The science of gamification: Reimagining biomedical education through gamified learning

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Dr Michael J. Dillon and Prof Laura Bowater examine the science of gamification to transform biomedical education through gamified learning

Biomedical education stands at a crossroads. As the volume and complexity of scientific knowledge expands exponentially, traditional models of teaching struggle to keep pace. Across higher education, there is a dawning recognition that, although the traditional lecture model still has its advocates, it is not always fit for purpose. (1) Students dutifully sitting in rows and take notes is too reliant on passive listening and rote memorisation, leaving little space for the inquiry and collaboration that modern science demands.

If we expect future biomedical scientists and clinicians to think critically and creatively, then educational methods must become dynamic, experiential and responsive. At Peninsula Medical School, we have begun to explore different approaches grounded in the science of gamified learning. (2) Gamification of learning can take two approaches: serious games and structural gamification.

Serious games have educational objectives integrated into the gameplay; on the other hand, structural gamification adds game-like features such as points, badges, and leaderboards to classroom activities. By applying principles of gamification to complex biomedical concepts, we are transforming the way students engage with topics such as microbiology, immunology, anatomy, and physiology.

What is gamified education?

Gamified education takes the core elements that make games engaging – challenge, feedback, progression and reward – and applies them to learning. This approach is not about adding superficial fun or competition; it is about designing educational experiences that tap into deep human drives for exploration and problem-solving. When structured with academic rigour, gamification can make abstract or complex material tangible and memorable.

Gamified approaches can take many forms. For example, at Peninsula Medical School, we developed Wordotomy (3), a card game that helps students decode biomedical terminology through linguistic play.

We've also created the Micro-Immune Battles board game (4), which helps students understand how the immune system responds to infection, and how symptoms can be traced back to a pathogen's life cycle and diagnostic features. We use card games to explore antimicrobial

resistance, where students draw and trade “pathogen” and “treatment” cards to understand mechanisms of resistance and stewardship. And we’ve even designed escape room-style puzzles where students solve puzzles to trace a disorder through symptoms and test results!

Each of these examples transforms abstract, and at times, hard-to-grasp concepts into active challenges, where students apply knowledge actively rather than recall it passively, to reinforce conceptual understanding through experience.

Why gamification works

Gamified learning works because it makes complex science both active and social. Rather than memorising pathways or definitions, students collaborate, discuss, and test ideas in real-time. This sense of shared problem-solving is especially powerful in biomedical education, where understanding often depends on seeing how biological systems interact.

Our students consistently report that these activities help them “see the bigger picture”. They find the learning engaging, which helps them retain knowledge more effectively. Many describe a sense of immersion and progression, of being part of the process rather than an observer of it. They also describe how they enjoy learning this way; they find it rewarding.

The sessions are active and purposeful. They hold attention in a way that traditional lectures often struggle to match. Also, for many students, playing alongside their peers creates a sense of camaraderie, friendly challenge, and competition. It helps them to make friends and build a community. Learning becomes something they do with one another, not just in front of an instructor.

These observations echo what educational theory has long suggested: that learning is a social process as much as an individual one. (5) Understanding develops through conversation: students explain ideas to each other, test their reasoning, and work together to make sense of complex systems. Gamified activities create these moments of exchange. The structured challenges encourage dialogue and collaboration, but in a way that feels spontaneous rather than forced.

As students take ownership of the task and begin to rely on one another’s strengths, confidence builds almost without them noticing. Learning shifts from something received to something constructed, a process of discovery that invites curiosity and risk-taking. (6)

Looking ahead: The future of biomedical education

Gamified learning is still evolving, but its impact on biomedical education is already clear. When students are invited to learn through play, they don’t just remember more; they think differently. (7) The same principles that make games engaging can also make education more inclusive, collaborative and adaptive to change.

As teaching increasingly takes place online or in hybrid formats, these approaches offer new ways to sustain connection and curiosity at a distance. Virtual simulations, challenge-based modules and team competitions can give students a sense of belonging and purpose even

when they're learning remotely. The technology will continue to change, but the underlying idea remains constant: that meaningful learning happens when people are active participants, not passive observers.

At Peninsula Medical School, we see gamified education as part of a broader transformation that connects scientific rigour with creativity, and something that prepares graduates for the unpredictability of modern healthcare and research. By combining evidence-based design with the spirit of play, we're shaping an environment where discovery is not only taught, but experienced.

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