How are autonomous weapon systems in video games training future soldiers?

June 29, 2026 | SnugLab Research | readme.snuglab.com

Executive Summary

Autonomous weapon systems (AWS) in video games are training future soldiers by significantly enhancing their cognitive and sensorimotor skills, while also providing a cost-effective and scalable platform for military simulation. This training improves rapid decision-making, visuospatial attention, and task-switching abilities, and allows for the development of authentic operational competencies through AI-driven simulations that mirror real-world combat unpredictability [6, 12, 13, 5]. However, reliance on commercial game mechanics risks desensitizing soldiers to the gravity and ethical complexities of warfare, and can create skill gaps due to simplified AI difficulty and a narrow focus on individual combat rather than broader strategic implications [6, 8, 3].

Key Findings

AWS Definition and Simulation Fidelity

Autonomous weapon systems (AWS) in video games are defined by their use of algorithms for targeting and engagement without human judgment, manifesting as AI-enabled robots, android combatants, and drone swarms [3, 8]. This definition aligns with modern military training, which employs AI to generate dynamic environments with AI-controlled drones and smart enemy forces that adapt tactics in real-time [5]. Military simulations leverage advanced machine learning, including deep neural networks and reinforcement learning, to mimic complex human thought processes and unit behaviors [10]. Transfer learning further allows AI models trained in structured gaming environments to be adapted for real-world military applications, accelerating development and reducing costs [9, 11].

Despite these advancements, commercial video game AWS often simplify mechanics, creating "ludonarrative dissonance" where AI weapons are portrayed as threats but made "easy targets" for mass-market appeal [8]. Game design frequently prioritizes futuristic, flashy AI over existing systems like automated sentry turrets, distorting public

understanding of real risks [8]. Additionally, first-person shooter perspectives limit training to individual combat, often neglecting broader strategic considerations [8]. While AI algorithms in military simulations effectively replicate adaptive tactics through dynamic environments and "red teaming" [5, 7, 10], the transfer of skills from commercial gaming to military contexts requires rigorous validation [6].

Cognitive and Sensorimotor Skill Development

Exposure to AWS in video games enhances soldiers' real-world tactical decision-making and sensorimotor skills through both general action-game mechanics and specific AI-driven simulations. General action-game mechanics improve foundational cognitive abilities such as visuospatial attention, visual anticipation, visual search strategies, contrast sensitivity, and faster integration of sensory information [12]. Frequent players exhibit superior sensorimotor decision-making skills and enhanced activity in key brain regions [13]. These general cognitive enhancements, including rapid decision-making under pressure, task-switching, and processing complex information quickly, are directly relevant to military roles [6, 12].

Authentic operational competencies for AWS, however, require specific AI-driven simulation mechanics. Military simulations use AI to process vast battlefield data, creating dynamic environments with adaptive enemy forces that mirror real combat unpredictability [5, 7, 10]. These systems provide continuous feedback, enhancing tactical decision-making and team coordination [5, 7]. Studies show that PC-based gaming simulations, such as Virtual Battlespace 2 (VBS2), are at least as effective as traditional methods like sand tables for preparatory tactical training, with trainees reporting feeling better prepared [16]. The U.S. Army Command and General Staff College (CGSC) conducted an AI-enabled wargame in November 2025 using the Vantage platform, where AI-enabled participants identified 40% more risks and branches, completing planning turns significantly faster than human teams [18].

Specific military training pipelines and cognitive assessment protocols quantify this transfer. Online tank games are used by units like the 9th Cavalry Regiment for maneuver formations and tactical decision-making [4]. The Dismounted Soldier Training System (DSTS), an immersive virtual simulation, trains approximately 30,000 soldiers annually in squad operations [14, 15]. The Army's Games for Training (GFT) program uses Virtual Battlespace 3 (VBS3) for over 100 combined arms tasks [17]. Quantification relies on in-game metrics like kill/death ratios [1, 2], simulated task performance (e.g., Unmanned Aerial System operations) [6, 14], and standardized cognitive batteries measuring

visuospatial and executive functions [19, 20]. Commercial PlayStation controllers have even been adapted to operate 510 Packbot bomb disposal Unmanned Ground Vehicles, allowing gamers to quickly master the hardware [4].

Cost-Effectiveness and Scalability

The military's reliance on commercial video game engines and AI-driven simulations provides a cost-effective and scalable path for training future soldiers. The U.S. Army plans to invest over $26 billion annually in gamification and simulation training by 2028 [4]. AI enables simulations to process vast amounts of battlefield data, creating dynamic, real-time environments that mirror combat unpredictability [5, 7, 10]. Transfer learning in gaming AI allows models trained in one scenario to be adapted to another, leading to cost efficiency, faster development cycles, and enhanced scalability [9]. Video games are ideal for AI training because their structured, repetitive nature allows algorithms to develop much more quickly and at a lower cost than in physical spaces [11]. Large-scale systems like the DSTS leverage the Virtual Battlespace game engine to train thousands of soldiers annually [14, 15].

Risks: Desensitization and Training Gaps

While beneficial, this reliance creates a technological dependency that can fragment standardized training and increase vulnerability to software-driven gaps. The military heavily depends on proprietary commercial engines like Bohemia Interactive's VBS3, which serves as the collective engine for systems such as the Engagement Skills Trainer II and the Army's Games for Training program [14, 15, 17]. Proprietary updates can alter core mechanics, disrupting standardized training pipelines and creating inconsistencies across units. The transfer of skills from commercial gaming to military contexts is not always straightforward and requires rigorous validation [6].

Furthermore, video game AWS training, while building cognitive flexibility, simultaneously desensitizes soldiers to the ethical complexities and error rates of machine-led combat. The gamification of military training risks trivializing the gravity of warfare and normalizing rapid, algorithm-driven violence [6, 8]. Commercial games often reduce AI difficulty to maintain mass-market appeal, creating "ludonarrative dissonance" that distorts the understanding of real-world AWS risks and lethality [8]. This focus on futuristic, flashy AI weapons can overshadow existing, more mundane systems, making real threats seem like distant science fiction [8]. The first-person shooter perspective also restricts training

to individual human-versus-machine combat, rarely encouraging broader strategic considerations or emphasizing the unpredictability and lack of accountability inherent in real AWS [3, 8].

Specific Military Applications and Platforms

Major armed forces utilize a range of commercial video games and military simulation platforms for AWS training. Commercial titles include *Arma 3* (used by RAND for object-detection algorithm training) [2], the *Call of Duty* franchise (for tactical combat scenarios and AI-enabled weaponry) [6, 8], and historical examples like the 1980 *Battlezone* (commissioned by the U.S. Army as the "Bradley Trainer" for gunner targeting) [4]. *America's Army*, launched in 2002, served as a virtual recruitment and training tool [4]. Other games like *Full Spectrum Warrior* focused on realistic squad-level strategy [1].

Dedicated military simulation platforms, often built on commercial game engines, include VBS3 (the collective engine for the Engagement Skills Trainer II and the Army's Games for Training program) [14, 15, 17], the DSTS (an immersive system training 30,000 soldiers annually) [14, 15], and PARASIM (a parachute training simulation) [15]. These platforms offer significant cost and efficiency advantages, with AI training algorithms developing much faster and at lower cost in game environments than in physical spaces [11].

Implications

The integration of autonomous weapon systems in video games for soldier training has profound implications for military readiness and ethical considerations. It suggests a future where soldiers are highly adept at human-machine teaming, possessing enhanced cognitive and sensorimotor skills crucial for operating complex AI-driven systems [6, 12, 13]. This approach offers a scalable and cost-effective method to prepare a large force for the complexities of modern warfare, where AI will play an increasingly central role in decision-making and mission execution [4, 5, 9, 11].

However, the findings also imply a critical need for careful oversight and ethical frameworks. The risk of desensitization to the gravity of warfare and the potential for distorted perceptions of AWS lethality due to simplified game mechanics must be actively mitigated [6, 8]. Future training programs must balance skill development with robust

ethical education, emphasizing the unpredictability and accountability challenges inherent in real autonomous combat scenarios [3, 8]. This dual impact necessitates a strategic approach that leverages the technological benefits of gaming while proactively addressing its inherent risks to ensure soldiers are not only tactically proficient but also ethically prepared for the future battlefield.

Limitations and Caveats

The available research, while extensive, does not provide specific quantitative cognitive metrics such as decision latency in milliseconds or precise accuracy rates for drone swarm tracking, making direct numerical comparisons of readiness challenging. The transfer of cognitive skills and AI behaviors from commercial game environments to real-world military contexts is not always straightforward and requires rigorous testing to validate effectiveness [6]. Furthermore, the "ludonarrative dissonance" inherent in commercial game design, where AI difficulty is often reduced for mass-market appeal, can distort soldiers' understanding of real-world AWS risks and capabilities [8]. The research also highlights a potential over-reliance on a few key sources for certain claims, necessitating broader corroboration in future studies.

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