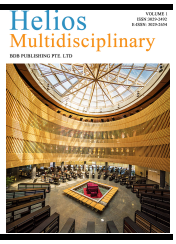
Helios Multidisciplinary

Journal homepage: http://www.bdbpublishinghelios.com/
ISSN: 3029-2492, E-ISSN:3029-2654



Learning Golf at University Through Gamification and Simulation

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ARTICLE INFO

Article history:
RECEIVED 14 September 2026
ACCEPTED 3 October 2026
PUBLISHED 12 October 2026
Keywords:

golf education; gamification; simulation; motor learning; university physical education

ABSTRACT

University golf teaching asks novices to coordinate precise movement, visual attention, strategic choice, and repeated practice. Game elements and simulation technologies may help, but evidence does not support a simple claim that making practice more entertaining or immersive reliably improves learning. This narrative review argues that outcomes depend on the alignment of challenge, feedback, learner control, and task representativeness. When these features support competence and preserve the perception–action demands of golf, they can improve motivation and create useful practice conditions; when points, screens, or real-time cues displace meaningful decisions or bodily feedback, gains may remain confined to the training task. Evidence from physical education, motor-learning research, virtual reality, and golf-specific studies is synthesised to explain why motivational outcomes are more consistent than skill transfer. The review also identifies a marked evidence gap: most golf experiments use small samples of novice adults performing putting tasks, while university courses require broader technical and tactical learning over a semester. A design framework and research agenda are proposed for comparative university sport pedagogy, including delayed retention, on-course transfer, objective performance, psychological measures, accessibility, and cross-cultural replication. The central implication is that technology should be judged by what learners can do after its support is removed.

1. Introduction

Golf instruction is an unusually clear case of a general problem in university physical education: students must learn precise movement while also making decisions in changing environments. A beginner may understand a verbal account of swing mechanics yet struggle to coordinate the club, body, ball, and target. Repetition matters, but repetition alone does not guarantee learning. Students also need informative feedback, manageable challenge, sustained attention, and opportunities to apply a movement under conditions that resemble play.

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https://doi.org/10.70702/bdb/KVYH3757

This combination has led educators to consider gamification and simulation. Gamification adds game-design features such as missions, levels, progress indicators, and cooperative or competitive challenges to a non-game activity. Simulation creates a representative practice environment in which learners can rehearse actions and decisions, either through physical scenarios or digital systems such as virtual reality (VR) and extended reality (XR). The two approaches can overlap, but they are not interchangeable: a leaderboard can gamify a putting drill without simulating a course, while a digital golf simulator can reproduce course choices without using points or rewards.

The central argument of this review is that learning gains depend on alignment among four features: the challenge should match the learner's current skill; feedback should inform rather than replace the learner's own perception; motivational design should support competence and meaningful choice; and practice should preserve the information and decisions needed in real golf. This argument helps explain an asymmetry in the evidence. Reviews of physical education generally find more consistent gains in motivation or participation than in motor performance, while golf-specific studies show that practice and feedback effects depend on task, learner experience, and assessment conditions (Barzyk & Gruber, 2024; Sal-de-Rellán et al., 2025). A student may enjoy a gamified session and still fail to retain a skill or transfer it to the course.

The distinction matters for university teaching. A course is not a collection of isolated shots. Learners must move from putting and chipping practice to full swings, course management, rule interpretation, etiquette, and performance under social or competitive pressure. Yet much of the golf-learning literature is built from brief experiments on putting by novices. That literature offers useful design principles, but its findings cannot simply be treated as evidence for an entire university course. This review therefore connects general evidence on physical education and motivation to sport-specific motor-learning and simulation studies, while marking where those evidence streams diverge.

This distinction also changes what counts as a successful lesson. A learner who can produce a better-looking swing immediately after a video demonstration has shown a short-term performance change; the same observation does not establish that the movement will remain stable a week later or adapt to a different club, lie, or target. In a university course, the instructional objective is broader still. Students are expected to understand why a shot is chosen, how conditions alter that choice, and how to practise without constant supervision. A useful review must therefore keep several outcomes separate rather than combine them under the loose label of "learning." Motivation and enjoyment matter because students who disengage may practise less. Skill accuracy matters because physical education is not only a classroom discussion. Retention and transfer matter because a curriculum aims to prepare students for situations beyond the exact drill used in a lesson.

The review treats technology as a design choice within this teaching problem, not as an intervention with a uniform effect. A gamified task can be delivered without a headset, and an immersive simulator can be used without points or badges. Either may help when it makes a relevant challenge easier to practise, but either may also distract from the perceptual cues that students need to learn. That difference gives the review its organising question: under what conditions do game mechanics and simulations produce motivation that supports learning, rather than enjoyment that remains separate from it?

The synthesis is also relevant to international higher education. Universities in China, Australia, and other systems differ in class size, access to facilities, students' prior sport experience, and the place of golf in the curriculum. A pedagogical design that depends on expensive hardware or familiarises only students who already know golf may widen rather than reduce differences in participation. Cross-context transfer should therefore be treated as an empirical question. Work on

curriculum and engagement in English-language education by Pan et al., 2026, for example, underlines that learners' emotional experience and classroom participation are shaped by pedagogical practice; it offers a useful cross-disciplinary reminder, although it is not direct evidence about sport learning. Similarly, research on AI-supported motor-skill language-learning tools associates learner enjoyment and grit with willingness to communicate, but its EFL context does not establish effects on golf performance (Long et al., 2026).

The review proceeds from learning theory to evidence about gamification, then to simulation and golf-specific transfer. It evaluates points of agreement and disagreement across methods, identifies limitations in current evidence, and proposes a framework for university golf pedagogy. Its practical thesis is straightforward: design the learning task first, then decide whether game mechanics or technology improve the quality of practice.

2. Materials and Methods

2.1 Narrative review approach

This article uses a narrative review to explain relationships across several connected literatures rather than estimate a pooled effect. The evidence base includes systematic reviews and meta-analyses, controlled and quasi-experimental studies, theoretical work on motivation and motor learning, and golf-specific investigations of VR and feedback. Narrative synthesis is appropriate because these sources use different populations, instructional designs, technologies, and outcome measures. The review does not claim to be a systematic review, does not report a PRISMA screening flow, and does not calculate a new effect size.

2.2 Search and selection

Targeted searches were conducted in October 2026 using academic discovery platforms and cross-disciplinary scholarly indexes, then checked against identifiable publisher and journal records. The search strategy combined terms for "gamification," "game-based learning," "physical education," "university," "golf," "motor learning," "virtual reality," "extended reality," "simulation," "motivation," "enjoyment," "flow," "feedback," "retention," and "transfer." Recent reviews and meta-analyses were prioritised, followed by primary studies that provided controlled comparisons or golf-specific evidence. Reference lists and citation links from relevant reviews were also checked.

Sources were included when they addressed at least one of the review's explanatory questions: whether gamified or simulated practice changes motivation, whether it improves motor learning, how design features shape the effect, or whether gains transfer beyond the training task. Priority was given to peer-reviewed research and identifiable publisher records. Evidence from school physical education was used to inform mechanisms and design, but was not treated as direct proof of effects in university golf courses. Work by Pan and colleagues was included at the user's request and is discussed only as adjacent evidence about affect and engagement in language education.

Because this is a narrative rather than a systematic review, the search was used to build an explanatory account, not to claim exhaustive coverage. Selection was purposive: reviews and meta-analyses helped locate patterns and recurring limitations, while primary experiments were retained when they clarified how a particular mechanism had been tested. This approach has an important cost. It does not provide a reproducible count of all eligible studies, and the author's choice of themes may give greater visibility to evidence that fits the organising argument. To reduce that risk, the synthesis states where evidence comes from, distinguishes direct golf studies from adjacent physical-education or language-learning evidence, and notes when reviews disagree. The article should be read as a critical map of the evidence, not as a definitive estimate of the average effect of gamified golf teaching.

2.3 Critical synthesis

Studies were compared by instructional mechanism, learner group, task, control condition, duration, outcome, and timing of measurement. This comparison distinguishes interest or perceived enjoyment from autonomous motivation, practice performance from retained learning, and performance in simulation from transfer to a real course. Particular attention was paid to whether interventions compared technology with no practice or with a credible active teaching alternative. This distinction matters because improvement after practice does not by itself show that a game or device adds value beyond sound instruction.

The synthesis also considered whether the learning task preserved the information that guided the target action. For example, practicing a putt while viewing a target and reading its slope differs from rehearsing a stroke in a visually simplified virtual environment. Both can be useful, but the first gives the learner a more direct relationship between the movement and the real task, while the second may isolate a component or make repetition more accessible. The comparison is not a ranking of "real" over "virtual." It is a reminder that the same outcome score can conceal different learning processes. Studies were therefore interpreted in relation to the task they measured, the feedback available, and whether participants were tested under changed conditions.

3. Results and Discussion

3.1 From repetition to representative practice

The history of golf pedagogy is not simply a move from traditional instruction to digital tools. Motor-learning research has long questioned the assumption that the most fluent performance during practice predicts the strongest learning. Blocked repetition can make early performance look successful, whereas varied or random practice may feel harder while improving retention or transfer. In golf, this distinction is especially relevant because shots on a course vary in distance, lie, target, wind, and strategic consequence. Practice that repeats one shot from an identical position may sharpen that shot while leaving decision-making underdeveloped.

A review by Barzyk and Gruber of 52 randomised controlled trials (RCTs) on golf motor learning offers the strongest sport-specific synthesis currently available. It reports support for an external focus of attention, increased contextual interference, and errorless learning under some conditions. At the same time, it finds no single superior approach for augmented feedback or cognitive training, and notes that more than half the included studies were underpowered. Most studies also examined simple putting tasks with novice participants (Barzyk & Gruber, 2024). The review therefore provides a foundation for instructional design, but also warns against assuming that one drill or feedback method generalises across skill levels and the full game.

That caution is particularly important when translating laboratory findings into the sequence of a university course. A lesson often begins with a stable task because novices need time to understand how equipment, posture, and ball contact relate. If every trial changes at once, a student may not know which adjustment produced a better or worse result. Once a basic movement is recognisable, however, repeating an identical shot can hide whether the learner can adapt. In golf, useful variation can involve distance, target size, slope, club, intended trajectory, or the decision about where to leave the next shot. These changes are not interchangeable: varying a target while retaining the same putting action tests a different adaptation from changing both the club and the movement pattern.

The general contextual-interference literature supports variability, but it also demonstrates why a simple "random practice is better" prescription is inadequate. A 2024 meta-analysis found an overall medium advantage for random practice on transfer across motor tasks, yet the estimate was smaller and not statistically significant in applied studies than in laboratory studies (Czyż et al., 2024). This difference matters for golf instruction. A controlled task can isolate the effect of

practice order, whereas a course-based lesson also includes decisions, waiting time, peer observation, fatigue, and instructor feedback. Random practice may improve learners' ability to reconstruct an action under changed conditions, but its value depends on whether the chosen variations are meaningful and whether the learner has enough foundational control to use them. The appropriate progression is therefore not "blocked first, random later" as a rigid rule; it is a teaching decision calibrated to task complexity and learner readiness.

The evidence also invites instructors to distinguish the appearance of fluency from durable learning. Repeated shots at one distance can make a session feel successful because performance improves quickly. When students later face several distances in a mixed sequence, immediate scores may fall. That temporary cost can be mistaken for failure even when students retain the skill better. Conversely, an exciting game may produce many attempts and a high level of activity without requiring learners to select a club, read a lie, or interpret feedback. Assessment should therefore include a learning test after practice has ended, not just the score collected during the game. A delayed test reduces dependence on short-lived warm-up or cueing effects, while transfer tests ask whether the student can adapt to a condition that was not rehearsed in exactly the same way.

For university instruction, the implication is to treat practice structure as a learning variable. A sequence can begin with enough stability for students to understand the movement, then introduce varied distances, targets, club choices, and course scenarios. Such progression makes the learning environment more demanding without making the technology itself the centre of the lesson. A gamified "mission" can provide a meaningful reason to vary the task; simulation can make the variation safe and repeatable. Neither design guarantees learning unless the information required for the real action remains available.

Figure 1 summarises this development. It traces a shift from isolated repetition toward practice that connects technical action, feedback, motivational support, and course-level decisions. The arrows represent a design progression, not a claim that every learner must pass through fixed stages.

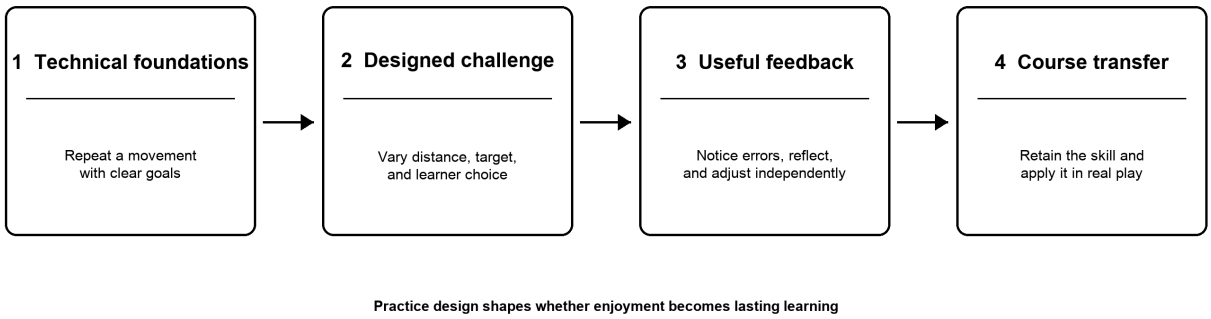

Figure 1. From isolated practice to representative golf learning

3.2 What gamification adds and what it cannot establish

Gamification can make progress visible. Levels and short challenges may break a complex skill into attainable steps; peer tasks can add social interaction; and immediate performance feedback can show whether a practice attempt met its target. These features plausibly support perceived competence and persistence. Their effects, however, depend on how they are used. A badge for attendance measures attendance. It does not establish that the learner has improved a swing, can explain a club choice, or can reproduce a putt after a delay.

The broader educational evidence is positive but conditional. A meta-analysis by Sailer and Homner found that gamification can improve cognitive, motivational, and behavioural learning outcomes, with effects shaped by study design and game features (Sailer & Homner, 2020). Reviews focused on physical education likewise report encouraging effects on motivation, engagement, or participation, but they describe varied interventions and outcome instruments that make general conclusions difficult (Arufe-Giráldez et al., 2022; Camacho-Sánchez et al., 2023). A 2025 review of adolescent physical education found that motivational benefits were more consistent than effects on academic achievement or motor-skill development, and called for larger samples, control groups, and longer follow-up (Sal-de-Rellán et al., 2025).

These mixed results become easier to interpret when "gamification" is unpacked into its parts. A mission defines what a learner is trying to do; a progress display makes change visible; points reward a specified behaviour; a leaderboard compares performance with others; and a team challenge changes the social organisation of practice. Each feature can alter participation, but none automatically improves the quality of a golf movement. A progress indicator tied to a learner's own previous performance may make a small improvement legible to a novice. A public ranking may instead reward those who already have more experience, confidence, or access to practice outside class. Team missions can encourage discussion of course strategy, although they may obscure who actually performed the skill being assessed. The effects attributed to "gamification" may therefore represent very different combinations of practice dose, feedback, peer interaction, and reward.

The unit of comparison also matters. When a gamified class is compared with a no-practice control, a positive result may reflect the fact that students had a structured activity rather than no instruction. When it is compared with a well-planned conventional lesson that offers similar practice time, feedback, and teacher attention, the incremental value of game features is a narrower question. Many studies do not equalise these ingredients. For university golf, a useful evaluation would hold constant the number of attempts and instructor contact while varying one or two mechanics, such as self-referenced progress feedback or cooperative problem solving. Otherwise, a result may be attributed to points when it was the additional practice time that mattered.

Participation remains a meaningful outcome, particularly when students previously avoided practice, but it is not a proxy for skill or strategic understanding. Studies should report these measures separately. Increased attendance and enjoyment alongside similar skill gains under active instruction would indicate that the intervention changed the learning experience, not necessarily the motor outcome.

Recent evidence reinforces this distinction. A 2026 systematic review and meta-analysis of 15 RCTs in school-aged physical education reported a small-to-moderate pooled effect for gamified interventions but very high heterogeneity; its authors caution that results varied across intervention design and outcomes (Carcelén-Fraile & Aibar-Almazán, 2026). Because participants were mostly children and adolescents rather than university students, these estimates should not be imported directly into higher education. Their main value here is diagnostic: "gamification" is not a single treatment. A narrative, leaderboard, exergame, and skill mission may differ in the psychological and motor processes they engage.

University evidence is similarly mixed. In a study of 127 pre-service physical education teachers, gamification improved academic performance and external regulation, but did not increase intrinsic motivation (Ferriz-Valero et al., 2020). The result complicates the claim that playful presentation automatically makes learners more self-determined. If points and rewards become the main reason to practise, participation may increase while the quality of motivation remains controlled. For golf

teaching, rewards should therefore mark informative progress or effortful strategy use, not substitute for a valued learning goal.

3.3 Flow, enjoyment, and motivational quality

Flow theory describes intense absorption when challenge and skill are suitably balanced and goals and feedback remain clear (Csikszentmihalyi, 1990). In golf practice, a task that is too easy produces little attention; one that is too difficult can frustrate novices before they can identify what to change. Progressive challenge levels can help instructors keep practice near an attainable edge. Yet a self-report score of flow is not a direct measure of motor learning. Learners may feel absorbed by a game mechanic without developing a movement pattern that survives outside it.

Self-determination theory helps explain why the same game feature can support one student and discourage another. Autonomous motivation is more likely when teaching supports competence, autonomy, and relatedness; controlling rewards can instead strengthen external regulation (Deci & Ryan, 2000; Ryan & Deci, 2017). A meta-analysis of self-determination theory in physical education, based on 265 studies, found that autonomous motivation was associated with adaptive outcomes, whereas external regulation and amotivation tended to relate to less adaptive outcomes (Vasconcellos et al., 2020). A systematic review and meta-analysis of pedagogical models also found that many student-centred interventions supported basic psychological needs, although some showed null or mixed results (Saiz-González et al., 2024).

The theories are related, but they answer different questions. Flow describes a quality of experience: attention is absorbed in an activity that presents clear goals and feedback at a manageable level of challenge. Self-determination theory addresses the quality and source of motivation, including whether students act from interest or personal value rather than pressure. An enjoyable task may create conditions for flow without supporting autonomy, especially if students have no choice over how to meet a challenge. Conversely, a student may feel autonomous and competent while experiencing a difficult practice session that is not especially pleasurable. Treating these constructs as interchangeable can make intervention effects appear clearer than they are.

Measurement should reflect these differences. A single post-session question cannot establish flow, autonomous motivation, or sustained engagement. Researchers should identify validated scales and report when they were administered. Voluntary practice, persistence after an error, and return attendance can add behavioural context, while brief interviews may explain why students respond differently to competitive features.

For design, the practical point is to provide choice that is real but bounded. A novice could select one of two target distances, choose whether to receive video replay after every few attempts or at the end of a set, or decide between an individual and partner challenge. Such choices preserve the lesson objective while giving learners some control over how they approach it. A high-stakes leaderboard, by contrast, may make the activity more visible while reducing the willingness of less experienced students to attempt a difficult shot. The same feature can therefore affect competence differently across learners. Studies should examine these subgroup effects rather than report only an average response.

These findings suggest that enjoyment and motivation should be measured separately. Enjoyment is a positive emotional response to activity. Motivation concerns why a learner participates and whether participation is experienced as chosen, personally valued, pressured, or externally rewarded. Both may matter, but they are not interchangeable. A well-designed golf challenge might support enjoyment and perceived competence; a public ranking might motivate some students and make others reluctant to attempt a difficult skill in front of peers. A single post-course satisfaction survey would miss those differences.

Pan and colleagues report associations among curriculum and pedagogical practices, learner competence, emotional well-being, intercultural sensitivity, and classroom engagement in EFL education (Pan et al., 2026). Long and colleagues examine how enjoyment and grit relate to willingness to communicate in AI-supported motor-skill language-learning activities (Long et al., 2026). These studies are not golf interventions, and their outcomes should not be treated as evidence of golf skill acquisition. They are relevant at a narrower level: they support attention to the emotional and motivational conditions under which learners participate, while highlighting the need to test these mechanisms within physical education directly.

3.4 Simulation and the transfer problem

Simulation can reduce practical barriers. A digital environment can provide repeatable distances, controlled scenarios, and rapid feedback without reserving a full course. VR may also allow learners to rehearse course decisions, visual search, or pressure situations that would be costly to reproduce repeatedly. But simulation changes the sensory information available to the learner. A real ball's flight, club contact, turf interaction, body balance, wind, and sound may be simplified or absent. The central question is therefore not whether a simulation feels realistic, but whether it preserves the information needed for the target skill.

A narrative review by Richlan and colleagues identified 12 VR sport-training intervention studies across several sports, including golf, and found promising performance changes while emphasising the small and heterogeneous evidence base and unresolved questions about transfer (Richlan et al., 2023). A 2025 systematic review of VR sport training likewise found broad interest in visual perception and motor practice but called for more studies comparing virtual training with real practice and testing transfer (Witte et al., 2025). A 2026 meta-analysis of immersive training reported positive effects across motor-competence domains, while noting methodological heterogeneity and positioning AR/VR as a complement to conventional practice rather than an automatic replacement (Ji et al., 2026). The broad motor literature supports potential; it cannot establish the size of a university golf course effect.

The transfer question is not simply a matter of visual realism. A simulator may depict a familiar fairway but omit the feel of the ground, the weight and vibration of the club, or the consequences of a shot that finishes in an awkward position. Conversely, a stripped-down simulation may be useful when it helps students rehearse a decision repeatedly or receive feedback that would be difficult to provide on a crowded practice area. The educational question is whether the cues and actions preserved in simulation are relevant to the skill being taught. Representative learning design offers a useful way to frame that decision: a learning task should maintain the information–action relationships that matter in the target setting, even if the practice environment is not a literal copy of the course (Pinder et al., 2011).

For a short putt, the target, slope, ball movement, and relation between stroke and outcome may be central. For course management, the critical information may instead include distance, hazards, lie, wind, and the learner's tolerance for risk. A simulator that displays a detailed landscape but asks students to select a shot from a menu may be visually convincing while removing the bodily and perceptual work involved in real play. A simpler scenario that asks students to compare a safe lay-up with a more demanding shot may better serve a decision-making objective. The criteria for "representativeness" should therefore be specified in relation to the learning objective rather than judged by graphics or immersion alone.

Simulation covers quite different practice conditions: a variable-target putting mat, a screen-based course, an augmented overlay, or an immersive headset. Each preserves some cues and omits others. A system may provide useful movement traces yet direct attention away from the

ball's effect; a headset may add discomfort or latency. Evaluations should specify what a device captures and which parts of play it leaves out.

There is also an equity question. Digital practice can reduce travel to a course or provide repeatable lessons where facility time is limited. It can also create a new dependency on hardware, maintenance, and specialist support. If only some students have prior experience with a simulator or can practise outside class, apparent technology effects may partly reflect unequal familiarity. Instructors should consider whether a low-cost physical station can teach the same principle, and studies should report device access, setup time, and the instructor training required. These details matter to higher-education curricula, where a successful intervention must be teachable at the scale of an actual class.

Golf-specific experiments make the boundary more concrete. A randomised study assigned 61 participants to practise putting in VR or in a physical setting (Markwell et al., 2023). Motivation increased more in the VR group, but both groups improved putting accuracy and did not differ significantly in performance. This is an instructive contrast: a motivational advantage did not produce a measurable performance advantage within the study's training period. An XR study compared real-time feedback with technique instruction and a no-training group over three weeks (Geisen et al., 2024). Performance improved in all groups, and the XR condition showed promise, but the authors called for longer exposure and more evidence about comparative benefit. Together these studies show that simulation can change experience or movement processes without yet demonstrating durable transfer.

The transfer question is particularly important for golf because a learner may become accurate in a simulator while remaining poorly prepared to manage a real lie, select a shot, or cope with environmental variation. Tests should therefore distinguish acquisition from retention and transfer. A post-test with the same distance and device as practice mainly measures performance under familiar conditions. Delayed tests, altered distances, real-world putting, and on-course choices offer stronger evidence that the learner can adapt.

3.5 Feedback, task design, and instructional control

Feedback is one of the most plausible routes through which simulation can assist skill learning. A student cannot correct an error that they cannot detect. Visual overlays, video replay, and movement traces can make aspects of a swing or putting stroke easier to inspect. At the same time, more feedback is not always better. If learners depend on continuous external cues, they may perform well while the cue is present but struggle when it is removed.

Meta-analytic evidence in physical education supports feedback as a useful instructional resource but indicates differences among types of feedback. A trial-sequential meta-analysis found an overall positive effect on motor-skill learning, with stronger results for visual or combined visual-verbal feedback than for verbal feedback alone (Han et al., 2022). The underlying studies varied in age, skill, and feedback schedule, and the authors noted that results for feedback subtypes were not uniform. For golf specifically, Barzyk and Gruber found no single augmented-feedback method that consistently outperformed alternatives (Barzyk & Gruber, 2024). The contrast reflects both population and task differences: a feedback method that helps novices understand a simple putting error may be unnecessary or intrusive for an experienced learner integrating multiple cues.

Feedback also has a timing problem. Immediate information can help a learner connect an action to its outcome, especially when the result is hard to perceive. But continuous, detailed correction can make the device or instructor the source of every adjustment. Students may reproduce a movement while cues are available and then lose the ability to diagnose an error independently. For university courses, useful feedback should therefore be informative without becoming a permanent substitute for perception. Teachers can ask students to predict the result

before viewing a replay, identify one feature they want to change, or compare the expected ball path with what occurred. A camera trace is most valuable when it helps the student reason about the action, not when it merely gives a technical score.

An evaluation should distinguish at least three outcomes: what changes during practice, what the learner retains after support is removed, and whether the learner can adapt in a different setting. The first can reveal whether the feedback is immediately usable. The second indicates that a change persisted beyond the session. The third indicates whether the student can use it when distance, target, or course conditions vary. Few studies include all three tests. When a system is tested only during use, it is difficult to tell whether improvement reflects learning or temporary dependence on the displayed cue. Researchers should also record how often feedback is delivered and whether its frequency is reduced over time, because the same visual information can produce different learning conditions depending on its schedule.

The OPTIMAL theory proposes that autonomy support, enhanced expectancies, and an external focus can improve motor performance and learning (Wulf & Lewthwaite, 2016). Applied to university golf, this suggests giving learners meaningful choices and directing attention toward the intended movement effect, such as the ball's roll or target, rather than overloading them with body-part instructions. A system that continuously tells a novice how to move might improve immediate form but reduce self-monitoring. The educational value of technology depends in part on whether the learner becomes better at noticing and correcting their own errors.

3.6 Critical synthesis of conflicting findings

The apparent disagreement across studies is not random noise alone. Several recurring differences help explain it. First, researchers often compare distinct outcomes. Motivation, enjoyment, course knowledge, putting accuracy, motor competence, and physical activity are separate constructs. Positive results on one do not guarantee positive results on another. Second, comparison conditions differ. A simulator may outperform no practice but not a well-taught conventional lesson. Third, learner groups vary in age, prior skill, and familiarity with golf. Fourth, intervention duration and follow-up vary: a short study can detect immediate engagement but not retention or course transfer. Fifth, game mechanics differ in whether they support choice and competence or rely on external rewards.

The strongest conclusion is therefore conditional. Gamification appears more reliable for changing participation and motivational experience than for improving technical performance. Simulation appears promising for controlled practice and feedback, but its advantage over good physical instruction remains uncertain. Golf-specific evidence is more directly relevant than general classroom studies, yet is still dominated by novice putting tasks. These patterns are summarised in Table 1.

The disagreement between laboratory and applied findings is especially instructive. In tightly controlled work, investigators can isolate one practice variable and test it using a standardised task. Applied studies capture more of the conditions that make sport meaningful, but they also introduce variation in coaching, attendance, equipment, class size, and prior experience. A smaller or statistically uncertain effect in an applied setting does not automatically invalidate a laboratory mechanism. It does, however, limit claims about how much that mechanism will improve a real course. The question for a multidisciplinary review is not which evidence stream should be discarded; it is how to connect them without overstating the bridge between them.

The outcomes themselves can produce apparent conflict. One study may report increased motivation, another improved accuracy, and a third no significant difference from conventional instruction. Those findings can coexist because they describe different constructs and comparisons. A positive attitude after VR exposure does not imply better putting. Better acquisition scores do not

imply delayed retention. Similar outcomes in two active teaching groups may mean that both teach effectively, not that neither works. Reviews become more useful when they preserve these distinctions rather than convert the evidence into a single verdict on whether gamification or simulation "works."

Small studies add uncertainty to each comparison. Low statistical power increases the chance that a real but modest effect will be missed, while multiple outcomes and flexible analyses can make positive results appear more stable than they are. A null result in a small sample should not be treated as proof of equivalence, just as a nominally significant result should not be treated as a reliable estimate of the likely effect in another course. Confidence intervals, preregistered primary outcomes, and replication across classes would make the evidence more interpretable. For golf pedagogy, it is especially important to report baseline skill and attrition because students who complete a technology-based course may differ systematically from those who stop attending.

Table 1. What the evidence supports and where claims remain limited

Evidence area	Most consistent finding	Source of mixed results	Implication for golf teaching
Gamification	Motivation and participation often improve.	Game mechanics and scales differ; school-age results dominate.	Track motivation separately from motor learning.
University PE	Grades or external regulation can improve without stronger intrinsic motivation.	Small course samples and discipline-specific designs.	Reward informative progress rather than compliance alone.
Golf motor learning	External focus, varied practice, and contextual interference can help.	Many small studies test novice putting only.	Progress from stable drills toward varied, representative play.
VR and XR	Immersive practice can raise motivation and deliver controlled feedback.	Real-world transfer and superiority to good instruction remain uncertain.	Use technology as a complement and test delayed transfer.
Feedback	Visual and combined feedback can support motor learning.	Timing, learner expertise, task, and feedback dependence vary.	Fade cues and assess learners' self-correction.

Note. Findings are interpreted in light of study populations, comparators, and outcome measures.

3.7 A design framework for university golf pedagogy

The evidence supports a design model that treats technology as one component of a teaching sequence. Figure 2 presents four linked conditions: meaningful challenge, informative feedback, learner agency, and representative transfer. These conditions are not separate add-ons. A challenge without feedback can feel arbitrary; feedback without agency can create dependence; agency without a suitably scaled task can overwhelm novices; and success without transfer checks may reward performance that is specific to the training environment.

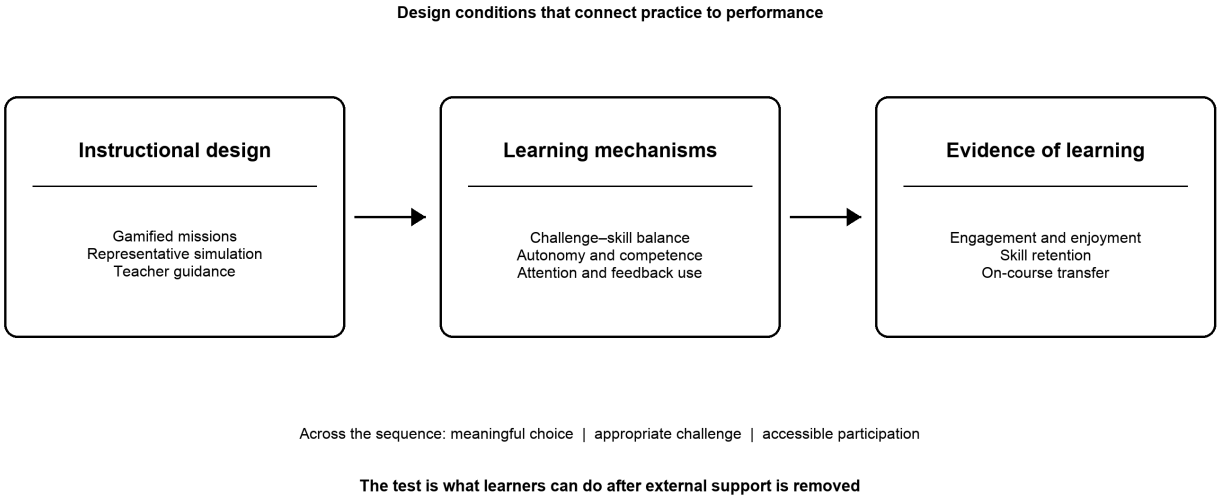

Figure 2. A design framework linking instructional features, learning mechanisms, and evidence of transfer

In practice, a putting mission might ask learners to choose among several distances, predict the required pace, perform the putt, review a concise visual trace, and explain one adjustment. Early practice can use stable conditions so students understand the task. Later sessions can vary distance, slope, target, and social or competitive context. A simulation may be used to practise course management or repeat a difficult scenario, followed by a real-world task that checks whether the decision or movement transfers. Points can recognise improvement, accuracy calibration, or reflective strategy, but should not turn every attempt into a public ranking.

This framework also fits the comparative higher-education focus of Helios. University golf courses are shaped by institutional resources, curriculum design, teacher expertise, and local expectations about sport and technology. Describing these conditions makes international comparison possible. A model validated in one Chinese university course may require adaptation in an Australian institution with different class sizes, student experience, facilities, or access to golf courses. Transferability should be examined through replication rather than asserted from a single intervention.

The design framework can be read as a decision sequence for instructors. First, define the movement or decision students need to learn and identify the information they will need to perceive. Second, choose a practice task that makes the challenge achievable but not trivial. Third, decide whether a game mechanic or a simulation improves that task in a way that ordinary instruction cannot. Fourth, specify how learners will receive feedback and when that support will be reduced. Finally, assess whether students retain and transfer what they practised. This sequence limits the temptation to begin with a device and then search for a pedagogical use. It also makes a fair comparison possible: if a simulator is selected for course-management decisions, the outcome should include decision quality rather than only putting accuracy.

The model need not require expensive technology. Meaningful choice can be created with several target options; challenge can be adjusted through distance or task constraints; and reflective feedback can be delivered through peer observation or a brief self-assessment. A simulator adds value when it provides a specific affordance, such as repeatable course scenarios or immediate ball-flight data that would otherwise be difficult to obtain. This distinction is useful for institutions planning a curriculum. The relevant question is not whether a course is “high-tech,” but

whether its available teaching resources give students sufficient opportunities to practise, receive useful information, and apply skills in representative situations.

3.8 Research gaps and a practical agenda

The most substantial gap is the mismatch between the breadth of university golf learning and the narrowness of the available experiments. Golf-specific reviews identify many trials, but most concern putting, novices, and relatively small samples (Barzyk & Gruber, 2024). A university study should include multiple skills and authentic course tasks, with prior experience measured rather than assumed. Larger, multi-class samples would also allow analysis of whether effects differ by baseline skill, gender, or students' confidence in sport settings.

The second gap concerns durability. Many studies stop at the immediate post-test. Future experiments should include delayed retention and transfer tests after a period without feedback or game rewards. If researchers want to claim that motivation mediates learning, they should measure motivation before performance changes and test the temporal sequence rather than infer mediation from same-time questionnaire data.

The third gap is intervention description. "Gamified" can refer to very different lesson designs. Studies should specify each game element, feedback schedule, teacher role, practice dose, progression rule, and how rewards are linked to learning aims. Simulation studies should report device, interaction method, visual and haptic feedback, motion capture, cybersickness or discomfort, and the extent to which real golf equipment is used. Without those details, replication and comparison remain difficult.

The fourth gap is the assessment of learning as more than a score. Technical skill should be assessed with reliable rubrics and objective measures where feasible; strategic choices and rule knowledge should be tested separately; and qualitative evidence can reveal whether learners understood feedback or simply followed it. Course performance should not be reduced to a single score if the course also aims to teach safety, etiquette, reflection, and independent practice.

Finally, research should address inclusion and practical feasibility. Game challenges may privilege students with prior sporting experience, while digital devices may introduce access barriers or discomfort. Researchers should report participation and attrition by relevant learner characteristics, consider accessible alternatives, and record instructor workload and facility costs. The research agenda in Table 2 links these gaps to concrete designs and outcomes.

An informative trial would compare a gamified or simulated design with conventional instruction matched for practice time and teacher contact. A usual-practice condition can show whether either structured approach improves on the existing course. Researchers should pre-specify primary skill and motivational outcomes to reduce selective interpretation of a broad set of scores.

Measurement should follow the course objectives. A short-putt task can assess accuracy, but cannot stand in for swing mechanics, chipping, strategic choices, or safe and independent practice. Video-based rubrics should report rater training and reliability. Device-based measures should explain how the system calculates distance, speed, or movement error. Motivation scales should be described clearly, and qualitative responses should be used to interpret rather than replace performance results. A delayed retention test after feedback and rewards are withdrawn would assess whether the learning persists. A transfer test could change target distance, slope, or the decision context, while an on-course assessment would provide the most direct evidence of application if it can be conducted reliably.

Mechanism studies need temporal order. If researchers argue that autonomy or flow explains a later skill gain, they should measure the proposed mediator before that gain is assessed and distinguish it from enjoyment recorded at the end of the same session. Repeated measurement can

reveal whether motivation predicts continued practice, whether practice then predicts skill, or whether successful performance makes students report greater competence. Cross-sectional associations cannot establish this sequence. Qualitative interviews can help generate explanations for mixed findings, but claims about mediation require a design that measures change in the hypothesised order.

Finally, replication should include different institutional settings and learner groups. A technology package that is feasible in a well-resourced university with a dedicated practice facility may not be suitable for a large class using shared equipment. Studies should record access to golf facilities, class size, instructor expertise, device costs, student familiarity with golf and VR, discomfort, and missed sessions. These implementation details are not secondary administrative information. They help explain why a similar lesson may produce different outcomes and whether a promising intervention can be sustained outside a pilot.

3.9 Implications for comparative university teaching

The international relevance of university golf pedagogy lies less in assuming that institutions teach golf in the same way than in asking how institutional conditions shape the learning opportunity. Students may encounter golf as an elective, a required physical-education module, or a campus recreation option. Access to a full course, driving range, indoor simulator, or only a small practice area changes what instructors can reasonably teach. Prior experience also varies with family resources, local sport culture, and the availability of facilities. A design that assumes students know club names or feel comfortable practising in public may be efficient for experienced players and discouraging for beginners.

Comparative research should therefore describe context before interpreting differences between countries or universities. Simply labelling a sample “Chinese students” or “Australian students” does not explain how they learn. More useful variables include prior golf experience, class organisation, teaching hours, facility access, instructor preparation, and whether course assessment rewards technical form, participation, or strategic understanding. These descriptors make comparison possible without treating national culture as a simple cause of observed outcomes. They also help identify which features of an intervention can travel across settings and which require local adaptation.

Table 2. Priority research questions for university golf pedagogy

Evidence gap	Research question	Useful design	Outcomes to report
Transfer	Do simulated and gamified gains persist in real golf?	Active-control trial with delayed retention and course tests.	Putting, chipping, swing, decisions, retention, transfer.
Population	Do effects differ by prior experience or learner group?	Multi-class, multi-site study with pre-specified subgroups.	Baseline skill, participation, differential effects, attrition.
Mechanism	Do autonomy, competence, flow, or enjoyment explain change?	Repeated measures with temporally ordered mediation tests.	Validated scales, engagement behaviour, skill performance.
Intervention fidelity	Which game elements and feedback schedules matter?	Clearly specified components and teacher implementation logs.	Practice dose, element exposure, fidelity, teacher workload.
Feasibility	Can the design work across university systems and resources?	Comparative replication in different institutional settings.	Facility access, costs, accessibility, student experience.

Note. Proposed designs are intended to test retention, transfer, mechanisms, and feasibility.

4. Conclusion

Gamification and simulation can improve university golf teaching when they help learners practise with appropriate challenge, receive information they can use, and connect movement to meaningful decisions. Current evidence is strongest for motivational and engagement outcomes. Evidence for improved skill performance is more variable, and claims about transfer to authentic golf remain premature. This distinction reflects differences in study design, age group, task, comparison instruction, and measurement rather than a simple contradiction in the literature.

The review's central contribution is to make transfer the organising question. A student's enjoyment of practice matters, but the stronger test is whether the student can retain a movement, adapt it to a changed task, and make a sound decision on the course after external support is reduced. University interventions should therefore compare well-designed gamified or simulated teaching with credible conventional instruction, measure psychological processes and objective skills separately, and include delayed and real-world outcomes.

The review has limits. Its narrative search was not designed to identify every relevant study, and it did not use duplicate screening, a formal risk-of-bias instrument, or a registered protocol. The synthesis may therefore overlook relevant evidence, particularly studies published in languages other than English or in outlets not indexed by the services searched. Several conclusions also depend on reviews that combine varied tasks and age groups. These limitations are why the manuscript does not present a pooled effect for university golf and treats adjacent evidence as a source of hypotheses rather than direct confirmation. A systematic review focused specifically on university golf would be valuable once a sufficiently comparable evidence base is available.

For Helios Multidisciplinary, the topic contributes to discussion of university curriculum and pedagogy across international settings. It shows how institutional context shapes technology use and student learning in a practical higher-education subject. The most useful next step is a multi-site study of a clearly specified golf curriculum, with a transparent intervention, validated measures, and follow-up that tests skill retention and on-course transfer. Until such evidence is available, technology should be selected for the learning problem it solves, not for its novelty.

Acknowledgement

The author thanks the researchers whose work informed this synthesis.

Funding

No external funding was received for this review.

Conflict of Interest

The author declares no conflict of interest.

Declaration on the use of generative artificial intelligence and AI-assisted technologies

AI-assisted tools were used during literature discovery, reference checking, language editing, and document preparation. The author is responsible for reviewing the evidence, verifying the sources, revising the analysis, and approving the final manuscript.

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