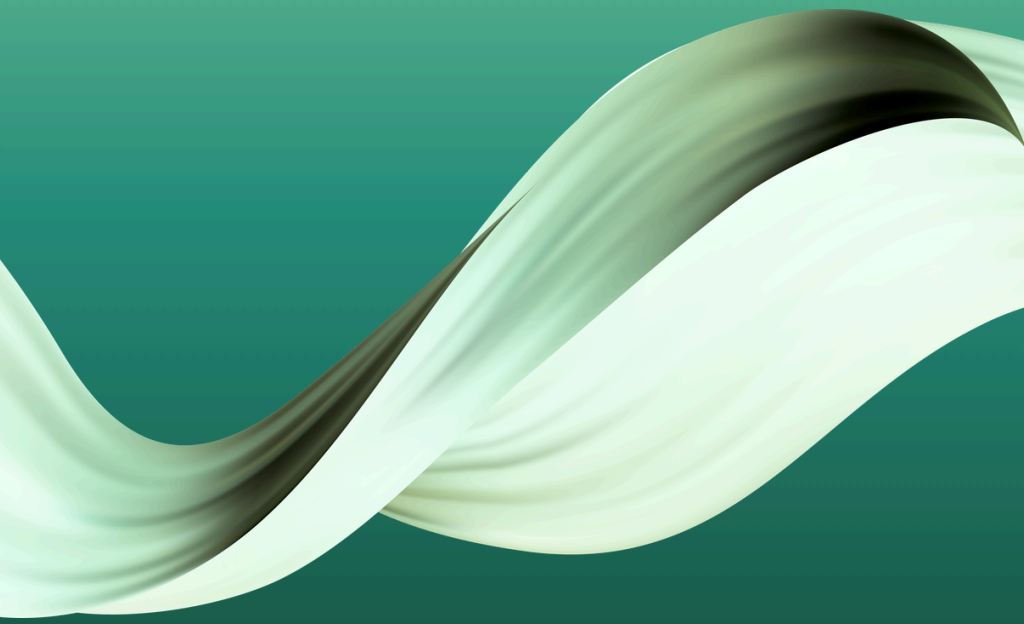
ALGORITHMIC HEARTBEATS

Affective Education in the Age of the Fourth Revolution



Edited by

FRANCESCO PELUSO CASSESE

PRESS

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Beyond Pharmacological Enhancement: Digital Technologies and Motor Didactics as Ethical Vectors for Doping Prevention

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The persistent challenge of pharmacological enhancement in sport demands a pedagogical shift from a predominantly reactive anti-doping model, centred on biological testing, surveillance, and sanctions, towards a more proactive educational model capable of addressing the motivational, cultural, and psycho-behavioural roots of doping behaviour. Although medical screening and regulatory deterrence remain indispensable for protecting athlete health and competitive fairness, they most often intervene only after risk-taking attitudes, distorted performance beliefs, and normalisation of pharmacological shortcuts have already taken root. Within the framework of motor learning and motor didactics, doping can therefore be interpreted not only as a violation of rules, but also as an educational failure: a breakdown in the athlete's capacity to understand performance as a long-term, embodied, and ethically situated process that extends beyond the mere athletic performance.

This conceptual study examines how digital technologies and motor didactics may be integrated as ethical vectors for doping prevention. Building on values-based anti-doping education and research on the spread of performance-enhancing drug use among young athletes [1,2], the paper argues that doping prevention should not be limited to communicating risks or enacting prohibitions. Instead, educational interventions should help athletes develop critical awareness of training processes, recovery, fatigue, adaptation, and the meaning of performance itself. In this perspective, emerging tools such as wearable sensors, biofeedback systems, inertial measurement units, and data-driven video analysis can be used not merely to optimise performance, but to make the dimensions of motor learning more visible and teachable.

When integrated into pedagogically grounded coaching practice, digital technologies can provide real-time or near-real-time feedback on movement quality, neuromotor adaptation, asymmetry, load management, recovery, and biomechanical efficiency [3]. These data may function as mediators between the coach, the athlete, and the motor task, fostering reflection and awareness rather than sterile measurement. For example, feedback on gait, posture, coordination, or fatigue can help athletes recognise that performance improvement is the result of progressive adaptation, learning, and self-regulation, rather than of immediate enhancement. Additionally, it offers an objective means to assess injury risk and therefore also acts as an preventive tool against overuse/misuse injuries. In this way, the didactic use of technology can redirect attention from the obsession with the result, which may foster vulnerability to pharmacological shortcuts, toward mastery of the movement process, health literacy, and responsible decision-making.

The proposed approach is particularly relevant in youth and developmental sport contexts, where athletes are still constructing their values and body image, and developing their personal concept of success. Digital feedback, if used ethically and pedagogically, may strengthen autonomy by allowing athletes to participate actively in interpreting their own data, setting realistic goals, and understanding the consequences of overload, inadequate recovery, or pharmacological enhancement. At the same time, the study emphasises that technology is not inherently ethical. Without appropriate educational framing, digital tools may reinforce performance pressure, surveillance, comparison, and reductionist views of the body as a set of metrics to be maximised. Therefore, the central issue is not simply the

adoption of technology, but the development of digital-ethical competencies among coaches, kinesiologists, physical educators, and sport organisations.
Accordingly, this paper proposes a model of technology-supported anti-doping education based on four interconnected principles: process-centred motor learning, embodied self-awareness, critical interpretation of performance data, and ethical responsibility. Within this model, the coach or educator does not use digital technologies solely to identify deficits or accelerate performance, but to create meaningful learning situations in which athletes can understand their bodies, respect physiological limits, and recognise the risks of pharmacological enhancement for health, personal identity, and sporting integrity. Such an approach may complement traditional anti-doping systems by acting earlier in the prevention pathway, before doping intentions consolidate into behaviour.
In conclusion, integrating digital technologies with motor didactics and ethical physical education may offer a scalable, preventive, and athlete-centred contribution to the fight against doping. By transforming data into reflective learning, and performance monitoring into self-awareness, sport education can help preserve the integrity of competition while protecting the health and dignity of athletes. Future research should develop and evaluate structured educational protocols that combine digital feedback with values-based anti-doping curricula, particularly in youth, elite-development, and coach-training settings.

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