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AntiDop: Training Missions on Nutritional Supplements for Athletes Support Personnel to Support Anti-Doping

D2.3. Teaching Strategies & Tools for AntiDop

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Contributors	Vassilis Barkoukis (AUTH) Sousana Papadopoulou (IHU) Anne-Marie Elbe (LU) Ladislav Petrovic (SCE)
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Abbreviations

ADEL	Anti-Doping Education and Learning of World Antidoping Agency
ASP	Athlete Support Personnel
GBL	Game-based Learning
ICT	Information and Communication Technologies
IOC	International Olympic Committee
KPI	Key-Performance Indicator
MOOC	Massive Open Online Courses
OVEP	Olympic Values Education Programme
PEDs	Performance-Enhancing Drugs
PBL	Problem-based Learning
PjBL	Project-Based Learning
SCT	Social Cognitive Theory
SDT	Self-Determination Theory
STEM	Science-Technology-Engineering-Mathematics
TPB	Theory of Planned Behavior
WADA	World Anti-doping Agency
WADC	World Anti-doping Code
UKAD	UK Anti-Doping

Executive Summary

This deliverable outlines a comprehensive framework of teaching strategies, instructional design approaches, and technological tools to support the development of educational materials to be used during the training missions. These materials will be merged into the eLearning/mLearning platform to deliver training for Athlete Support Personnel (ASP). Apart from traditional educational material the contents will be enhanced with gaming elements and media in order to deliver modern, targeted and visually appealing training content, according to the project's mission.

The report begins with an analysis of current trends in teaching and learning, emphasizing the need for an instructional framework tailored to AntiDop's context. Learner needs and objectives are examined in relation to the specific professional, cultural, and regulatory environment in which ASP operate. The results of D2.1 and D2.2 will be used in D2.3 to highlight the importance of flexible, learner-centered methods that combine evidence-based pedagogy with practical, real-world applicability.

Building on this foundation, the deliverable reviews instructional design trends such as Bloom's taxonomy-based objectives, microteaching, gamification, STEM approaches, problem-based and collaborative learning, and media-enhanced resources. It also integrates lessons learned from other initiatives and stresses strategies to address the diversity of ASP backgrounds. Proposed teaching strategies aim to maximize engagement and knowledge retention, supported by clearly defined KPIs and assessment mechanisms to monitor impact.

The methodological approach for AntiDop is mapped through the transition from scientific models to practical learning pathways, taking into account ASP personas and special athlete needs. Learner engagement strategies and feedback mechanisms are embedded to ensure continuous refinement and relevance of the training.

A dedicated section evaluates software solutions for educational content development, including MOOCs, open-source and Creative Commons-based platforms, and third-party examples. These tools are benchmarked against modern requirements such as scalability, adaptability, accessibility, and interactivity, ensuring that AntiDop can adopt sustainable and cost-effective solutions for both eLearning and mLearning environments.

The report concludes with a synthesis of findings and preparation guidelines for upcoming training missions. Central to the recommendations is the integration of innovative teaching methods, evidence-based design, and robust technological solutions that collectively empower ASP to act as informed, ethical, and effective agents of doping prevention.

In summary, this deliverable works closely with the other WP2 deliverables to provide both a theoretical and practical roadmap for teaching strategies and tools in the AntiDop project, ensuring that the training is scientifically grounded, learner-centered, technologically enabled, and adaptable to the diverse needs of the European athlete support community.

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1. Current trends in teaching strategies

1.1. The need to define an instructional framework for AntiDop

In recent years, the fight against doping in sport and education has gained increasing attention, not only through the implementation of regulatory provisions, but also through preventive educational approaches. While numerous anti-doping programs have been implemented at different educational levels and in different sporting contexts, most initiatives are of an informative nature rather than a pedagogical basis for the education of athletes and their coaches. This reveals a critical gap: the lack of a clearly defined didactic framework to guide the planning, implementation and evaluation of educational interventions related to anti-doping awareness and prevention (Backhouse et al., 2016; WADA, 2021).

The urgency of creating a systematic educational framework for AntiDop stems from the realization that awareness campaigns and sporadic workshops - however well-intentioned - fail to create sustainable changes in the attitudes and behaviors of trainees. Because of this lack, educational efforts often rely on some non-directional dissemination of new information on the topic, such as an organization's lectures or promotional videos and brochures, with limited engagement, reflection or contextualization (Mazanov & Huybers, 2010).

These methods may show a temporary increase in individuals' awareness, but rarely promote deeper understanding, critical thinking or awareness of personal responsibility for both athletes and their circle (coaches and family environment). The risk, therefore, is that learners become passive recipients of anti-doping content knowledge, but not active participants in a meaningful process aimed at making ethical decisions (Pappa & Kennedy, 2012).

Moving from a communication-based approach to a learning-based approach, one that embraces instructional design principles and aligns content with clearly stated learning outcomes, pertinent teaching methods, and the larger learning context, is necessary to overcome these limitations (Biggs & Tang, 2011). By allowing for pedagogical coherence and internal consistency, such a framework enables the creation and assessment of AntiDop instruction with the necessary rigor and academic standards.

The incorporation of evidence-based learning theories and models that are particularly well-suited for anti-doping education is also made possible by the design of an instructional framework. For example, learning experiences may be made interesting and personally relevant by using motivational models like Keller's ARCS (Attention, Relevance, Confidence, Satisfaction) (2010). In situations where moral quandaries and behavior modification are crucial, experiential learning theories, like Kolb's cycle of learning through experience, reflection, conceptualization, and application, are especially helpful (Kolb, 1984). Similarly, transformative learning theory can be used as a basis for promoting critical reflection on identity, values, and social norms (Illeris, 2014), while constructivist approaches can direct the creation of digital learning environments that promote collaboration and self-directed inquiry (Laurillard, 2012; Qureshi et al., 2023), while transformative learning theory can serve as a foundation for facilitating critical reflection on identity, values, and social norms (Illeris, 2014).

Moreover, by adopting a stable educational framework, teachers and the designers of this application are better equipped to choose the appropriate tools and technologies that are aligned with the pedagogical objectives. The use of digital storytelling, simulation-based learning, serious games, and virtual or augmented reality can significantly enhance the learning experience, but only if these tools are used within a coherent design structure (Huang et al., 2021; Liu et al., 2022). Without an underlying

framework, technology risks becoming a gimmick rather than a facilitator for meaningful anti-doping learning.

Equally important is the alignment of any educational intervention with the broader anti-doping recommendations issued by international organisations and responsible bodies. Documents such as the WADA International Standard for Education (ISE) and the UNESCO International Convention against Doping in Sport (UNESCO, 2005) should be made known throughout the athlete community, and they should continue their athletic journey in the light of these recommendations and guidelines.

Overall, defining an educational framework for AntiDop is not just a theoretical exercise; it is a practical necessity. It ensures that anti-doping education goes beyond awareness-raising and becomes a transformative, learning-centered process that empowers individuals to make informed and ethical decisions.

1.2. Overview of the learner's needs, learning objectives & learning context of AntiDop

Designing successful anti-doping teaching programs requires that one first understands the requirements of the learners. These demands are multifaceted, including emotive, behavioral, and environmental elements in addition to the cognitive dimension (such as knowledge gaps about drugs, norms, and procedures). There are differences in motivation, prior knowledge, digital literacy, and ethical growth among learners, whether they are coaches, young athletes, or general education students (Woolf, 2020). AntiDop initiatives must consider these differences and address the unique needs of each target group in order to have an effect.

Meaningful involvement is one of the most important requirements. According to studies, conventional, didactic methods of anti-doping instruction that only include imparting knowledge of rules and facts are ineffective at changing behavior over time (Bingham et al., 2025).

Learners need opportunities to engage in authentic learning experiences, where they can explore ethical dilemmas, reflect on personal values, and simulate decision-making under pressure. Virtual reality and immersive media have been found to offer promising environments in this regard, creating experiential contexts that foster emotional connection and critical thinking (Liu et al., 2022; Pouliou et al., 2023).

Autonomy in the learning process is another essential demand for learners. Instead of allowing students to passively absorb static information, anti-doping education should empower them to choose their own pathways, engage with the subject in a dynamic way, and make decisions that have consequences. The importance of interactive digital platforms in facilitating learner-centered methods is becoming more widely acknowledged.

Furthermore, content contextualization and relevancy are crucial. Learners, especially on the athlete side, should be able to see how anti-doping principles relate to their daily environment, personal goals and professional ambitions. When education fails to connect with the learner's context, whether that context is competitive sport or sporting culture, the message may not be strongly conveyed to the individuals receiving the education. Therefore, the educational content needs to be adapted both linguistically and culturally, reflecting the learners' lived experiences and their daily lives.

From a pedagogical point of view, learners also require clear and achievable learning objectives, and through the program they follow they also acquire new developed competences and not only knowledge. Anti-doping education should not only teach which substances are prohibited, but also cultivate moral reasoning, self-regulation and resistance to social influence. This requires a competency-based approach

that is grounded in measurable learning outcomes (Blank & Petróczi, 2023). To concretize the alignment between these diverse learner needs and appropriate instructional strategies, the following table (see Table 1) summarizes the key categories of learner needs and their corresponding pedagogical responses:

Table 1: Category of learner's needs and the pedagogical strategies

Category of Need	Specific Learner Need	Instructional Strategy / Pedagogical Response
Cognitive	Understanding substances, processes, and regulations	Use of interactive content with embedded quizzes, simulations of regulatory procedures, and feedback-driven decision-making scenarios
Affective	Development of ethical awareness and empathy	Narrative-based learning with emotionally charged scenarios in VR, avatar-based interactions, and storytelling from real or fictional athletes facing dilemmas
Behavioural	Practicing resistance to pressure and promoting responsible decision-making	Serious games with branching choices and consequences, role-playing modules, and "What would you do?" simulations with multimodal feedback
Social and Cultural	Connection to real-world environments and athletic cultural norms	Cultural adaptation of content, collaborative activities (peer interaction), and integration of athlete communities or sports institutions into learning experiences
Learner Autonomy	Enabling active participation and control over the learning journey	Non-linear navigation, branching narratives, and personalized learning pathways based on learner choices
Contextual / Institutional	Access, support, and perceived relevance within real-life educational or athletic settings	Blended learning models combining digital and in-person formats, instructor-supported activities, and leveraging existing school or club infrastructures to enhance relevance and support

Finally, the broader learning context, including institutional support, access to technology, teacher training and social support, significantly influences the effectiveness of anti-doping education. As a result, the AntiDop experience has to accommodate learner-driven inquiry and group collaboration while also being sensitive to limitations like time, infrastructure, and digital literacy (Liu et al., 2022).

By tackling these interrelated components, needs, aims, and context, AntiDop positions itself as a transformational learning environment that enables students to make morally sound decisions and support an integrity-based culture in sports, rather than just as an educational instrument.

1.3. Innovative teaching & learning methods

In contemporary educational environments, traditional lecture-based models are increasingly being replaced by learner-centered and technology-enhanced strategies. The shift reflects a broader understanding of how learning occurs in digital, fast-paced, and socially interconnected contexts. Particularly in digital education, current trends emphasize flexibility, personalization, and learner agency, as well as active knowledge construction over passive reception (Wang et al., 2021). These trends are not only a response to technological advancements but also to the growing diversity of learners' needs, backgrounds, and learning styles.

1.3.1. Flipped Classroom

The flipped classroom model represents a significant shift from traditional instructional methods by reversing the sequence of content delivery and practice (Bishop & Verleger, 2013). In a typical flipped approach, students engage with instructional materials, such as videos, readings, or micro-lectures, prior to class, and then use classroom time for interactive, hands-on activities that reinforce and deepen their understanding. This strategy not only increases time for active learning but also provides opportunities for personalized feedback and collaborative learning experiences (see Figure 1).

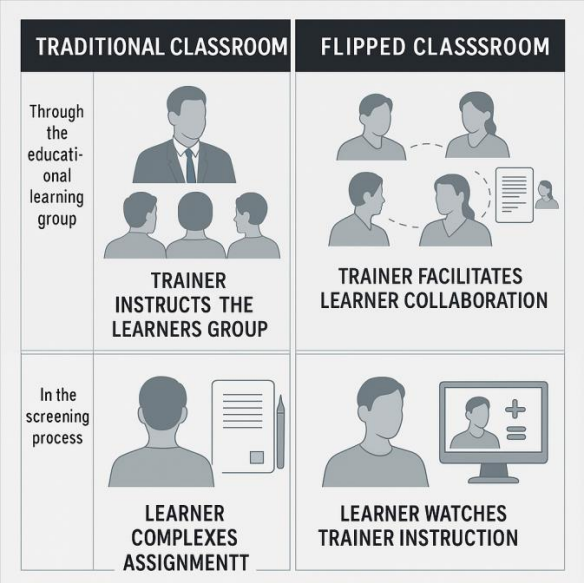

Figure 1: How is flipped classroom used, graph based on Tyne Brack's article entitled "The flipped classroom and hybrid learning" (2020).

Recent studies highlight the effectiveness of flipped classrooms in fostering learner engagement, especially in digital and hybrid educational contexts (Chen et al., 2022). For instance, research has shown that use of flipped classroom holds promise for students' success and satisfaction (Arslan, 2020). Moreover, students exposed to flipped models demonstrated improved critical thinking skills, greater motivation, and deeper content comprehension compared to traditional lecture-based instruction (Awidi & Paynter, 2019). Additionally, the flipped classroom aligns with constructivist theories of learning, which emphasize the importance of active knowledge construction and learner autonomy. By promoting peer-to-peer interactions and instructor facilitation during class time, it creates a dynamic and socially enriched learning environment. In the context of digital education, flipped classrooms benefit from learning

management systems (LMS), embedded quizzes, and interactive multimedia tools that make content more engaging and trackable.

1.3.2. Game-based learning

Game-based learning (GBL) and gamification strategies harness the motivational power of games to create engaging, interactive learning experiences. While GBL integrates actual games designed with educational objectives, gamification involves the application of game elements, such as points, badges, leaderboards, and narratives, in non-game educational contexts. Both approaches aim to foster learner motivation, autonomy, and sustained engagement.

The technique of adding (motivational) affordances to services to create game-like experiences and encourage behavioral results is known as gamification. This perspective, building on Al-Azawi et al. (2016) suggests that there are three key components to gamification:

1) Incentives put in place, through activity

2) The psychological effects that follow

3) The additional behavioral results (see Fig. 2)

Game-based learning involves instruction with realistic game experiences (Cicchino, 2013). Recent research underscores the benefits of GBL and gamification in enhancing cognitive, emotional, and behavioral aspects of learning. Similarly, Mao et al. (2022) found that game-based approaches not only improved students' conceptual understanding but also fostered their self-regulated learning skills and collaborative behaviors.

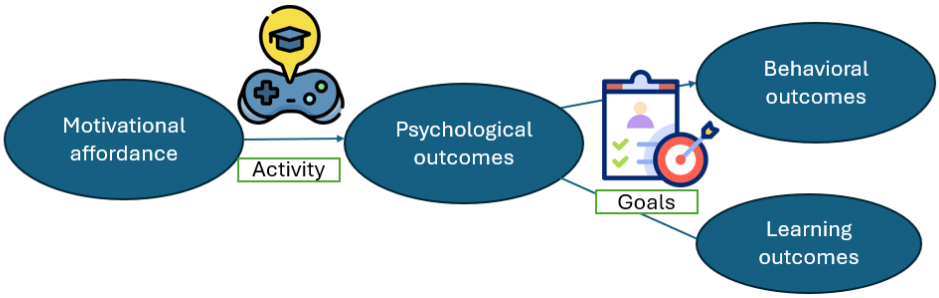

Figure 2: Gamification steps as an extended graph of Al-Azawi et al. (2016)

Importantly, these strategies align with principles of experiential learning and self-determination theory, as they often involve elements of challenge, feedback, autonomy, and competence. In digital education contexts, gamified platforms provide immediate feedback, support repetition, and offer goal-oriented pathways that help learners remain focused and motivated.

In the context of AntiDop, GBL elements can offer unique opportunities to simulate realistic scenarios, dilemmas, and decision-making under conversation. Such immersive and interactive contexts, like in GAME[1] project (Barkoukis et al., 2019), allow learners to practice ethical reasoning and witness the consequences of their choices. Thus, GBL and gamification serve as powerful tools for attitude change, value formation, and knowledge consolidation.

[1] https://projectgame.phed.auth.gr

1.3.3. Problem-based learning (PBL)

Problem-based learning (PBL) is a student-centered instructional approach that organizes learning around complex, real-world problems. In this method, students collaboratively investigate scenarios, identify knowledge gaps, and seek solutions through inquiry and reflection. PBL has certain advantages such as critical thinking, interdisciplinary learning, and the ability to transfer knowledge across contexts.

Recent studies affirm the relevance of PBL in both traditional and digital educational environments. For instance, Yew and Goh (2016) reported that PBL improved learners' problem-solving abilities, communication skills, and intrinsic motivation, especially in higher education settings. Similarly, based on the research findings (Maulisa et al., 2024), it can be concluded that the development of a problem-based learning teaching module based on blended learning is suitable for implementation within the framework of the independent curriculum.

PBL aligns with constructivist and socio-cultural learning theories, encouraging collaboration, learner autonomy, and contextualized knowledge application. It is especially effective in domains where ethical decision-making, negotiation, and critical judgment are crucial, such as in the context of AntiDop education. Through carefully designed problem scenarios, learners are exposed to moral dilemmas, institutional frameworks, and stakeholder perspectives that reflect real-world challenges in sports ethics and doping prevention.

Digital tools such as collaborative platforms, interactive cases, and simulation-based environments further enhance the implementation of PBL in online or blended learning settings. They allow learners to conduct research, engage in dialogue, and co-construct solutions in a distributed learning environment.

1.3.4. Project-based learning

Project-based learning (PjBL) is an instructional methodology that encourages students to learn and apply knowledge through extended inquiry and the creation of meaningful products. Unlike problem-based learning, which centers around problem-solving, PjBL emphasizes long-term engagement with open-ended tasks that often culminate in the presentation of a final deliverable. This process not only enhances content understanding, but also cultivates soft skills (e.g. collaboration, time management).

Recent research highlights the value of PjBL in both face-to-face and digital settings. Crawford et al. (2024) showed that the group-based project was a useful instrument for undergraduate education. Moreover, Song et al. (2024) state that PjBL, with the help of collaborative learning, shows significant potential and has a positive impact on the development of new knowledge for students. PjBL is well-aligned with the principles of authentic learning and experiential pedagogy. It allows learners to engage with real-world issues that are socially relevant and personally meaningful.

In contexts such as AntiDop, projects might include designing awareness campaigns, analyzing case studies of doping scandals, or developing VR-based scenarios that promote ethical decision-making in sports. These applications not only contextualize knowledge but also foster a deeper sense of responsibility and ethical reasoning. Technology further expands the potential of PjBL by enabling multimodal representations, remote collaboration, and real-time feedback.

1.3.5. Personalized learning

Personalized Learning (PL) refers to instructional strategies that tailor learning experiences to individual students' needs, preferences, prior knowledge, and pace. At its core, PL seeks to empower

learners by providing differentiated pathways, adaptive content, and learner autonomy. Advances in educational technologies have made PL more feasible, especially in online and hybrid environments.

Studies indicate that PL enhances student motivation, learning outcomes, and metacognitive awareness. According to Pane et al. (2015), technology-enabled personalization in K–12 settings led to significant gains in mathematics and reading comprehension.

PL is particularly important in ethically sensitive and multidisciplinary domains like AntiDop, where learners may come from varied educational backgrounds and possess differing levels of familiarity with topics like pharmacology, biochemistry, ethics, and sports law. Personalized pathways allow learners to progress through content according to their readiness, revisit challenging concepts, and focus on areas most relevant to their roles (e.g., athlete, coach, policymaker).

Technology plays a key role in implementing PL through features like diagnostic assessments, real-time analytics, content recommendation engines, and learner dashboards. These tools support formative feedback loops and adaptive scaffolding, ensuring that instruction remains both efficient and learner-centered.

1.3.6. Immersive learning (XR-based learning)

A growing trend in educational innovation is the integration of immersive technologies, such as virtual reality (VR), augmented reality (AR), and mixed reality (MR), into learning environments. Immersive Learning (IL) enables learners to experience simulated environments where they can explore, manipulate, and interact with complex scenarios in real time, fostering experiential and embodied learning.

Recent evidence underscores the effectiveness ofImmersive Learning IL in enhancing engagement, knowledge retention, and affective outcomes. Liu et al. (2022) demonstrated that VR-based learning environments increased motivation and presence, particularly when combined with instructional scaffolds. In the context of ethical training and AntiDop education, Pouliou et al. (2023) showed that VR scenarios helped young athletes better understand the emotional and social consequences of doping, leading to increased empathy and ethical awareness.

Immersive learning aligns with situated learning theory, emphasizing context-rich and emotionally salient learning experiences. These environments provide safe spaces for learners to confront dilemmas, fail, reflect, and try again, essential components for developing moral reasoning and behavioral competence.

Platforms such as EngageVR, Merge EDU and Unity-based simulations are used to design learning environments that are not only realistic but also adaptable to specific learning objectives. However, in the case of AntiDop, this approach may not be used, since using XR would increase the requirements and costs in both the implementation and maintenance of the training material.

1.3.7. Blended learning

Blended learning (BL) integrates face-to-face instruction with online learning activities, aiming to harness the benefits of both modalities. It provides flexibility in content delivery while maintaining human interaction and immediate feedback. BL models vary in structure but generally involve online pre-work, in-person collaboration, and post-lesson reflection facilitated through digital tools.

Evidence from recent research supports the effectiveness of BL in enhancing learning outcomes, student satisfaction, and cognitive engagement. According to Cao (2023), students in blended courses can

improve in performance, attitude, achievement, and particularly in developing higher-order thinking skills.

In contexts like AntiDop education, BL provides a practical solution for reaching geographically dispersed audiences, such as athletes, coaches, and stakeholders, while ensuring that sensitive discussions and ethical inquiries occur in interactive, moderated spaces. Online modules can introduce foundational knowledge, while in-person or synchronous discussions allow for case study analysis, peer reflection, and collaborative problem-solving.

Key elements for successful BL include alignment between online and offline components, learner support mechanisms, and the strategic use of technology for content delivery, communication, and assessment. Tools like Moodle, Microsoft Teams, and Canvas support blended workflows by integrating asynchronous content, synchronous sessions, and feedback loops.

Ultimately, the relevance of these trends lies in their capacity to foster autonomy, critical thinking, and transferable skills, preparing learners to not just recall content, but to navigate uncertainty, solve real-world problems, and collaborate across digital platforms (Tang et al., 2023). In this sense, teaching strategies today are not simply tools for transmission, but mechanisms for empowerment, equity, and lifelong learning.

2. Instructional design trends & teaching strategies

The use of prohibited substances and methods in sports, widely referred to as doping, constitutes a persistent challenge to the integrity of sporting events, the well-being of athletes, and the established principles of fair competition. However, it is not only a sporting phenomenon but also a serious social phenomenon, as the administration of these substances can also occur online without medical supervision. In the context of addressing this phenomenon, education campaigns emerge as a fundamental pillar. The primary goal of these initiatives is to foster increased awareness among athletes, coaches, and their support environment regarding the inherent risks and the multifaceted consequences of doping. Simultaneously, the aim is to cultivate a sporting culture grounded in ethical integrity and respect for the regulatory framework. Educational interventions aim to empower stakeholders by providing them with the necessary tools to make informed decisions and effectively resist pressure to adopt prohibited practices. In this way, they contribute to the creation of a sporting environment characterized by greater fairness and promoting the health of athletes (Shionoya et al., 2011).

Effective anti-doping education, awareness, and information are multifaceted. A primary goal is rooted in deepening the understanding of the multidimensional impacts of the phenomenon of doping, focusing on its ethical, health-related, and legal dimensions. Simultaneously, the aim is to empower athletes and their support system, promoting the ability to make informed decisions that align with the principles of ethical integrity. Similar projects carried out periodically mainly suggest the use of images and videos as more effective. The research study "Concept design to develop the e-learning contents for effective anti-doping education using Kansei parameters" (Shionoya et al., 2011) focused on investigating the effectiveness of various forms of visual material in the context of eLearning regarding the prevention of doping. More specifically, an experimental procedure was conducted with the participation of trainees, during which electronic educational content, including slides and visualizations (images and videos) of varying emotional charge, was presented. During the participants' exposure to the aforementioned material, systematic recording of physiological parameters was carried out, including electrocardiogram (ECG), breathing cycle length (BCL), skin potential reflex (SPR), and salivary amylase levels. The collection of this data aimed at the objective evaluation of the participants' level of attention and physiological responses. The subsequent analysis of the correlations between the visual stimuli and the recorded physiological reactions had the ultimate goal of drawing evidence-based conclusions regarding the best practices for designing effective electronic educational material for the prevention of doping in sports (Shionoya et al., 2011).

A further effort to inform and raise awareness about doping is the intervention named ALPHA. This specific intervention consisted of an interactive e-learning seminar. The primary goals of the intervention included awareness-raising regarding the issue of doping, the provision of evidence-based information regarding anti-doping regulations and related consequences, the promotion of values-based education, and specialized anti-doping education.

The analysis of the findings of ALPHA indicates a complex picture regarding the effectiveness of the educational intervention (ALPHA seminar). Specifically, the intervention demonstrated a statistically significant positive effect on increasing the participant's level of knowledge on doping issues and causing significant changes in their explicit and implicit attitudes towards doping, with a clear trend towards the adoption of more negative or rejecting approaches.

However, a critical result of the study was the finding of no statistically significant effect of the educational intervention on the self-reported likelihood of participants to engage in doping practices,

regardless of the hypothetical analysis framework (benefit or cost). Overall, the research team concluded that the ALPHA seminar is a valid tool for disseminating information and raising awareness about the issue of doping. Nevertheless, the findings highlight its limited effectiveness in substantially establishing the values of clean sport and in preventing decisions to use prohibited substances in the examined sample of Chinese sub-elite athletes. Consequently, the study underscores the urgent need for further research investigation and improvement of anti-doping education programs, with particular emphasis on their adaptation to the respective cultural contexts and the integration of strategies aimed at modifying behavior and establishing strong ethical values (Deng et al., 2022).

Another interesting intervention is, in brief, the iPlayClean intervention. The iPlayClean intervention is an anti-doping education program delivered to adolescent athletes through three modes: face-to-face presentation, online, and a combination of the two. Its aim was to reduce favorable attitudes towards doping and vulnerability to it (Nicholls et al., 2020).

In the following sections, some of the most important instructional design trends will be presented as ideas to influence AntiDop educational design in WP3. Moreover, some literature evidence on the effectiveness of existing initiatives for anti-doping education will be presented to conclude -at the end- the most successful approaches. Not all design trends have been used and evaluated in AntiDoping education since it is a very targeted educational sector, but a creative combination of widely accepted educational design trends and findings from the learning evaluation of existing initiatives will guide us on making final decisions.

2.1. Bloom's taxonomy as a starting point for SMART educational goals

Bloom's taxonomy (initially formulated by Benjamin Bloom and his colleagues and later revised by Anderson and Krathwohl) hierarchically structures learning objectives into distinct levels of cognitive complexity (Krathwohl, 2002). The architecture of the pyramid focuses on promoting higher-order cognitive functions, crucial for deepening learning and the subsequent transfer of knowledge to various work and conceptual environments (Adams, 2015).

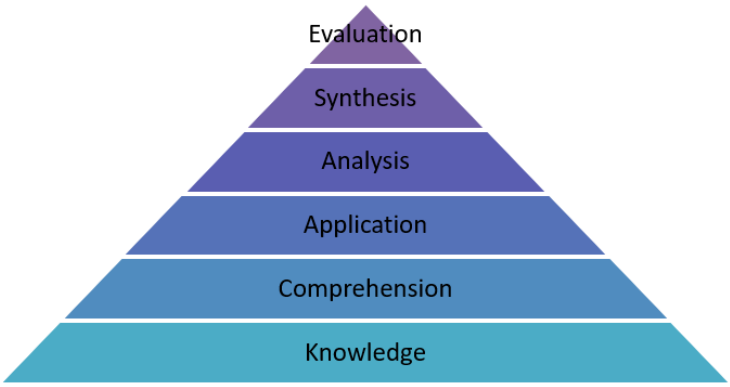

Figure 3. Bloom's pyramid for categorizing educational goals

In Bloom's Taxonomy (Figure 3), knowledge is situated at the bottom of the pyramid and focuses on the necessary foundation through the memorization of data, definitions, and procedures. However, the mere possession of information does not constitute sufficient evidence of meaningful learning.

Comprehension goes a step further, requiring the learner to interpret information, rephrase it in their own words, and identify connections between different concepts. The ability to compare and contrast signifies a deeper level of information processing.

Application is a critical stage, as it allows the transfer of theoretical knowledge to real or simulated situations. Successful application demonstrates the learner's ability to use their knowledge and skills in a functional way.

Analysis introduces the critical dimension to the cognitive process. Learners are asked to break down complex issues into their component parts, recognize the relationships between them, and distinguish objective data from subjective opinions. The recognition of logical fallacies and the evaluation of the structure of an argument are indicative activities at this level.

Synthesis represents a creative cognitive function. Learners are asked to combine different elements of knowledge and skills to create a new product, an original solution to a problem, or an innovative idea. The ability to organize and synthesize information is key to the production of new knowledge.

Finally, evaluation, as the highest level, requires learners to form judgments about the value, validity, or significance of information, ideas, or procedures. Supporting judgments with clear criteria and reasoned argumentation is a characteristic of mature critical thinking (Adams, 2015).

Bloom's taxonomy is vital in educational design because it ensures clarity, alignment, progression, and balance between lower- and higher-order cognitive skills, ultimately leading to deeper learning and better preparation for real-life challenges. Modern instructional design initiatives combine more than one educational goals, preferably on a combination of low-level cognitive domain (like basic recall) and higher-order thinking (like synthesis or evaluation). AntiDop approach will make explicit references to the Bloom taxonomy throughout the design process and especially in educational objectives. Today, the use of Bloom's Taxonomy is considered essential for formulating learning objectives, as it provides a structured and measurable framework that aligns teaching activities and assessment with clearly defined levels of cognitive success (Ogbeide et al. 2025; Ramirez, 2017). Especially in AntiDop, we will follow the SMART (Specific, Measurable, Achievable, Relevant, and Time-bound) framework for effective learning goals definition (Chatterjee & Corral, 2017).

2.2. Current instructional design trends

Apart from a clear and effective way to define learning goals, our route from theory to practice involves the application of modern approaches in educational content design. In the following paragraphs, an outline of the most modern educational approaches will be presented.

Solutions for low-level cognitive domains can be efferently by executed using **Microteaching**. According to this approach, an instructor or a learning system delivers short, focused lessons (no more than 5 to 10 minutes) to a peers or students, followed by feedback and reflection. A very good example of microteaching is the educational application Duolingo[2], which helps in learning foreign languages in a gamified way. The structure of the lessons is characterized by short, focused and highly interactive units. This approach allows learners to focus on distinct language skills or specific lexical categories, facilitating the processing and assimilation of manageable amounts of information in each teaching interaction. Feedback and gamification are provided in combination. Another application based on the microteaching

[2] https://www.duolingo.com

trend is the chemistry application Periodic Table by the Royal Society of Chemistry: An interactive application with detailed information for each element[3]. It contains videos, podcasts, visualizations with images of elements in their natural state, and a large interactive table with detailed information for each chemical element.

The design trend in teaching is to enrich it with **interactive multimedia** material (i.e. game-like elements). The paper "El Greco's Travels and Artwork: A 3D Serious Game for Cultural Heritage Education" deals with the design and development of a three-dimensional digital serious game, focused on understanding the biography and artistic work of Doménikos Theotokópoulos or El Greco (Drosos et al., 2017). Founded on the constructivist learning principles of Piaget and Vygotsky, the project highlights the ever-increasing importance of technology-supported learning, especially through serious games, in the educational process, with an emphasis on historical and cultural education.

The developed game creates an immersive virtual environment where students, through a bonus-malus mechanism and an experiential approach, gain the ability to virtually navigate El Greco's artworks. Particular emphasis is placed on the attractiveness of the graphic user interface (GUI) and the optimization of the user experience (UX), aiming to achieve quality levels comparable to entertainment digital games, with which modern youth are familiar.

The pilot implementation of the game in a student population showed positive results in terms of learning impact and the enhancement of intrinsic learning motivation. Additionally, the paper provides a theoretical foundation, analyzing the conceptual distinctions between educational and serious games, their structural characteristics, and their potential applications in the cultural sector, highlighting their prospect for upgrading the learning process and attracting young people to cultural heritage (Drosos et al., 2017).

Undoubtedly, the integration of gamification and multimedia into the educational process emerges as a field with remarkable prospects for the transformative upgrading of the learning experience. The utilization of reward mechanisms, challenge, and the reinforcement of the sense of progress, characteristic features of gamification, brings about a dynamic revival of student interest, catalyzing the deepening of their conceptual understanding.

At the same time, the strategic use of multimedia, which extends from interactive audiovisual materials and virtual tours to simulations and digital games, provides a wide range of rich and multisensory learning opportunities. These opportunities allow for a more effective response to the diverse learning preferences and styles of learners.

Problem-based learning (PBL), which is internationally recognized and already described further up, constitutes an innovative teaching method, designers need to adopt a student-centered pedagogical strategy that overturns the foundations of conventional teaching methodology. Instead of the primary presentation of theoretical frameworks and abstract concepts in traditional educational design, PBL approaches need to focus on authentic and multidimensional problems rooted in reality. Thus, designers need to study well the previous knowledge and attitudes of the students and propose learning scenarios that fit well on their everyday life. It is not uncommon that learners have a misunderstanding on a key-concept, or gaps in their knowledge. Educational designers take advantage of these gaps in order to present to learners a new kind of problem that cannot be resolved with existing knowledge. In other

[3] https://periodic-table.rsc.org/video/25/manganese?videoid=rHjkOf5eUTw

words, PBL is a way to create a 'cognitive conflict' on learners which then have to take an active and decisive role in the initial identification and definition of the problem, the systematic investigation of the necessary knowledge areas, the search and evaluation of various potential solutions, and the final presentation of their conclusions and proposed actions. Ultimately, the problem emerges as the core of the learning process, acting as a powerful stimulus that motivates students to independently seek information and deeply understand the examined topic as they strive to develop a well-supported and applicable solution. From an educational design point-of-view, the role of the educator in PBL undergoes a fundamental transformation, moving away from the role of the traditional lecturer and assuming the role of facilitator and supporter of the learning journey. What we expect from a PBL design approach is the cultivation of critical thinking, the development of effective problem-solving skills, the enhancement of collaboration and communication among students, as well as the development of self-directed learning skills, making it an extremely effective approach for preparing future professionals for the demands of a constantly changing and complex environment (Barrows, 1996).

Collaborative learning (CL) emerges as another innovative approach, in which the educational design gives to both facilitators and learners an active role in the educational process. In this context, the traditional hierarchical structure between teachers and students is abolished, initiating a spirit of community. The knowledge has to be produced not as a product of simple transfer (like in a traditional educational design), but as a result of collective construction.

CL is founded on principles of experiential and student-centered learning, influenced by the distinguished theories of Dewey, Piaget, and Vygotsky, as well as Lewin's small group theory and the pedagogical directions of critical and problem-based learning. The fundamental assumption lies in the social construction of knowledge, where the formation and verification of ideas constitute a collective process open to every participant.

In this sense, it would be more challenging for AntiDop not to present all the knowledge in text or other formats, but to orchestrate learning activities that are based on small study-groups and to offer a roadmap to reach knowledge, not the knowledge itself. Especially, sport coaches and medical personnel have the ability to prove that the knowledge is based in the community of learners and not exclusively in individuals.

For the effective facilitation of CL in formal adult education, like in AntiDop, we need to create a learning environment where participants will feel free to exchange ideas and share their experiences for the purpose of collective knowledge production. This presupposes a safe and democratic framework that discourages competition and encourages mutual respect and tolerance towards different perspectives. The best design approach for this, is to allow group discussions and small collaborative projects. Modern LMS offer such features, not always those features are being used in the right way. Forums and similar tools, will not be used as a Question-and-Answer area, but learners will be transformed from passive listeners into active problem solvers and will make fruitful discussions, taking increased responsibility for their personal learning and recognizing their peers as reliable and important sources of knowledge.

The significant advantages of CL include the creation of an environment of democratic design and decision-making, the development of student autonomy, the improvement of critical ability through the confrontation of prejudices, and the utilization of the accumulated experience of adults. Literature findings, already have shown high reliability of the collaborative learning assessment rubrics and a significant positive correlation between collaborative learning and scientific inquiry, supporting the

validity of such digital cooperation tools. A statistically significant and gradual improvement in students' collaborative learning ability was observed during the research activities (Lee et al., 2014).

Last but not least, AntiDop design approach will apply some additional rules to avoid the 'Ghost Town Phenomenon' in online cooperation tools. Without users who take the role of 'animators', a small group of learners may participate less than expected, and at the end a silent and disappointing online environment may appear. One of the mitigation actions in our educational design plan is to have group-leaders (i.e. volunteers, or the most experienced ASPs) to motivate other learners and report progress. This can make a nice fit to the gamification elements of the solution, especially in leaderboards, or badges. In other words, the most active learners -according to the learner analytics data to be collected- ban be proposed as team-leaders and this role will become visually approved by a badge in their learner profile.

2.2. Teaching strategies followed by other initiatives and their results

This section provides a concise, evidence-based roundup of teaching strategies used by leading anti-doping initiatives and the most important results they report.

A first approach followed by WADA with ALPHA (WADA, 2014) and its descendant ALPHA 2.0 which delivers updated, bite-sized lessons with interactive content (WADA, 2019) is **structured eLearning with role-specific pathways.** According to this approach, modular, self-paced courses tailored to athletes, coaches, ASP and other roles; scenario-based micro-lessons; knowledge checks; certification. The focus is not only on rules, but also on attitudes and decision drivers. Evaluation results from WADA's educational program were effective in relation to knowledge and attitudes, however partially effective in relation to the likelihood of engaging in doping (Deng et al., 2022). Possibly, these findings suggest that the development of values-based anti-doping education programs should take into account the varying value priorities of athletes from different countries

Key-results included increased knowledge of rules/processes and higher engagement with anti-doping practices. Attitude-focused content (ALPHA) targeted intention formation, not just recall (Woolway et al. (2021). Another analysis of this educational approach and its outcomes revealed significant differences across nationalities in how participants valued clean sport, as well as in their prioritization of general values and Spirit of Sport values.

Another similar approach is followed by UK Anti-Doping (Clean Sport Hub & Coach Clean). Its strategy is more focused on **role-specific, modular eLearning** tailored to athletes, coaches, parents, and ASP, endorsed by professional bodies (e.g., CIMSPA[4]). This approach was tested with the participation of 340 sport coaches and revealed strong support for clean-sport education, but a lack of confidence and knowledge (UKAD, 2021). Moreover, the results indicated that sport coaches prefer "bite-sized," entertaining, storytelling formats embedded in coaching pathways.

An **ethics-based education** approach which emphases values across the athlete ecosystem is the U.S. Anti-Doping Agency's (USADA) TrueSport[5], a positive youth sports initiative and in UK's "100% Me" campaign[6]. This campaign was delivered by a mobile app (available in marketplaces of Apple app store and Google Play). In this approach, medical experts unanimously support the principle of strict liability,

[4] https://www.ukad.org.uk/cleansporthub?utm_source=chatgpt.com

[5] https://truesport.org

[6] https://www.ukad.org.uk/100-me

which holds athletes fully accountable for any substance detected in their system, regardless of how it was ingested or whether there was intent to cheat. This approach is being taught in multi-audience programs (with the participation of different audiences like athletes, coaches, parents, and educators), workshops, school resources, recognition/awards; educator training cascades at federation level.

Key results include culture-building beyond rule compliance, reported improvements in ethics/sportsmanship and trained educator networks and an extended reach through face-to-face, webinar, or hybrid formats.

A well-grounded approach which is based on **Evidence-informed instructional design** (Bloom-aligned objectives, microlearning, scenarios) is the "One Resource Kit for Teachers" Project[7]. This is an excellent example of how evidence-informed instructional design can be applied in anti-doping and values-based education.

According to this, the carefully designed learning outcomes are being mapped to the Bloom's levels (as seen previously in Figure 3) and the Guidelines for the International Standard for Education (WADA 2021b) are taken into account. The "One Resource Kit for Teachers" was specifically tailored for primary and middle school students, where direct anti-doping education may be too abstract. Instead, it builds on age-relevant values education (empathy, prosocial behavior, fairness in play). By situating anti-doping education within broader ethical development, it adapts the evidence to the learners' developmental stage and context. Moreover, microlearning is being used for just-in-time topics and iterative evaluation is embedded. Overall, the resource kit has been piloted, evaluated, and refined having teachers' feedback and learners' responses have informed revisions, making it a living resource shaped by evidence from practice. According to evaluation results, teachers reported that the toolkit was feasible and useful for promoting prosocial behavior and values education, though they suggested that longer implementation periods could enhance its effectiveness (WADA 2021b). AntiDop can benefit from this strategy by the application of a similar evaluation framework which track behavior, not just knowledge to maintain 'living resources' and not static educational interventions.

The **extensive use of media** like images, animations and videos in educational content has certain advantages. As in the eLearning program of Shionoya et al. "Sports ethics and Sports Science" (2011), the experiment of using images and videos has been proven more effective in Antodoping education. Data from physiological monitoring of learners offered enough evidence that that strong-impact visual educational content decreases the index of the parasympathetic nervous system and increases the index of the sympathetic nerve system. In other words, effective eLearning content must be designed to capture the attention of the learners. Moreover, media-enhanced educational material can explain better some key-concepts. Actually, visuals not only make complex ideas more accessible, but they also aid in retention. This dual-modality presentation—combining words with relevant images—makes understanding more intuitive and memorable (Mayer, 2005).

The introduction of game elements into the education process can be found in two different approaches: **Gamification** and **serious games**. The first refers to the integration of selected game elements, such as points, badges, leaderboards, progress bars, or challenges, into contexts that are not games by nature. Its main aim is to enhance motivation and engagement in existing activities. For

[7]https://www.wada-ama.org/en/resources/social-science-research/one-resource-kit-teachers-project?utm_source=chatgpt.com

example, an eLearning module on anti-doping might use a point-system and badges to reward learners for completing sections, thereby encouraging progress without altering the underlying instructional structure. Moreover, gamification gives the possibility to work with different knowledge, profession or cultural levels. By contrast, serious games are fully developed games designed with a primary purpose beyond entertainment, such as education, training, or raising awareness. They immerse the learner in a game-based environment where decisions, interactions, and outcomes are central to the learning process. For instance, a serious game on anti-doping could simulate real-life scenarios where a coach or athlete must make choices about supplement use, peer pressure, or ethical dilemmas, with the consequences reflecting real-world risks and responsibilities. Both approaches are being used to create motivation for participation and to enhance the adherence in user's plans.

An example for such a type of anti-doping education is TARGET, a serious game for supporting the Anti-Doping awareness for a healthy lifestyle which was designed and implemented in the context of GAME, a recent Erasmus + project (Barkoukis et al., 2020). The results of the evaluation during pilot studies were very satisfying, indicating a user-friendly user interface and a high technology acceptance from its target-audience (Stylianidis et al., 2021). Another example, "I Am on Top!" is a serious game designed to promote self-regulation processes in the fight against doping in high schools' students. This anti-doping game intervention successfully impacted students' doping intentions, levels of moral disengagement, and knowledge about doping (Galli et al., 2023). However, it did not appear to enhance their self-regulatory efficacy in resisting social pressure to use substances. Importantly, the choices made by the study participants reflected their genuine beliefs about doping.

Last but not least, the **delivery model** of the education (i.e. either face-to-face, or online) is an important factor. As seen in the iPlayClean project[8], the training intervention had an immediate positive effect in reducing favorable attitudes towards doping across all delivery modes (face-to-face, online, and combined), and this effect was maintained for 8 weeks. Regarding vulnerability to doping, the intervention had an immediate positive effect in reducing it across all delivery modes. However, this reduction was not maintained for 8 weeks in the online and combined groups, but was maintained only in the face-to-face presentation group. Therefore, the iPlayClean intervention appears to be effective in improving anti-doping attitudes in the short term, regardless of the delivery method. However, the maintenance of the reduction in vulnerability appears to be influenced by the delivery method, with the face-to-face method showing more stable results (Nicholls et al., 2020). There is enough evidence that mixed models (i.e. a combination of face-to-face and online) is a better option to mitigate

2.3. Addressing diversity: Strategies for learners with different scientific, cultural and professional backgrounds

Diversity in learners' scientific, cultural, and professional backgrounds represents both a challenge and an opportunity in the context of anti-doping education. A one-size-fits-all approach risks creating uneven knowledge acquisition, reduced relevance, and limited behavioral impact. Recent reviews of anti-doping education emphasize the importance of aligning content to the learners' prior knowledge, professional role, and sociocultural context, while ensuring that educational outcomes extend beyond recall of factual information to attitudes, values, and behaviors (Woolf, 2020b).

[8] https://iplayclean.co.uk

Learners with different social roles and scientific backgrounds require tailored pedagogical strategies. Novice learners, such as parents or educators outside of sport sciences, often struggle with terminology and complex regulatory procedures, while experts, such as sports physicians, demand more advanced and role-specific content. One effective strategy involves providing layered learning pathways that progress from introductory to advanced levels, supported by scaffolding for novices and complex decision-making cases for experts, as highlighted in D2.1. The target audience matrix we adopted include parents, sport coaches, and medical experts. For each category of learners, we will apply a different route to reach goals, as a level of differentiation (based on social role). This content and learning strategy adaptation mechanism will be based on diversity strategies, as explained below.

First of all, **differentiated learning** can be effectively applied in the context of anti-doping education in order to address diversity in learner's profiles. Differentiated instruction involves adapting methods, materials, and learning processes to effectively address the diverse needs of all learners (Tomlinson, 2001). The study of Manges et al. (2022) provides such a strong example of how a training intervention can be explicitly tailored to the developmental stage and cultural background of adolescent elite athletes, recognizing that traditional, one-size-fits-all approaches to anti-doping education often fail to resonate with diverse learner groups. By grounding the program in values-based education, the authors addressed not only cognitive knowledge but also the moral reasoning and emotional dimensions of learning. This reflects a core principle of differentiated learning: the recognition that learners vary in readiness, motivation, and preferred ways of engaging with educational content. It is worth mentioning that the outcomes of the study demonstrated reductions in moral disengagement and an increased alignment with prosocial values, and underscore the effectiveness of tailoring education to learners' backgrounds and needs (Manges et al., 2022). From a pedagogical perspective, this supports the argument that anti-doping education should move beyond uniform information dissemination toward approaches that integrate developmental psychology, cultural sensitivity, and learner-centered design.

This design approach (i.e., differentiated learning) can ensure that the intervention "speaks" directly to the lived experiences and developmental needs especially of the young learners, rather than replicating content designed for adults or professionals. Thus, apart from role-based categorization of learners (parents, sport coaches and medical professionals), we can take into account the age of the participants in order to embed additional contextual differences of learner profiles within the training missions. This will be of particular importance in the case of young sport coaches (represented well in interviews in D2.2), who have a dual role: being athletes themselves and provide sport coaching services to others.

Another strategy to deal with diversity is **microlearning** (i.e. short, focused learning modules) which has also demonstrated flexibility that fits very well in diverse audiences. Its effectiveness in enhancing retention and reducing cognitive load, particularly on mobile platforms used by time-constrained professionals (Díaz Redondo et al., 2021). Thus, while parents may appear more flexible, this approach will be a nice fit to the needs and time availability of sport-coaches and medical professionals.

Cultural diversity can further impact the learning reception. Learners in different contexts interpret messages through varying cultural values and societal norms. Culturally **responsive design** enhances engagement by adapting narratives, dilemmas, and values-based messages to the learners' societal context (Paris & Alim, 2017). Moreover, the study by Manges et al. (2022) contributes to differentiated learning by emphasizing a values-based approach to anti-doping education that can be adapted to diverse learner profiles, like those of AntiDop. By targeting psychological factors such as moral disengagement,

anticipated guilt, and empathy, the intervention acknowledges that athletes differ in their moral reasoning, cultural backgrounds, and prior exposure to anti-doping knowledge.

Similarly, Kavussanu et al. (2020) tested a **moral intervention** among athletes in the United Kingdom and Greece and found significant reductions in doping likelihood and moral disengagement, alongside increases in anticipated guilt and moral identity. Crucially, these effects persisted at follow-up, indicating that interventions addressing ethical reasoning and emotional engagement resonate strongly across different cultural contexts. These results emphasize that anti-doping education should not be restricted to the transmission of factual knowledge but should also engage with learners' values, identities, and emotions, which differ across diverse groups. This flexibility allows educators to tailor content to individual learner needs, promoting engagement and relevance. For instance, learners who are more influenced by social norms or peer behavior benefit from scenarios and discussions that emphasize ethical decision-making, whereas learners with strong analytical skills may engage more deeply with reflective exercises.

Importantly, **co-design approaches** which involve representatives from target cultures in content development, like in the case of the VIRAL project[9], can improve contextual relevance and learner acceptance (Barkoukis et al., 2022). In VIRAL, a VR solution was designed following an "open innovation" framework, involving active collaboration between VR designers and young athletes. Since one of the central challenges in this field is the heterogeneity of learners, who vary in age, cultural background, professional role, and prior exposure to anti-doping knowledge. By employing a co-design approach, VIRAL addressed these differences by creating interactive scenarios that could be adapted to diverse learner profiles. This adaptability reflects the essence of differentiated learning, as the intervention can provide multiple pathways for learners to acquire knowledge and internalize values according to their unique needs.

Learners' access contexts further shape learning design for all. **Universal design for learning** (UDL) principles guide the provision of multiple means of representation, engagement, and expression. Research in online and virtual learning contexts finds that UDL improves inclusivity, satisfaction, and learning efficacy (Almeqdad et al., 2023). Accessibility can be achieved by integrating accessible design elements described in international standards like WCAG 2[10], to ensure equitable participation for learners with sensory, motor, or cognitive challenges.

Finally, evaluation mechanisms must reflect diversity, and multilevel learning goals in order to actually measure meaningful outcomes. Disaggregated analysis by learners' roles, expertise, and cultural background can help to identify inequities in the project's impact. Our educational and awareness raising interventions should assess not only factual knowledge, but also shifts in attitudes regarding doping, moral reasoning, and intentions, factors strongly correlated with behavior change (Manges et al., 2022).

[9] https://viraltheproject.aau.dk

[10] Web Content Accessibility Guidelines, https://www.w3.org/WAI/standards-guidelines/wcag

3. Methodological approach for AntiDop

3.1. A Route from scientific to learning models

First, we need to define well the target audience and its needs. According to the results of D2.2, ASP is a diverse group of individuals who play different roles and are involved in an athlete's development and performance in multiple ways. From a broader point of view, ASP can be sport-coaches and trainers, medical and paramedical personnel, physicians, physiotherapists, nutritionists and healthcare providers, sport scientists, sport psychologists, team managers, administrators, parents, guardians, agents and sponsorship representatives. Moreover, anti-doping officials and ethics committee members as well as others who ensure compliance with anti-doping regulations and fair play principles can be classified as ASP.

The landscape is quite wide and thus we proposed an ASP classification based on domain experts' advice, common sense and everyday praxis. This classification takes into account three (3) main categories of ASP or 'personas': 1) parents and other family members, 2) sport coaches, and 3) medical personnel. Other categories of ASPs are not excluded by our methodology, but are rather included in one of the three personas.

In parallel, we defined seven (7) areas of interest that should drive the education of ASP, namely:

1. What are nutritional supplements, pros and cons, how to choose supplements
2. Information on what anti -doping is, international rules and regulations, ethics
3. What are the risks of nutritional supplements, in which cases and for whom
4. How and where to have supplements checked
5. Sources of information, validation processes, certifications
6. Who is the right person to consult, who not to consult
7. Links to high quality resources, scientifically valid content

Given these preparatory results (from the kick-off meeting and WP2 groups), and the literature review performed within WP2, a personas matrix resulted as seen in Table 2. This effort is justified as a shortcut to target learning results according to the profile (persona) of each ASP as learner individuals. It is worth to be mentioned that all topics will be included in the training of ASP, no matter in which persona the AntiDop system fits them in, but there are some required topics in order to complete the training. Alternatively, ASP can skip some chapters/topics and can directly go for the final test in case they need to save some time.

Table 2. The three Personas matrix and links to areas of interest

	Parents (including family members)	**Sport coaches**	**Medical personnel**
Description and average needs	Unknown previous education, wrong previous beliefs and unwished attitudes, more free time and learning curiosity, instinct-based decisions.	Low or fragmented anti-doping training, limited time, important time of the day 'on the move', strong feeling of responsibility, decisions based on previous experience	Limited time, high professionalism, very deep but often one-sided knowledge, work with evidence-based decisions.

Knowledge	None or limited	Average	High
Awareness	None or limited	Average	High
Areas of interest	All	1, 3, 4, 6 and 7	3, 4, 5, 6 and 7

3.2. Best options and proposals for AntiDop

Literature findings imply that the design of education programs against doping can be improved if they are based on principles from educational sciences, particular in term of constructive and integrative alignment (Woolf, 2020b). To this end, best options for AntiDop include collaborative learning, serious games and gamification, use-cases and storytelling, differentiated learning and media-enhanced educational content. It will maintain the awareness raising and moral elements like the Global Anti-Doping Athlete Education Programme (GADA) of WADA, but at the same time it will integrate innovative elements, described below.

The collaborative group teaching method emerges as a highly suitable pedagogical approach for adult education, leveraging the inherent characteristics and needs of this age group. Primarily, adults possess an extensive cognitive and experiential background, which this method seeks to highlight for the benefit of collective learning. Through dialogical interaction and the mutual exchange of ideas, adults can process new information from diverse cognitive perspectives, engage in critical thinking and reflection, and construct knowledge synthetically. Additionally, group work promotes the cultivation of key social and communication skills, such as focused listening and reasoned argumentation, skills of paramount importance for professional and personal fulfillment. In conclusion, the creation of a supportive and collaborative learning environment enhances social integration, reduces learning anxiety, and promotes individual autonomy and active participation, making the method highly effective and empowering for their personal learning journey (Matsagouras, 2008).

Gamification can be used in AntiDop application to enhance existing processes with game mechanics, relying on extrinsic motivators like rewards or rankings. Serious games, on the other hand, are self-contained experiences that promote intrinsic motivation through storytelling, exploration, and problem-solving. As an example, the serious game TARGET (Barkoukis et al., 2019) achieved user engagement and offered memorable experiences and this approach should not be missing from AntiDop solution. On the other hand, immersive experiences, like the virtual reality program VIRAL (Barkoukis et al., 2022) is not a good example to follow in AntiDop, mainly because the virtual reality concept is a totally different technology, is delivered by a different educational model not friendly to mLearning and has budget risks.

Use cases in training missions will be a must to support problem-based learning and story-telling. While both can be powerful educational tools for AntiDop, serious games generally can provide a more immersive learning experience, whereas gamification offers a lighter, more accessible way to boost engagement in conventional training. The use of a "simulator" to test use-cases was coined by some study participants also during the interviews (D2.2) and thus, it should not be missing from the AntiDop solution.

AntiDop need narrative-driven learning experiences that use emotionally engaging scenarios and storytelling inspired by real or fictional athletes navigating dilemmas. There is accumulated experience and oral stories that the domain experts of the consortium and the interview participants can bring into the project. Our educational program, if built around use-cases and storytelling, can make anti-doping topics more meaningful and impactful for ASPs, especially for younger populations. Most of the existing educational content found on other initiatives, as well as in the international organizations, is based on a

set of rules and prohibitions. In AntiDop we will integrate educational narratives which will place learners inside emotionally charged situations where ASP face real-world dilemmas and pressures. This narrative immersion makes the anti-doping issues more tangible, helping learners empathize with the challenges athletes and ASP experience and reflect on the human consequences of decisions. These stories will provide a bridge between (abstract) doping regulations provided by international organizations like WADA and lived realities, thus allowing learners to see how principles can be applied in practice. Moreover, this approach is expected to strengthen engagement and long-term retention, since people naturally connect with and remember stories. Good examples of such interactive tools which uses scenario-based learning have been presented by other eLearning platforms like the 'Real Winner Platform' (Developed by Anti-Doping Norway, as presented in D2.1)

Another pillar of the AntiDop approach is media-enhanced educational content which has the power to make education more dynamic, accessible, memorable and impactful. Rich audiovisual material and interactive content can attract and maintain attention, involve emotion and thus create stronger connections to the educational content, allowing ASP to experience scenarios rather than simply read about them. Moreover, media-enhanced formats mirror the communication habits of younger generations (coach assistants, young medical professionals and family members), who are already accustomed to learning, socializing, and engaging through digital platforms. By meeting learners in this familiar environment, our training missions can become more approachable and relevant.

Flipped classroom was discussed in D2.1 as part of the state-of-the-art, but this approach can be implemented only in classroom-delivered education and probably is not friendly to an eLearning context like AntiDop. Despite this, we can propose a similar model fitted to the AntiDop training missions. This model can allow learners to first engage with new material and theoretical concepts through pre-recorded videos, podcasts, readings, or other digital content, and then use 'forum time' for active learning (such as online discussions, or applying knowledge in group projects).

All of the above approaches are ideal for the AntiDop project and have already given positive results in other educational initiatives. Especially when combined with a co-design approach, this will ensure that the outcome, as an educational program, will be culturally relevant and engaging for its target audience. Last, differentiated instruction will be applied to fit into varying cultural context, will not be limited to content variation only, but it will be extended to align pedagogical strategies with ASPs' values, beliefs, and motivational drivers, fostering more effective and meaningful learning outcomes during the pilot studies. In any case, emphasis will be placed on ASP and not on athletes themselves as in other projects like SAFEYOU+ (Barkoukis et al., 2022).

3.3. Key performance indicators and tools for measuring usability and learning effectiveness

Nielsen's ten heuristics constitute a fundamental frame of reference for the evaluation and optimization of user interface (UI) usability. Each of these principles focuses on a critical aspect of human-computer interaction, with the ultimate goal of creating systems that are effective, efficient, and satisfactory for the end user (Molich & Nielsen, 1990).

Visibility of system status: This principle emphasizes the imperative need for continuous user updates regarding the current state of the system. Providing timely and appropriate feedback ensures the transparency of the system's operation and enhances the user's sense of control.

Match between system and the real world: The design of the interface should align with the cognitive structures and real-world conventions familiar to the user. The use of terminology, concepts, and metaphors that reflect reality facilitates understanding and interaction.

User control and freedom: Users should have the ability to undo unwanted actions and easily escape from erroneous choices. Providing clear "exit" mechanisms minimizes frustration and enhances user confidence.

Consistency and standards: Internal consistency in design and compliance with established interface standards are essential for creating predictable and easy-to-learn systems. Avoiding inconsistencies reduces the user's cognitive load.

Error prevention: This principle emphasizes a proactive approach to dealing with errors. Careful design that prevents errors from occurring is preferable to simply providing error messages.

Recognition rather than recall: Minimizing the requirement for users to recall information from memory enhances usability. Displaying options, actions, and objects reduces cognitive effort and the risk of errors.

Flexibility and efficiency of use: The interface should cater to both novice and experienced users. Providing shortcuts and customizable features allows experienced users to accelerate their interaction.

Aesthetic and minimalist design: The interface should focus on essential information, avoiding unnecessary elements that can distract and reduce the visibility of important information.

Help users recognize, diagnose, and recover from errors: Error messages should be clear, understandable, and provide constructive instructions for resolving the problem.

Help and documentation: Although the ideal interface is self-explanatory, providing easily accessible and targeted help and documentation may be necessary for handling more complex tasks.

Nielsen's heuristics are a powerful tool for interface designers and evaluators, offering a common vocabulary and a set of guidelines for creating usable and effective systems. The integration of these principles into the design process (and not only in the final evaluation) can lead to a significantly improved user experience (Nielsen & Molich, 1990). The AntiDop solution will be tested against Nielsen's criteria in **formative assessment** protocol (i.e. during the design and development of the solution and not only at the end), in order to give room for improvements before the pilot studies.

There are a lot of instruments to test software solutions based on heuristic criteria, but not all are free or targeted. The QUIS (Questionnaire for User Interaction Satisfaction (Chin et al., 1988), for example is limited to the Human-Computer Interaction (HCI) domain and it is not free to use (it typically requires a paid license). Another alternative is the SUMI (Software Usability Measurement Inventory), developed in the late 1980s and early 1990s (Kirakowski & Corbett, 1993), but is also not available for free use. The SUS (System Usability Scale) is well known, generic enough to fit in all cases (Brooke 1996), but it is considered by a part of researchers as outdated and less useful to help designers fix things (Sauro, 2013). Free and good quality alternatives which maintain Nielsen's evaluation criteria is **PSSUQ (Post-Study System Usability Questionnaire,** Lewis, 1992). It is free and provides detailed sub-scales like system usefulness, information quality, and interface quality. As a testing instrument, it contains 18-items[11], and

[11] An online example of the PSSUQ questionnaire can be found here: https://uiuxtrend.com/wp-content/uploads/PSSUQ-Questionnaire-PDF-Template.pdf

there is literature evidence that this scale is suitable for educational content used in mobile devices (Vlachogianni & Tselios, 2023).

To this end, the PSSUQ is proposed as a "post-study" questionnaire for usability testing of the AntiDop solution. By post-study we mean that it will be used after the study participants have completed a system interaction session (during the pilot studies). The purpose is to capture users' impressions, satisfaction, and perceived usability of the system after they have actually used it, rather than predicting usability beforehand or measuring it during the interaction. A few additional questions may be added to measure the learning effectiveness of the solution, and the motivation offered by the game elements integrated into the final solution. The final evaluation instrument will be designed in WP3 and will be included in the Annex of D4.1 (Assessment Report). It is to be noted that other evaluation criteria to be taken into account during pilot studies will be described in the WP4 deliverable and will include instruments for assessing scientific efficacy, medical value of the interventions and social influence.

3.3. Learner's engagement approaches

Learner engagement approaches are strategies aimed at actively involving learners in the educational process to enhance understanding, retention, and motivation. Our engagement goals go beyond simple participation or -even worst- passive reception of information. We will focus on cognitive, emotional, and behavioral involvement of the learners. As an overview of our approach, we will use behavioral, emotional, cognitive, social and technology-enhanced engagement.

First, we will use **learning analytics tools**, embedded into the AntiDop solution, to measure learners' interaction with the system, the educational material and the interactions between learners (e.g., in forums, group projects, etc.). Apart from active learning techniques (group projects, problem-solving sessions), we will monitor gamification elements consumption (points, badges, leaderboards to motivate participation) and the usage of interactive tools like the 'athlete simulator', quizzes after each learning module, polls, and other response systems.

As explained earlier, the educational content of AntiDop will be enhanced with use cases, real-life scenarios and didactic narrations. These elements introduce strong **emotional engagement** and are related to students' feelings about learning, including interest, enjoyment, and sense of belonging. Such positive emotions are expected to improve motivation and attention. Our approaches include **narrative-based learning** (stories, real-life scenarios, case studies), **personalized learning paths** (adapting content to learner interests and abilities), mentorship and peer support (building connections and trust) - when possible.

Some approaches for **cognitive engagement** employ mental effort and strategies that learners invest in understanding and mastering the educational content. We have already proposed problem-based learning approaches and in addition we can involve some **metacognitive strategies** (like self-reflection and goal-setting) to allow learners have control over their learning experience.

Technology is a key concept in AntiDop solution and the learning materials will be **interactive** and **media-enriched**. This combination (Technology-Enhanced Engagement) can significantly boost engagement by making learning interactive and fun.

Social engagement will be achieved by collaboration on the online learning platform (peer interaction and co-creation). Starting from the fact that learning is socially mediated, we conclude that peers can play a critical role. Thus, learners will review and provide feedback to each other, discussion

forums and collaborative projects will be part of our approach, and group-based problem-solving tasks will be included as well.

The personas matrix in Table 2 and the links to areas of interest will be a starting route for ASP (proposed learning routes), but we will apply some **Self-determined engagement** strategies in order to promote autonomy and ownership over learning. Our approach to enhance intrinsic motivation to learners include a choice in assignments and topics, some self-paced learning modules, as well as reflection exercises and portfolios. In addition, assessment processes can reinforce engagement if they are meaningful and interactive. Interactive self-tests with immediate feedback and teaching aids (e.g., alternative answers, explanations for each right and wrong answer), quizzes and challenges will be gamified as well (i.e., directly linked to the gamification elements like points and badges).

3.4. Gathering feedback from learners and instructors

Gathering feedback from learners (i.e., ASP) and educational content developers is crucial because it provides direct insight into the effectiveness, usability, and impact of an educational program. Feedback closes the loop between design and learning outcomes and will allow us to make evidence-based improvements.

From the learners' perspective, feedback reveals whether educational content is understandable, learner-friendly, accessible, engaging, and motivating. It will help us (the developers) to identify challenges they face during the training missions, possible misconceptions that may arise, or elements that fail to capture attention. Learners' feedback can also highlight gaps in knowledge transfer, or the relevance of scenarios to the goals of the learning program.

On the other hand, from the instructors' perspective, feedback will help us to assess whether teaching approaches, tools, or learning modules effectively support training goals. Live instructors will be present due to the eLearning nature of our solution, but educational content developers and pilot site responsible persons, or learners' team leaders can report on usability issues and the level of engagement of learners.

Both feedback collection channels will allow us to continuously improve the educational content during pilot studies (fix inconsistencies, broken links, improve media, etc.), to enhanced learner engagement (e.g. tailor methods to what actually motivates learners), integrate evidence-based decision-making (e.g. use concrete data, or simulations), and finally validate the educational outcomes (e.g. understanding if ethics, or skill acquisition are truly being met).

4. Software solutions available for educational content development

There are various solutions and categories regarding educational content development. Learning management systems (LMS) are primarily designed for delivering, managing, and tracking learning content and learner progress. Examples of LMS with built-in authoring tools include Moodle, Blackboard Learn, Canvas.

On the other hand, standalone or cloud-based eLearning authoring tools are available. They are software applications focused specifically on creating digital learning content. Their main characteristics are interactivity, collaboration features, responsive design, SCORM/xAPI compliance, multimedia support and drag-and-drop interfaces. Examples of such tools include Lectora Online, Genially, Camtasia, Adobe Captivate, Articulate Storyline 360/Articulate Rise 360, Easygenerator ,1Gomo Learning, H5P, iSpring Suite, and Elucidat.

Learning content management systems (LCMS) focus on the creation and management of content itself, while LMS focus on the delivery and administration of learning programs and learners. They are designed for creating, managing, and distributing learning content at a granular level. Examples of such tools include Absorb, Auzmor, Docebo, and Litmos.

Other specialized software and development services for educational content which may include virtual classrooms, eLearning Apps, learning experience platforms (LXP), education portals, and AR/VR Development. The video and animation tools are used for creating explainer videos, animated lessons, or recorded lectures. The main tools are Camtasia, Vyond, Powtoon and Animaker.

Open-source software is free for anyone to use, modify, and distribute. When applied to eLearning, these tools allow educators and businesses to create and modify training courses without paying for expensive licenses. Open-source eLearning authoring tools provide control over the learning environment, making them appealing to organizations that need to customize their learning management systems (LMS) or develop specific course content.Popular open-source eLearning authoring tools include H5P, Adapt Learning and EXeLearning.

4.1. Modern educational technology characteristics

Modern educational technology (EdTech) shifts the emphasis from teacher-centric instruction to a more learner-centric, personalized, and engaging educational experience (Morel & Spector, 2022). EdTech refers to the use of technology in the classroom to enhance teaching and learning (Bouchrika, 2025; Umida et al., 2024). It includes tools, platforms, and strategies that facilitate innovative instructional strategies and promote student engagement (Akintayo et al., 2024).

Modern EdTech solutions have as main key characteristics (G'aybullaev, 2024; Vikaasa, 2023):

- Learner-centered since it supports personalized and adaptive learning
- Interactive and multimedia-based with the integration of emerging technologies
- Ubiquitous learning with increased accessibility, flexibility and inclusivity (anytime, anywhere)
- Real time collaboration and communication
- Safety and security
- Automated assessment and feedback
- Enhanced engagement and interactivity
- Cost-effective and sustainable

- Support of lifelong learning
- EdTech allows for highly individualized learning experiences
- Data-driven decision making

These key-characteristics of the online platforms, apps, and digital modules (e.g., quizzes, e-learning courses) can extend access and scalability, but they are not automatically effective unless paired with good pedagogy and contextual relevance (Facer & Selwyn, 2021), as explained in previous chapters.

4.2. Massive open online courses (MOOCs)

Massive open online courses (MOOCs) are online courses designed for unlimited participation and open access via the internet (Irwanto et al., 2023). They offer a flexible and low cost or often free way to make high-quality learning content available to a global audience to learn new skills, gain knowledge and even earn certificates or degrees from top universities and institutions. They are massive because they can accommodate thousands of learners simultaneously. They are open to anyone with an internet connection often free or low-cost, with open registration. They are online since they are delivered through the internet accessible from anywhere. The courses are structured learning with lectures, readings, quizzes, modules, assessments and projects (Tao et al., 2022).

The most popular MOOC platforms are Coursera, edX, FutureLearn, Udacity, SWAYAM (India), and Khan Academy (Perifanou & Economides, 2022). The main benefits derived from MOOCs are (a) accessibility, inclusivity to high-quality education, (b) Flexibility by learning at one's own pace with cost-effectiveness, (c) skill development, career advancement and upskilling (d) global reach since the networking opportunities connect learners and instructors worldwide (e) diverse course offerings with certifications and degrees (Edumadze & Govender, 2024).

On the other hand, the main challenges remain (a) the high dropout/ low completion rates, (b) the lack of personalized interaction with instructors, (c) difficulties regarding accreditation and formal credit transfer, (d) challenges with the assessment and potential cheating and (e) difficulties with learners' self-discipline and motivation. Despite the challenges, MOOCs continue to evolve and remain a significant force in the landscape of online learning, contributing to lifelong learning and democratizing access to knowledge (Wei et al., 2021).

4.3. Benchmarking of software tools for eLearning/mLearning content development

Open-source tools and creative commons licensing empower the creation of accessible, adaptable, and shareable eLearning content. With the right combination of tools, educational experiences can be delivered without the high costs of proprietary platforms (Ossiannilsson, 2010).

Benchmarking software tools for eLearning and mLearning content development, particularly focusing on open source and creative commons, involves evaluating various aspects of the tools against defined criteria to determine their suitability for different needs (Šćepanović et al., 2011). The essential criteria for benchmarking tools are the core functionality and content creation such as content types supported, ease of use, design and

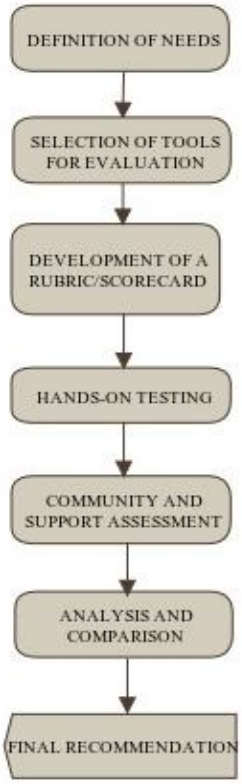

Figure 4. Steps of the benchmarking process

customization, interactivity and engagement, technical aspects and standards such as open source nature, creative commons, compatibility/integration, standards compliance, offline access, output formats, mobile optimization, integration with LMS, collaboration features and workflow efficiency, community and developer support, cost and license type (Li et al., 2024; Kear et al., 2016; Ossiannilsson, 2010).

Creative commons is a licensing framework but many open-source tools facilitate the creation and use of CC-licensed content (Miszczyński, 2022). Open-source eLearning/mLearning content development tools are e.g., H5P, Adapt Learning, CourseLab, Moodle, Mahara.

The steps of the benchmarking process are depicted in Figure 4. Regarding the authoring tools, Table 3 portrays their comparative evaluation (Košč et al., 2011). Similarly, Table 4 portrays the comparative evaluation results for LMS.

Table 3. Comparative evaluation of authoring tools

Tool	License	CC Support	Key Features	Mobile Ready
H5P	Open source	Yes	Interactive content (quizzes, videos, etc.), LMS plugins	Responsive
eXeLearning	Open source	Yes	SCORM support, offline use, HTML export	Limited
Adapt Learning	Open source	Indirect	HTML5 mobile-first courses	Fully responsive
Twine	Open source	Yes	Interactive stories and branching logic	Via HTML export

Table 2. Comparative evaluation of learning management systems (LMS)

LMS	License	CC Support	Mobile Support	Notable Features
Moodle	Open Source	Yes	App & responsive themes	Full CC integration, plugins, SCORM/xAPI
Canvas	Open-Source version	Yes	Mobile apps	Easy OER integration, intuitive UI
Chamilo	Open Source	Yes	Yes	Lightweight LMS, SCORM support
ILIAS	Open Source	Yes	Moderate	Complex features, strong CC/OER tools

Since the educational content will be media-enriched, a third cycle of benchmarking was performed especially for media-processing tools, as seen in Table 3.

Table 3: Comparative evaluation of media creation / editing tools

Tool	License	CC Export	Type	Notes
Audacity	Open source	Manual	Audio	Podcasting, narration
OBS Studio	Open source	Manual	Video	Screencasts, tutorials
GIMP	Open source	Manual	Images	CC image creation
Shotcut / Kdenlive	Open source	Manual	Video	eLearning video editing

The conclusion is that for educators a good combination is Moodle and H5P and OBS/GIMP for a full-featured, cost-effective eLearning stack. Developers can improve CC licensing with tools like Adapt or Twine.

4.4. Third party examples & application demonstrators

Third-party content refers to materials created by an external source that we can integrate into our educational offerings (Capogrossi, 2020; Killion, 2013). Examples of third-party educational content are curated news and articles, licensed content from notable publishers, brand ambassadors/influencers, open educational resources (OER) platforms like Photodentro[12], ENCORE platform[13], and user-generated content found on social media.

The application demonstrators for educational content development are tools and platforms that facilitate the creation and presentation of educational content, often with built-in features for interactivity and demonstration (Horst et al., 2024). They include content authoring tools, presentation and visual content tools, video creation and editing tools, interactive whiteboards and collaboration tools, assessment and gamification tools, AI-powered tools for content development, and STEM and simulation tools (Pack & Maloney, 2023). The list of third-party tools will remain open during AntiDop and the quality and suitability of the tools and contents will be evaluated as the project rolls. Each partner can propose and integrate third-party contents into the educational material, as long as there are no limitations on copyrights.

[12] Photodentro, the national (Greek) Learning Objects Aggregator, http://photodentro.edu.gr/aggregator/

[13] ENriching Circular use of OeR for Education, an Erasmus+ project, https://project-encore.eu

6. Epilogue

This work has explored innovative approaches to strengthen education and awareness in the field of anti-doping, emphasizing narrative-driven learning, media-enhanced modules, and interactive methodologies such as gamified scenarios and media-enhanced content. Central to these approaches is the recognition that meaningful engagement, both emotional and cognitive, is essential to fostering lasting knowledge, ethical decision-making, and behavioral change towards the modern challenges of anti-doping education.

The insights gathered highlight the importance of learner-centered design, continuous feedback from both learners and content developers, and the integration of storytelling and real-world dilemmas to transform abstract anti-doping rules into lived learning experiences.

Regarding developing tools for the educational content, this document provides a targeted list of proposals to be used in WP3. Emphasis was given on the ease of use, the 'openness' of the software tools and their technical ability to create high-quality learning objects.

Looking ahead, the next steps involve refining these contents and tools based on user (i.e., ASP) feedback, expanding their accessibility across diverse learning environments, and evaluating their long-term impact on attitudes and behaviors. This deliverable will be used by WP3 participants as a guide to develop the learning platform, the educational content and any other additional tools to deliver everything that is needed to start the pilot studies in WP4.

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