the reach of innovative training solutions. In contrast, AI-generated code enables educators to rapidly prototype, refine, and deploy tailored applications at a small fraction of the cost. This scalability is particularly valuable in resource-limited settings, where access to advanced educational technology has historically been

constrained. By streamlining the development process, AI-assisted platforms facilitate continuous iteration and improvement, ensuring clinical training remains dynamic, responsive, and widely accessible.

3. *Pedagogical alignment*. Successful AI integration in clinical education must align with pedagogical principles to enhance reasoning skills and decision-making. While some worry that reliance on AI-driven learning and clinical practice might impede the development of critical thinking and independent clinical reasoning [5], we suggest that pedagogically sound teaching and learning tools created with AI-assistance can enhance these essential skills. Educators should take an active role as creators, not just adopters, as they best understand their own teaching requirements. DDT, for example, helps learners develop structured thinking by reinforcing cognitive frameworks essential for accurate and efficient diagnostic reasoning. Grounded in schema theory, the application guides users in systematically constructing differential diagnoses. Similarly, IBSS provides a hands-on approach to glycaemic control, allowing trainees to experiment with clinical variables and observe real-time effects. By moving beyond rote memorisation, these tools foster deep learning, metacognitive skills, and clinical judgment, ultimately improving decision-making in practice.

What are the next steps?

This marks a paradigm shift, where educators transition from technology adopters to technology creators, leveraging AI to develop customised, scalable educational tools. To fully harness advancements in AI, educators must adopt a structured, pedagogically informed approach that positions them as active creators of learning tools. Rather than simply integrating existing technology, they can design asynchronous AI and non-AI-driven tools to address pedagogical challenges at scale.

We encourage medical educators to explore AI-assisted code generation and experiment with vibe coding to create customised, narrative-driven simulations tailored to their teaching needs. By starting with small-scale simulations, they can iteratively refine designs, integrating clinical variables, interactive storytelling, and real-time decision-making to enhance learning outcomes.

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