

## Opinion

## Can New Digital Technologies Support Parasitology Teaching and Learning?

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**Traditionally, parasitology courses have mostly been taught face-to-face on campus, but now digital technologies offer opportunities for teaching and learning. Here, we give a perspective on how new technologies might be used through student-centred teaching approaches. First, a snapshot of recent trends in the higher education is provided; then, a brief account is given of how digital technologies [e.g., massive open online courses (MOOCs), flipped classroom (FC), games, quizzes, dedicated Facebook, and digital badges] might promote parasitology teaching and learning in digital learning environments. In our opinion, some of these digital technologies might be useful for competency-based, self-regulated, learner-centred teaching and learning in an online or blended teaching environment.**

## Teaching and Learning of Parasitology in the Digital World

Currently, there are several face-to-face approaches to the teaching of parasitology, including the disciplinary-based and problem-oriented approaches as well as a combination of both [1–12]. Given increasing internationalisation, changing socioeconomic conditions, and the attendance of students from diverse backgrounds at higher education institutions [13], the demand is increasing for the improved access of students to learning materials, flexible study options, and enhanced learning experiences. In addition, there is a need for better processes and outcomes in university courses, and a life-long learning toolkit for various degree programs and/or courses. These circumstances pose many challenges to university lecturers in the 21st century.

In August 1999, Professor Eckert, from the University of Zurich, Switzerland, highlighted a future vision, challenges, and directions for teaching veterinary parasitology in the 21st century. He highlighted the use of new technologies and wrote 'We should also discuss the new teaching and learning technologies, such as computer-assisted learning and teaching, computer-assisted case simulation, and tele-education' [1]. Since Professor Eckert's publication and a special issue on teaching veterinary parasitology in 2002 [3–12], the higher education sector has undergone major changes in course content, delivery, and management worldwide. In addition, digital technologies have, in many aspects, revolutionised our day-to-day lives and some of them [e.g., MOOCs, FCs, social networking sites (SNS), games, etc.] have been used in various disciplines to promote learning and teaching, maintain student engagement, and increase student satisfaction in the 'tech-savvy' generation of the 21st century. We believe that some of these technologies can offer new opportunities for the teaching and learning of parasitology. Here, first we appraise the current trends in teaching curricula and practices in higher education, and then argue how digital technologies might be used for effective and engaging parasitology teaching and learning.

## Trends

Participation rates in the higher education sector are higher than ever.

The demands for improved access by students to learning materials, the development of life-long learning toolkits, and flexible study options for students are increasing.

Digital technologies offer unprecedented opportunities to respond to some of the challenges posed by these trends in the higher education sector.

Digital technologies, including MOOCs, FCs, gamification, social networking sites, digital badges, and learning analytics, are some of the recent innovations that could revolutionise the teaching and learning of parasitology in the digital world.

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### Digital Technologies and Pedagogy in Higher Education

Recently, Johnson *et al.* [14] published the *New Media Consortium (NMC) Horizon Report–2015 Higher Education Edition*, under the auspices of NMC, a nongovernmental organisation of more than 250 higher education institutions, museums, and companies. In this annual report, the authors conducted research into emerging digital technologies and identified important advances, major challenges delaying technology adoption, and future trends that might accelerate technology adoption in higher education. This report highlighted the decisions that institutions are making in relation to digital technologies for advancing and supporting teaching, learning, and/or creative enquiry in higher education across the globe [14].

There are seven categories of technologies, tools, and strategies that NMC highlights: consumer technologies, digital strategies, the Internet, learning, social media, visualisation, and enabling technologies [14]. Based on the input of leading researchers and thinkers in the educational technology community, Johnson *et al.* [14] divided trends in digital technologies into three future time periods: imminent technological trends (e.g., FC), which are expected to achieve widespread adoption in 1 year or less; slightly longer-term trends (e.g., wearables), which are likely to take 2–3 years to have an impact; and long-term trends (e.g., adaptive learning and internet technologies), which are predicted to have an impact on higher education in 4–5 years.

Given that digital technologies are becoming an important part of our daily and social lives, the Internet, rapidly evolving digital devices, and networks could offer opportunities to university lecturers to meet the demands of recent trends in the higher education sector [15,16]. However, this situation also demands unique pedagogical approaches for effective teaching online, because there are substantial differences between on-campus and online learning spaces [15,17–21]. Therefore, it is imperative that educators critically assess any new digital technology before its implementation and integration into the pedagogical framework and core principles of teaching (Box 1) for student learning in a digital world (Box 2).

### How Can Digital Technologies Be Used in Parasitology Teaching and Learning?

To develop and evaluate teaching and learning pedagogies for parasitology using digital technologies, we propose a model (Figure 1, Key Figure) in which an international consortium comprising key educators from various disciplines of parasitology from leading institutions around the world is formed. The overarching objective of this consortium would be to develop guiding principles, policies, and pedagogies for the teaching and learning of parasitology. Given

#### Box 1. Core Principles of Teaching in Higher Education

In March 1987, the Board of American Association for Higher Education (AAHE) published the Seven Principles of Good Practice in Undergraduate Education, following a meta-analysis of 50 years of research on good learning outcomes in the USA [59,60]. Since their publication, these principles have been used as a guide for evaluating the quality of university education, a philosophy of engagement, cooperation, learning community, interaction, quality, and efficiency [61], and are a rubric to assess policies and overall effectiveness [60]. The use of digital technologies in higher education can be assessed in light of the Seven Principles of Good Practice in Undergraduate Education to develop new and/or modify existing pedagogical framework of parasitology teaching and learning. The Seven Principles of Good Practice in Undergraduate Education are listed below:

- (i) Good practice encourages student–faculty contact (increases connectivity to faculty members, helps them to share useful resources, provides for joint problem solving and shared learning, encourages interactions with shy students).
- (ii) Good practice encourages cooperation among students.
- (iii) Good practice encourages active learning.
- (iv) Good practice gives prompt feedback.
- (v) Good practice emphasises time on task.
- (vi) Good practice communicates high expectations.
- (vii) Good practice respects diverse talents and ways of learning.

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