



**AUGMENTED REALITY-SUPPORTED
APPLICATIONS IN PHYSICAL EDUCATION**

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ABSTRACT

Augmented reality (AR) adds digital information to the learner's real environment without fully replacing physical space. This review examines how visual overlays, interactive markers and camera-based recognition can support instruction while students remain active in the gymnasium, classroom or outdoor area. The article focuses on motor guidance, station-based learning, anatomy instruction and location-based physical activity. AR can connect instructions directly to equipment and movement spaces, improve independence and make invisible information visible. At the same time, looking at screens during movement can create distraction and collision risk, tracking may be inaccurate, and unequal access to mobile devices may widen participation gaps. The review emphasizes that AR should use brief, readable cues and should not dominate attention. Effective implementation requires safe device placement, printed alternatives, pre-tested lighting and connectivity, and tasks that immediately require students to act on the information. AR is most educationally valuable when it reduces explanation time and supports real physical practice rather than turning the lesson into a screen-centered activity.



Introduction

Augmented reality differs fundamentally from virtual reality because learners continue to observe, interact with, and move within the real physical environment. Rather than replacing the surrounding world with a fully simulated space, AR adds digital information to the learner's existing view. Digital arrows, targets, labels, movement paths, instructional symbols, or three-dimensional objects can be placed over a live camera image or presented through wearable technologies. This feature makes augmented reality particularly relevant to physical education, where learning depends on direct bodily action, spatial awareness, and interaction with equipment, classmates, and the activity setting. One of the main educational strengths of AR is its ability to provide information at the exact moment and location where it is needed. For example, a visual marker positioned beside an activity station may open a short demonstration video, a digital target may appear on the floor during a throwing or jumping task, or an anatomical overlay may identify the muscle groups activated during a stretching exercise. Similarly, arrows or movement lines can guide students through agility drills, tactical routes, or positioning tasks. These applications can make instructions more concrete and reduce the gap between explanation and performance.

AR-supported activities may also help students work more independently. When instructions are available directly at activity stations, teachers may spend less time repeating the same explanations to different groups. This can allow them to focus more on observing performance, giving individual feedback, supporting students with additional needs, and monitoring safety. Learners may also revisit instructions when necessary, progress at a suitable pace, and take greater responsibility for completing tasks correctly. However, the use of AR in physical education also creates important challenges. The same device that provides useful information can distract students from classmates, equipment, boundaries, and environmental hazards. Looking continuously at a handheld screen while moving may reduce peripheral awareness and increase the risk of collisions or incorrect movement execution. Technical problems, inaccurate tracking, weak internet connections, poor lighting, or limited device access may also interrupt the lesson and reduce participation.

For these reasons, educational design must protect both visual awareness and physical safety. Digital cues should be brief, clear, and easy to interpret without requiring prolonged screen attention. Devices should be fixed or safely positioned whenever possible, and movement areas should be organized to prevent interference between students. Teachers should also provide non-digital alternatives so that learners without suitable devices or with different accessibility needs can participate equally. This article reviews the main instructional functions of augmented reality in physical education, examines examples of its integration into lessons, and discusses limitations related to technology, safety, access, and equity. It also presents practical design principles that can help teachers use AR purposefully, ensuring that digital guidance supports authentic movement rather than distracting from it.



Instructional functions of augmented reality

AR performs a guidance function when it places arrows, pathways or targets into the activity space. In agility or locomotor tasks, students can follow a changing route rather than a fixed printed pattern. In throwing activities, projected or screen-based target zones can vary difficulty. The benefit is that instruction becomes spatial rather than purely verbal. A second function is object-linked information. QR codes or image markers attached to equipment can provide rules, safety points or short demonstrations. Students do not need to search through a long digital menu because the relevant content is connected to the object being used. This supports station teaching, especially in large classes where the teacher cannot remain at every station. AR can also reveal information that is normally invisible. Anatomical overlays may illustrate joint alignment, muscle action or posture. In outdoor education, location-based prompts can connect movement challenges with features of the environment. These uses are most effective when digital information is brief and immediately followed by action.

Designing ar-enhanced lessons

An AR lesson should begin with a conventional movement objective. The teacher then identifies where learners need a visual cue, independent reminder or spatial challenge. The digital layer should solve that specific problem. Adding multiple animations, text panels and scores may increase novelty but also create cognitive overload. Device positioning is critical. Students should not carry a phone while sprinting, jumping or moving through crowded spaces. Safer options include fixed tablets at the side of a station, projection onto a wall or floor, or viewing the cue before beginning the movement. When handheld use is necessary, the task should involve walking or stationary observation rather than fast locomotion. AR should also be designed for rapid transitions. Long loading times and repeated scanning can reduce activity. Teachers should pre-test markers, lighting, camera angles and internet dependence. Offline content is preferable when connectivity is unreliable.

Table 1.

Ar functions, examples and design cautions

AR function	PE example	Design caution
Spatial overlay	Agility route or throwing target	Keep the device outside the movement path
Object-linked instruction	Marker attached to station equipment	Use short demonstrations, not long text
Anatomical visualization	Joint and muscle overlay during stretching	Connect the image to immediate movement
Location-based prompt	Outdoor activity trail	Protect awareness of traffic and terrain
Camera recognition	Posture or equipment detection	Check accuracy and avoid automated grading alone



Examples across the curriculum

In gymnastics and fitness units, AR markers can provide step-by-step station instructions and highlight alignment cues. Students may view a brief overlay showing hand placement, then perform the movement without the device. In ball games, target zones can support passing accuracy or spatial awareness, but tactical learning still requires interaction with real teammates and opponents. For health-related knowledge, anatomical models can connect theory to stretching, strength or posture activities. Rather than teaching anatomy separately, the teacher can ask students to identify which joints and muscles are active during a movement. This strengthens the relationship between conceptual knowledge and bodily experience. Location-based AR can support outdoor trails, orienteering and campus activity challenges. Prompts may appear at selected points and require a physical task, environmental observation or decision. Such activities can increase exploration, although teachers must ensure that students remain aware of traffic, terrain and weather.

Equity, accessibility and data issues

AR often depends on personal smartphones, which can make device ownership visible and create inequity. A bring-your-own-device model may exclude students with older phones, limited data or family restrictions. School-owned shared devices, pair work and printed equivalents are more equitable approaches. Accessibility requires more than device access. Small text, complex scanning gestures and rapid animations may disadvantage students with visual, motor or cognitive needs. Cues should be available in multiple formats, including audio, high-contrast visuals and plain-language text. The essential task should remain achievable without AR. Camera-based applications may collect images, location or usage data. Teachers should avoid platforms that require unnecessary accounts or retain student media. Privacy review is necessary before adoption, particularly when applications use cloud recognition or commercial analytics.

Conclusion and recommendations

Augmented reality can make a valuable contribution to physical education by embedding brief, clear, and context-sensitive guidance directly into real movement environments. Unlike fully immersive technologies, AR allows students to remain physically present in the gymnasium, sports field, classroom, or outdoor activity area while receiving visual cues, movement paths, targets, or instructions. Its most important educational advantage is the continuity it creates between information and action. Students can observe a prompt and apply it immediately in the same physical space, which may support faster understanding, more independent practice, and closer connection between instruction and performance. However, the effectiveness of augmented reality depends on careful lesson design. AR should not dominate the learning process or reduce physical participation. Instead, it should be used selectively to clarify a movement pattern, guide students through an activity station, support tactical



positioning, or provide short visual reminders during practice. Teachers should ensure that digital cues remain simple, relevant, and easy to interpret. Text-heavy screens, unnecessary animations, or excessive notifications may distract learners and reduce movement time.

Safety should be a central consideration when AR is used during physical activity. Devices should be fixed, securely positioned, or used in ways that do not create collision risks. Students should not be encouraged to move rapidly while continuously looking at handheld screens. Teachers should organize the activity space carefully, define clear movement zones, and supervise students' interaction with devices. When mobile phones or tablets are used, the duration of screen engagement should be kept as short as possible so that the main focus remains on physical performance. Schools should also prepare non-digital alternatives for students who do not have access to suitable devices, experience technical difficulties, or require different forms of support. Printed station cards, floor markers, verbal instruction, peer demonstration, and teacher feedback can provide equivalent participation routes. This is important for preventing digital inequality and ensuring that AR does not exclude students because of differences in access, confidence, language, disability, or prior technological experience.

Teachers should evaluate whether AR actually improves meaningful movement, skill understanding, decision-making, or student independence. The success of an AR activity should not be judged only by enjoyment or technological novelty. It should be assessed according to whether students move more effectively, understand the task more clearly, apply feedback successfully, and transfer the learning to situations where digital prompts are no longer available. Future research should therefore examine the durability of learning after visual cues are removed. More evidence is needed on whether students can perform independently, retain movement concepts, and apply acquired skills in new contexts. Researchers should also investigate the quality of self-directed practice, the effects of AR on different age groups and ability levels, and the accessibility of these applications for students with diverse educational needs. Overall, augmented reality can strengthen physical education when it is used briefly, safely, inclusively, and in direct support of authentic movement rather than as a substitute for it.

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