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A Meta-analysis of Learning Outcomes in Serious Games and Narrative Synthesis of Goal Orientation Effects

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ABSTRACT. The effectiveness of serious games as learning environments has been consistently documented but remains variable across individuals and contexts. The present study investigated the effect of serious games on learning outcomes and examined the role of goal orientation as an individual-difference variable within this relationship. A systematic review following PRISMA guidelines was conducted, combining a meta-analysis of pre–post learning outcome data with a structured narrative synthesis of goal orientation findings in accordance with Synthesis Without Meta-Analysis (SWiM) guidance. The meta-analysis included nine studies and revealed a statistically significant, moderate-to-large overall effect size (d = 0.637, 95% CI [0.483, 0.791], p < .001), indicating that participation in serious game environments is associated with meaningful improvements in knowledge acquisition. High heterogeneity was (I^2 = 82.13%), and no significant moderating effects were found for task type, sampling method, participant status, age, or gender. The narrative synthesis identified a consistently positive directional relationship between goal orientation and learning outcomes. Findings are discussed in terms of the motivational mechanisms underlying serious game effectiveness.

Keywords: serious games, goal orientation, learning outcomes, meta-analysis, narrative synthesis, systematic review

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INTRODUCTION

Recent years have seen a constant increase in the use of serious games in various learning contexts, reflecting a sustained growth in interest that continues into the present day, specifically linked to their potential positive outcomes on learning (Susi et al., 2007; Tene et al., 2025).

Work on serious games is rooted in the Experiential Learning Theory (Kolb, 1984) which reflects "the process whereby knowledge is created through the transformation of experience. Knowledge results from the combination of grasping and transforming experience" (Kolb, 1984, p. 41). The mechanism implies that participants in an experiential learning environment, such as a serious game setting, are immersed into concrete experiences which they then abstract and conceptualize, reflecting their ability to grasp experience and then transform it through reflective observation and active experimentation. In terms of learning outcomes, the experiential learning cycle is most productive when learners actively engage with all four stages—concrete experience, reflective observation, abstract conceptualization, and active experimentation—rather than cycling through them superficially (Kolb & Kolb, 2005). The proposition here is that serious games provide this exact outcome.

Drawing on experiential learning theory, we define serious games as "a game in which education (in its various forms) is the primary goal, rather than entertainment" (Michael & Chen, 2006, p.17). While entertainment still plays a crucial role, the main functionality of serious games is to facilitate and stimulate deep learning and understanding of the content or subject presented. They do that by providing opportunities for exploration, experimentation, and problem solving (Jenkins et al., 2009). Serious games create contexts in which players must engage their cognitive and motivational resources to advance through structured challenges (Facchino et al., 2025). This positions them as designed environments effective for the positive development of a number of different learning outcomes like skill acquisition (Fantozzi & Schiraldi, 2025), knowledge construction (Blasko et al., 2014), and behavioral change (Schuller et al., 2014).

While earlier work established the potential of employing serious games as learning tools in educational environments, the effectiveness of serious games remains a widely debated topic, with consistent reporting of mixed findings across the literature (Girard et al., 2013). Systematic reviews have documented both the potential and the limitations of educational games in producing reliable learning gains (Zuhri et al., 2025), and broader meta-reviews of the theoretical landscape have further highlighted the fragmented state of the field (Krath et al., 2021).

On the one hand, research shows that serious games and game-based learning interventions have positive effects on student cognitive learning outcomes like knowledge retention, problem-solving and critical thinking (Barz et al., 2024) and that they are positively related to academic achievement as well as affective-motivational outcomes (Soriano-Sánchez et al., 2026).

On the other hand, there is also evidence to suggest that, when games are not well integrated with curricular objectives, they might produce superficial level learning and reduced learning transfer due to shallow information processing (Yu et al., 2021), increase cognitive load (Chen & Chang, 2024), and even and lead to frustration, anxiety and demotivation (Karimov et al., 2024).

Most of these findings are anchored in game design effects. The introduction of meaningful choice, scaffolded learning, reward systems, and integration with curriculum objectives are crucial for maximizing learning benefits (Wong et al., 2024). The framing of the serious game itself (as a 'game' versus a 'serious exercise') can also influence depth of learning and information processing, sometimes even reduce learning if student focus shifts too much to gameplay at the expense of educational goals (Sanchiz et al., 2024).

However, the effectiveness of serious games as learning tools depends not only on game design features (Lameras et al., 2017) but also on the characteristics and orientations that individual learners bring to the experience, and how different learners interact with those features (Blasko et al., 2014). The intersection of these fields is critical because serious games do not merely coexist with learner motivation; they actively shape it. Understanding these individual differences is central to explaining the variability in learning outcomes documented across the literature (Blasko et al., 2014; Tene et al., 2025).

Current literature supports the idea that players are motivated to play games to satisfy their need for attaining or proving competency (Cheah et al., 2022). Achievement and learning motivation are generally thought to be a direct function of the individual's mindset (Garcia-Marquez & Bauer, 2021). Building on this idea, we clarify the connection by proposing that goal orientation dictates learning motivation—determining what makes games useful for learning for some individuals while remaining less effective for others (Backlund & Hendrix, 2013). Using the principles of experiential learning, serious games rely on the player's cognitive and motivational resources to transform the gaming environment into a setting for learning (Kolb & Kolb, 2009).

Learners who are oriented toward mastering new skills and deepening understanding are more likely to reflect on in-game feedback, revise their strategies, and extract transferable knowledge (Mayer, 2019), whereas those focused primarily on performance outcomes may disengage when faced with difficulty or failure (Garris et al., 2017). The motivational orientations that learners

bring to the game, in particular their goal orientation, may be a key variable in determining how effectively they engage with the experiential learning cycle embedded in serious game design (Garcia-Marquez & Bauer, 2021). Goal orientation, in this sense, may function as a moderator of how deeply learners traverse the experiential cycle embedded in serious game design.

Goal orientation theory (Dweck, 1986) encompasses the how and the why of people's approach to achievement situations. The origins of this theory are rooted in educational psychology, developed to interpret how individuals respond to learning and performance demands (Elliot & Dweck, 1988). Goal orientation is broadly defined as the disposition that guides individuals' purposes and behaviors in achievement settings, encompassing their desire for knowledge and skill acquisition as well as their concerns about demonstrating competence (Kaplan & Maehr, 2007). At its most foundational level, goal orientation has been described as a disposition toward developing or demonstrating mastery in an achievement situation (Dweck, 1986).

Moving from this foundational dichotomy, it is important to note that the literature has not converged on a uniform terminology for these constructs (Garcia-Marquez & Bauer, 2021; Krath et al., 2021). A more differentiated model is the 2×2 achievement goal framework proposed by Elliot and McGregor (2001), which integrates the mastery–performance distinction with an approach–avoidance dimension. This produces four goal types: mastery approach (MAP), mastery avoidance (MAV), performance approach (PAP), and performance avoidance (PAV). Furthermore, more recent research has refined this model to distinguish specifically between three dimensions: learning goal orientation (LGO), prove performance goal orientation (PPGO), and avoid performance goal orientation (APGO) to capture the nuances of how learners seek to demonstrate competence (Vandewalle, 1997; Garcia-Marquez & Bauer, 2021).

To provide a better transition between the stable trait view and context-specific behaviors, we must consider that goal orientation functions not only as a stable individual trait but also as a contextually activated motivational state that may be shaped by specific game attributes (Garcia-Marquez & Bauer, 2021). This underscores the need to account for goal orientation as an individual-difference variable when evaluating the effectiveness of serious games. Crucially, this perspective implies that the serious game environment acts as a situational moderator. While a learner might arrive with a specific trait orientation, the structural elements of a game, such as leaderboards, branching narratives, or sandbox exploration, which can temporarily 'override' these tendencies (Garcia-Marquez & Bauer, 2021; Vandewalle et al., 2019). By creating a specific 'state' orientation, the game environment dictates how the learner engages with challenges and, ultimately, how much knowledge they retain (Mayer, 2019; Tene et al., 2025).

We draw on goal orientation as an individual-difference variable that involves drive, cognition, feedback reactions, and achievement mentality (DeShon & Gillespie, 2005; Robins & Pals, 2002). While several studies have identified goal orientation as a trait influencing performance (Luijt, 2020; Shaw et al., 2026) and learning outcomes (Erhel & Jamet, 2016; Liu & Liu, 2020; Tapingkae et al., 2020), a systematic and methodologically rigorous investigation remains absent.

Unlike static instructional methods, the interactive and iterative nature of games provides a dynamic feedback loop that can 'prime' a learner's goal orientation. For instance, a game that rewards exploration and 'safe failure' may shift a learner from a performance-avoidance stance toward a mastery-oriented state, thereby directly influencing the cognitive gains measured in this meta-analysis. By identifying inter-individual differences as a potential moderator, we can more effectively justify the need for the proposed systematization of game-based learning research.

The primary contribution of this work lies in its dual synthesis: first, it provides a quantitative meta-analysis to establish the magnitude of learning gains, and second, it offers a narrative systematization of how goal orientation functions as a key individual difference that shapes those outcomes. The aim of the present study is to assess both the overall effect of serious games on learning outcomes and the role of goal orientation within this relationship.

H1. The use of serious games increases affective, cognitive, or achievement outcomes in the learning environment.
H2. The use of serious games has a significant positive effect on learning outcomes, in terms of gains and acquisition, compared to prior knowledge.
H3. Goal orientation has a positive effect on cognitive, behavioral, motor, and social learning outcomes in serious game contexts.

METHOD

We employed a dual-method approach to evaluate the current literature, following the updated PRISMA guidelines (Veroniki et al., 2025). There is a discrepancy between the 12 studies included in the narrative synthesis and the 9 studies shown in the meta-analysis; this arises because three studies lacked the specific pre–post statistical data (means and standard deviations) required for effect size computation. This exclusion is made early to ensure that the meta-analysis remains statistically rigorous while the narrative synthesis remains inclusive of qualitative findings.

Inclusion and Exclusion Criteria

Studies were selected based on specific inclusion criteria, including the use of serious games as a primary intervention and the assessment of learning or goal orientation outcomes, as summarized in Table 1.

Studies were excluded if they failed to report the necessary descriptive statistics required for effect size calculation, such as standard deviations or specific sample sizes for each experimental condition. This selection process ensured that the meta-analysis relied exclusively on complete, verifiable data to maintain high internal validity and prevent the introduction of bias through statistical estimation.

Table 1. *Inclusion and exclusion criteria*

Criterion	Description
Inclusion criteria	*1.* Using *serious games* for learning purposes; *2.* Utilizing *goal orientation theory* as framework, outcome explanation, moderator, mediator; 3. Reporting learning outcomes at /all levels: cognitive, social, motor, affective.
Exclusion criteria	4. Not using *serious games* as learning context 5. Using games and/or *serious games* for entertainment purposes; 6. Not reporting individual level learning outcomes 7. Not having a direct measure of the variable of interest (goal orientation, learning outcomes).

Note. Criteria developed in accordance with PRISMA (Veroniki et al., 2025).

Eligibility Criteria

Language constitutes the main eligibility criterion, based on potential language barriers and limitations. As such, only studies in Romanian and English were eligible for inclusion. No further eligibility restrictions were applied.

Information Sources

Selection of information sources was guided by recommendations for common search bases (DeCoster, 2004) and the available access possibilities. The final list consists of five research databases: Sage, Wiley, Science Direct,

ProQuest, and Google Scholar. From the initial list, three databases were excluded due to lack of relevant search results (SCOPUS, EBSCO, ERIC). Additional sources were identified through snowball sampling from the reference lists of selected articles. We included a range of publication types (journal articles, book chapters, case studies, dissertations, and conference papers); company reports were not included (Rahi, 2017). No attempts to contact authors for additional data were made, and no manual search of physical journals or books was conducted.

Screening

The flow diagram (Figure 1*)* provides a transparent summary of the review process and consists of five stages: (1) identification of studies from the literature search and removal of duplicates; (2) exclusion of ineligible studies based on title and abstract screening, with reasons documented; (3) exclusion of ineligible studies based on full-text review, with reasons; (4) inclusion of studies in the qualitative synthesis; and (5) inclusion of studies in the quantitative synthesis (meta-analysis) where applicable.

Search Strategy and Selection Process

The search strategy was constructed in accordance with the updated PRISMA checklist (Veroniki et al., 2025). For each database we have utilized the same sequence of key words, in the exact order, each time: *serious games, goal orientation theory/goal orientation, learning outcomes.* The intention of research is to identify the studies assessing individuals' goal orientation in serious games. We approached this topic broadly, without limiting to specific subdimensions, interventions, population or framework used.

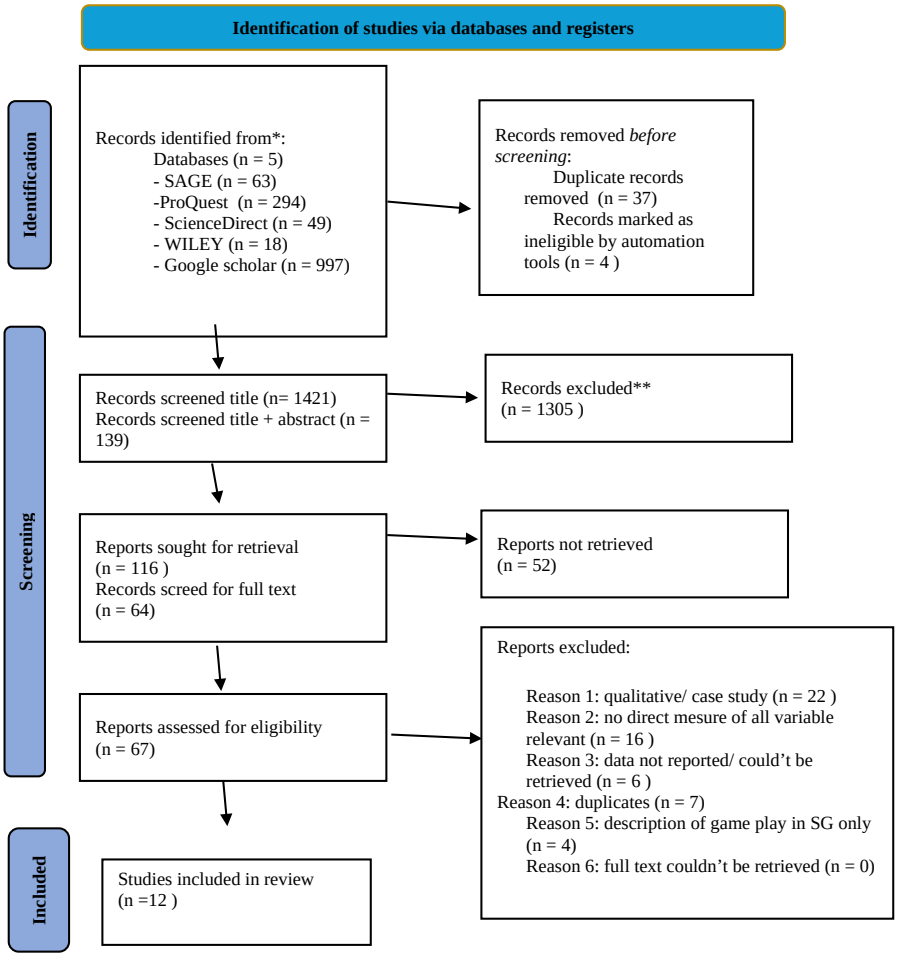
A record of the total results for each initial search has been kept and constantly updated. Specifically, the first step of the search process consists of sorting through articles by title screening (n =1421). While following the inclusion and exclusion criteria, articles have been included by judgement sampling. Furthermore, a duplicate of the database has been made and kept at each step in the search and selection process. The coding process has been conducted by two independent coders. This step includes a prior assembled and agreed upon protocol of coding.

Moving onto the second stage of the screening process, Referencing the inclusion, exclusion and eligibility criteria, we have conducted a screening of 131 articles. We paid close attention to the key words, assessment methods, sample and results presented in the abstract. The selection process was conducted by

two reviewers, with the second one comparing a random sample out of the pool of studies, for assessing their agreement rate. The overall agreement rate from all stages of the screening process is 84% from both reviewers.

The last stage of screening required evaluation of the remaining studies based on full text assessment. 52 papers were considered in this stage, and after full text analysis we have discarded most of them based on different arguments, such as: not meeting inclusion criteria, not having a direct measure for the relevant variables, study design (i.e. qualitative, case reports). At the end of this screening process, we ended up with a total of 12 studies.

Figure 1. *PRISMA (Veroniki et al., 2025) flow chart illustrating the screening process.*



Data Collection

The data collection process followed an established protocol based on DeCoster (2004) and the PRISMA checklist (Veroniki et al., 2025). We compiled a list of mandatory extraction requirements, including reference details, study purpose, population characteristics, study design, and type of intervention. We also developed codes relevant to the assessment of the study variables, including details on the serious games used (e.g., name, type, task type, game genre), description of goal orientation types and learning outcomes assessed, and methods of measurement. For the meta-analysis, additional codes captured the statistical data required for effect size computation (means, standard deviations, sample sizes).

Narrative Synthesis of Goal Orientation Data

For outcomes pertaining to goal orientation, a quantitative synthesis was not feasible due to substantial methodological heterogeneity across the included studies. Three distinct sources of incompatibility were identified.

First, the timing of goal orientation measurement varied considerably across studies. Some studies assessed goal orientation both prior to and following the game-based intervention (pre–post design), others measured it exclusively at a single post-intervention time point, and others embedded measurement within the game itself through in-game behavioral indicators. These differences precluded aggregation of scores, as the constructs captured at each time point are not conceptually equivalent.

Second, the instruments used to operationalize and measure goal orientation differed substantially across studies. Studies employed a range of validated and custom questionnaires, including the Achievement Goals Questionnaire (AGQ; Elliot & McGregor, 2001), the Goals Inventory (Roedel et al., 1994), the Goal Orientation Questionnaire (Button et al., 1996), the Science Motivation Questionnaire (Glynn & Koballa, 2006), the Learning Goal Orientation scale (VandeWalle, 1997), and instruction-based priming paradigms. This instrument diversity reflects a broader challenge in the field, as Krath et al. (2021) documented in their meta-review of theoretical foundations in gamification and serious game research, motivational constructs in this literature are operationalized inconsistently across studies, drawing on over 100 distinct theoretical frameworks. A pattern that seemed to surface and become apparent to this study as well.

Third, the theoretical framework underlying goal orientation was not uniform across studies. Some studies adopted a dichotomous model distinguishing learning or mastery goal orientation from performance goal orientation. Others

applied the more differentiated 2×2 achievement goal framework (Elliot & McGregor, 2001), which distinguishes mastery approach, mastery avoidance, performance approach, and performance avoidance goals. Still others employed a three-factor model (Garcia-Marquez & Bauer, 2021). This theoretical fragmentation means that studies using different frameworks are not measuring the same underlying construct, even when they use the same label.

In accordance with the guidance for Synthesis Without Meta-Analysis (SWiM; Page et al., 2021), we therefore conducted a structured narrative synthesis of goal orientation findings. This involved grouping studies by the direction and consistency of reported effects, describing patterns across the sample. Full details of the studies included in the narrative synthesis are presented in Table 7.

Following the narrative synthesis of goal orientation, the results of the meta-analytic synthesis for the remaining outcomes are presented below.

RESULTS

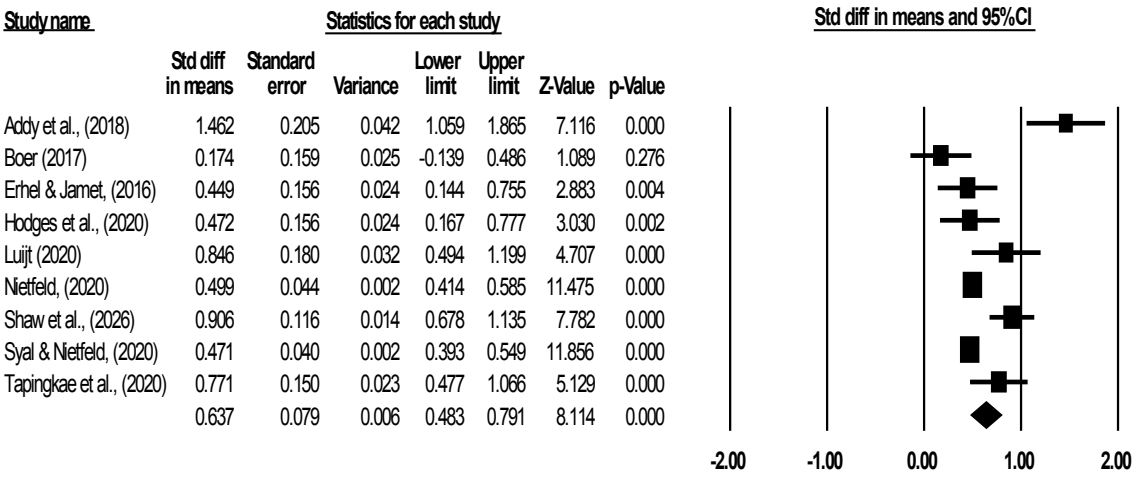
Heterogeneity analysis

The heterogeneity analysis performed for the distribution of effect sizes in our meta-analysis indicated a significant heterogeneity, $Q(8)= 44.77$, $p< 0.001$, $I^2=82.13$. Taking into account also the diversity related to the characteristics of participants, we decided to perform all the data analysis using a random-effects model.

The overall effect size

As illustrated in the forest plot (Figure 2), nearly all effect sizes are positive and significant, varying from small to large (Addy et al., 2018; Erhel & Jamet, 2016). Boer (2017) is the only study where a non-significant effect was found.

Figure 2. *Forest plot of studies included in the analysis and the overall effect size.*



The overall corrected effect size is d= 0.637, 95% CI= [0.483, 0.791] and statistically significant (Z= 8.11, p<0.001).

Table 2. *Summary of the effect size of each study included in the analysis*

Study	Std diff	Standard	Variance	Lower	Upper	Z-Value	p-Value
Addy et al	1.462	0.205	0.042	1.059	1.865	7.116	0.000
Erhel & Jamet	0.449	0.156	0.024	0.144	0.755	2.883	0.004
Hodges et al	0.472	0.156	0.024	0.167	0.777	3.030	0.002
Nietfeld	0.499	0.044	0.002	0.414	0.585	11.47	0.000
Shaw et al	0.906	0.116	0.014	0.678	1.135	7.782	0.000
Syal & Nietfeld	0.471	0.040	0.002	0.393	0.549	11.85	0.000
Tapingkae et	0.771	0.150	0.023	0.477	1.066	5.129	0.00

Note. Std. diff. in means = standardized mean difference (Cohen's d). Lower and upper limits reflect the 95% confidence interval boundaries. Effects estimated using a random-effects model. Two-tailed p-values reported.

Table 3 contains data regarding the magnitude of these findings. The results indicate a statistically significant, moderate-to-large overall effect size (d = 0.637, 95% CI [0.483, 0.791], Z = 8.11, p < .001). There was high heterogeneity among the studies, $Q(8)$= 44.77, p < 0.001, I^2=82.13, which suggests that the variance in effect sizes is likely due to moderating variables rather than sampling error alone.

These findings explicitly map back to our hypotheses, confirming that the data supports H1 and H2. Specifically, the results demonstrate that the use of serious games leads to substantial gains in learning acquisition compared to prior knowledge, even when accounting for the diversity of the study designs included in the sample.

Table 3. *Overall effect of learning outcomes*

Metric	Value
Mean effect size	**0.637**
Standard error	0.079
Variance	0.006
95% CI	[0.483, 0.791]
Z-value	8.114
p-value	**0.000**

Note. Effects estimated using a random-effects model. Two-tailed p-value reported.

Publication Bias Analysis

Publication bias analysis was performed using two methods, the Classic Fail-safe N of Rosenthal, and the Begg and Mazumdar's rank correlation test.

One concern of publication bias is that some non-significant studies are missing from our analysis and that these studies, if included, would nullify the observed effect. This meta-analysis incorporates data from 9 studies, which yield a z-value of 18.35 and corresponding 2-tailed p-value less than 0.001. The fail-safe N is 781. This means that we would need to locate and include 781 'null' studies in order for the combined 2-tailed p-value to exceed 0.05. Put another way, there would be need to be 86.8 missing studies for every observed study for the effect to be nullified.

The classic case of publication bias is the case depicted by the funnel plot. Large studies tend to be included in the analysis regardless of their treatment effect whereas small studies are more likely to be included when they show a relatively large treatment effect. Under these circumstances there will be an inverse correlation between study size and effect size. Begg and

Mazumdar suggested that this correlation can serve as a test for publication bias. Concretely, they suggest that we compute the rank order correlation (Kendall's tau b) between the treatment effect and the standard error (which is driven primarily by sample size).

In this case Kendall's tau b (corrected for ties, if any) is 0.25, with a 1-tailed p-value (recommended) of 0.174 or a 2-tailed *p*-value of 0.348 (based on continuity-corrected normal approximation) which indicates no publication bias.

Moderator Analyses

Type of Task

As shown in Table 4, no significant differences were found between categories $Q(1) = 0.52$, $p = .468$).

Table 4. *Effect size as a function of task type*

Tasks	No. of studies	*d*	Limits of confidence interval (95%)		*Z*	*p*
			Lower	Upper		
Decision-making	7	0.576	0.441	0.711	8.36	0.000
Problem-solving	2	0.947	-0.046	1.939	1.87	0.062

Note. k = number of studies; d = standardized mean difference (Cohen's d); CI = confidence interval. Effects estimated using a random-effects model. Two-tailed p-values reported. Heterogeneity between subgroups tested using Cochran's Q. Interpret problem-solving subgroup effect with caution due to small number of studies ($k = 2$).

The heterogeneity test between categories proved no significant differences, Q(1)= 0.52, p= 0.468.

Sampling Method

The results in Table 5 indicate that significant medium to large effect sizes were obtained for each sampling type, showing that the positive impact of serious games is not dependent on a specific recruitment strategy($Q(1) = 1.65$, $p = .198$).

Table 5. *Effect size as a function of sampling method*

Sampling	No. of studies	d	Limits of confidence interval (95%)		Z	p
			Lower	Upper		
Convenience sampling	5	0.757	0.370	1.144	3.836	0.000
Random sampling	4	0.499	0.430	0.569	14.049	0.000

Note. k = number of studies; d = standardized mean difference (Cohen's d); CI = confidence interval. Effects estimated using a random-effects model. Two-tailed p-values reported. Heterogeneity between subgroups tested using Cochran's Q.

Type of Participants

The data summarized in Table 6 demonstrates that the learning benefits of serious games remain robust across different populations, with no significant variance found between the performance of students and professionals $Q(1) = 0.74$, $p = .691$).

Table 6. *Effect sizes as a function of participant status*

Participants	No. of studies	d	Limits of confidence interval (95%)		Z	p
			Lower	Upper		
Middle school	3	0.537	0.369	0.704	6.27	0.000
Primary school	2	0.629	0.300	0.958	3.74	0.000
University students	4	0.738	0.255	1.221	2.99	0.003

Note. k = number of studies; d = standardized mean difference (Cohen's d); CI = confidence interval. Effects estimated using a random-effects model. Two-tailed p-values reported. Heterogeneity between subgroups tested using Cochran's Q.

Gender Differences

Gender was quantified as the percentage of women in each sample and tested as a predictor of the effect sizes. The meta-regression performed revealed that this variable had a non-significant predictive value (B= -0.007, Z= -0.23, p= 0.813).

Age

The meta-regression performed revealed that the mean age of the samples had no significant predictive value on the effect sizes (B= 0.008, Z= 0.99, p= 0.319).

Narrative Synthesis: Goal Orientation in Serious Game Contexts

The synthesis of 12 studies identified a consistently positive directional relationship between goal orientation and learning outcomes. These results are explicitly mapped back to H3, indicating that higher levels of mastery-oriented goals are associated with better achievement in serious game contexts.

Direction of effects

Across the twelve studies, the overall pattern of findings was positive in direction. Studies that examined goal orientation as a predictor or correlate of learning outcomes consistently reported positive associations, with reported effect sizes ranging from small to moderate. In studies employing pre–post designs, goal orientation scores showed small but statistically significant increases from pre- to post-game measurement, suggesting that engagement with serious games may exert a modest influence on learners' motivational orientations over the course of an intervention, in addition to its documented effect on knowledge outcomes. This directional consistency across varied populations and contexts lends preliminary support to the hypothesis that goal orientation operates as a relevant individual-difference variable in serious game learning environments.

Measurement heterogeneity and its implications

Despite the broadly positive directional pattern, direct comparison across studies was not possible due to the three sources of methodological incompatibility described in the Method section. Notably, studies using embedded in-game measurement capture a different facet of goal orientation, its behavioral expression during gameplay, than those relying on self-report questionnaires administered outside the game context. This distinction is theoretically meaningful as Garcia-Marquez and Bauer (2021) have argued, goal orientation functions not only as a stable individual trait but also as a contextually activated motivational state that may be shaped by specific game attributes. Measurement timing and method therefore constitute substantive moderating factors, not merely technical nuisances.

Framework heterogeneity and conceptual implications

The coexistence of dichotomous and multidimensional frameworks across the study pool reflects an unresolved theoretical debate in the goal orientation literature more broadly. Studies employing the simpler learning-versus-performance distinction (e.g., Addy et al., 2018; Boer, 2017; Evans, 2010) cannot be directly compared to those using the 2×2 approach–avoidance model (e.g., Syal & Nietfeld, 2020; Shaw et al., 2026; Liu & Liu, 2020), as the finer-grained distinctions between approach and avoidance subtypes carry different theoretical predictions. The field has not yet converged on a standard framework for examining goal orientation in game-based learning, a gap also identified in broader reviews of theoretical foundations in gamification research (Krath et al., 2021). This lack of consensus is itself a substantive finding of the present review, with direct implications for the design of future research.

The available evidence suggests a consistent, if modest, positive relationship between goal orientation and learning outcomes in serious game contexts. However, the methodological and theoretical fragmentation documented here underscores the need for greater standardization in how goal orientation is conceptualized, operationalized, and measured in this literature before cumulative quantitative synthesis becomes feasible.

Table 7. *Summary of studies examining goal orientation, context, and measurement instruments*

Study ID	Reference	Domain	Task Type	Participants	Goal Orientation	Instrument
SYAL2020	Syal & Nietfeld (2020)	Educational	Decision-making	Middle school	PAP; PAV; MAP; MAV	Achievement Goals Questionnaire (AGQ)
ADDY2018	Addy et al. (2018)	Educational	Problem-solving	University students	Learning; Performance	Goals Inventory (Roedel et al., 1994)
BOER2017	Boer (2017)	Educational	Decision-making	University students	Performance; Mastery	Goal Orientation Questionnaire (Button et al., 1996)
ERHEL2016	Erhel & Jamet (2016)	Educational	Problem-solving	University students	Mastery; Performance	Instruction-based priming (time on demonstration)

Study ID	Reference	Domain	Task Type	Participants	Goal Orientation	Instrument
EVANS2010	Evans (2010)	Military	Problem-solving	University students	Learning; Prove performance; Avoid performance	Survey (Yarbrough, 2007)
HODGES2020	Hodges et al. (2020)	Educational	Decision-making	Middle school	Performance (fixed); Learning (growth)	Mindset quiz
LIU2020	Liu & Liu (2020)	Educational	Problem-solving	University students	TAP; TAV; SAP; SAV; OAP; OAV	Goal Orientation Inventory (Elliot et al., 2011)
LUIJT2020	Luijt (2020)	Educational	Decision-making	Primary school	Performance (fun vs perform); Mastery (test vs learn)	Achievement goal reframing (Hawlitschek & Joeckel, 2017)
NIETFELD2020	Nietfeld (2020)	Educational	Decision-making	Primary school	Performance approach; Mastery approach	AGQ (Elliot & McGregor, 2001)
SHAW2026	Shaw et al. (2026)	Educational	Decision-making	University students	PAP; PAV; MAP; MAV	Achievement Goals Questionnaire (AGQ)
SUPER2020	Liu & Liu (2020)	Educational	Problem-solving	University students	Learning goal	Learning Goal Orientation (VandeWalle, 1997)
TAPINGKAE2020	Tapingkae et al. (2020)	Educational	Decision-making	Middle school	Goal orientation	Science Motivation Questionnaire (Glynn & Koballa, 2006)

Note. PAP = performance approach; PAV = performance avoidance; MAP = mastery approach; MAV = mastery avoidance; TAP = task approach; TAV = task avoidance; SAP = self approach; SAV = self avoidance; OAP = other approach; OAV = other avoidance; AGQ = Achievement Goals Questionnaire.

DISCUSSION

The present study investigated the effectiveness of serious games on learning outcomes while exploring the role of goal orientation as a critical individual-difference variable. Our meta-analysis of nine studies revealed a statistically significant, moderate-to-large overall effect size ($d = 0.637$), confirming that participation in serious game environments is associated with meaningful improvements in knowledge acquisition. These findings explicitly support H1 and H2, demonstrating that serious games lead to substantial gains compared to prior knowledge across diverse study designs in both academic and professional training contexts.

This study strengthens the current literature by bridging the gap between quantitative outcomes and qualitative drivers. By mapping robust learning effects directly to individual differences in goal orientation (H3), we provide a clearer picture of why games work. This dual perspective addresses the "mixed findings" often cited in the literature by demonstrating that while games are generally effective tools, the learner's motivational mindset acts as a critical boundary condition.

Furthermore, the narrative synthesis suggests that serious games may activate and reinforce learners' motivational orientations in ways that standard instructional approaches do not. By providing a safe environment for trial and error, these games allow for the "transformation of experience" into knowledge that is central to experiential learning theory. This confirms that goal orientation functions not only as a stable trait but as a situational state that is actively shaped by the game's goal-embedded structure and immediate, performance-contingent feedback mechanisms.

From a design perspective, these results suggest that a uniform approach to serious game mechanics may be counterproductive. Developers should consider implementing motivational tools, such as the option to disable public leaderboards for learners with a high performance-avoidance orientation, to mitigate the negative effects of goal interference and maximize cognitive gains.

Additionally, because the positive effect of serious games appears robust across different ages and genders, practitioners can confidently implement these tools in diverse settings, including employee training, leadership development, and simulation-based decision-making. Educators and organizational trainers should focus on the quality of feedback loops, as these are the primary drivers of engagement and knowledge retention. Ensuring that game challenges align with the learner's goal orientation will likely lead to more consistent and deeper cognitive engagement across both academic and professional environments.

While the absence of significant moderators indicates that the sources of variability remain largely unexplained, the consistency of the positive directional relationship between goal orientation and learning outcomes is encouraging. This study provides a necessary systematization of the field, moving beyond simple effectiveness measures to a more nuanced understanding of how individual differences dictate the success of game-based learning.

Limitations

Several limitations should be considered when interpreting these results. First, the relatively small number of studies included in the meta-analysis.

Second, many included studies employed pre–post designs without control groups. While such designs can detect improvements over time, they limit the ability to draw strong causal inferences regarding the effectiveness of serious games relative to other instructional methods.

Third, the high heterogeneity observed suggests substantial variability in effect sizes, which reduces the precision of the overall estimate. This variability may be partly explained by differences in study design, implementation, and measurement.

Fourth, learning outcomes were operationalized differently across studies, making it difficult to determine whether observed differences reflect intervention effects or measurement inconsistencies.

Fifth, a further limitation concerns the goal orientation component of this review. The inability to conduct a quantitative synthesis of goal orientation data is itself a reflection of the state of the field: the absence of a shared measurement standard and a common theoretical framework constrained what could be concluded. While the directional pattern of findings is informative, the narrative synthesis cannot establish the magnitude, moderators, or mechanisms of goal orientation effects with the same precision as a meta-analytic estimate.

Finally, although no evidence of publication bias was detected, the small number of studies reduces the sensitivity of these tests, and the possibility of unpublished null findings cannot be entirely ruled out.

Future research directions

Future research should aim to better understand the factors that contribute to variability in the effectiveness of serious games. In particular, studies should investigate the role of specific design features, such as feedback mechanisms, levels of interactivity and narrative elements, as well as instructional variables such as duration of exposure and integration into curricula.

There is also a need for more rigorous experimental designs, including randomized controlled trials that compare serious games with traditional instructional methods. Such designs would allow for stronger causal conclusions regarding their effectiveness.

With respect to goal orientation specifically, future research would benefit substantially from the adoption of a common theoretical framework, ideally the 2×2 achievement goal model (Elliot & McGregor, 2001) and a standardized measurement approach applied consistently across pre-game, in-game, and post-game time points. This would enable future meta-analytic synthesis of goal orientation effects and allow researchers to disentangle the contributions of mastery and performance orientations, and their approach and avoidance subtypes, to learning in serious game environments.

Finally, the development and use of standardized measures of learning outcomes would enhance comparability across studies and improve the overall quality of evidence in this field.

CONCLUSION

This study provides evidence that serious games have a significant positive effect on learning outcomes, with a moderate-to-large overall effect size. At the same time, the substantial heterogeneity observed across studies highlights the complexity of this field and the need for further research to identify the conditions under which serious games are most effective. A more systematic and standardized approach to research which would encompass both game effectiveness and goal orientation measurement, will contribute to a deeper understanding of how and when serious games can best support learning.

REFERENCES

Addy, T. M., Dube, D., Croft, C., Nardolilli, J. O., Paynter, O. C., Hutchings, M. L., ... & Reeves, P. M. (2018). Integrating a serious game into case-based learning. *Simulation & Gaming*, *49*(4), 378-400.

Backlund, P., & Hendrix, M. (2013, September). Educational games-are they worth the effort? A literature survey of the effectiveness of serious games. In *2013 5th international conference on games and virtual worlds for serious applications (VS-GAMES)* (pp. 1-8). IEEE.

Barz, N., Benick, M., Dörrenbächer-Ulrich, L., & Perels, F. (2024). The Effect of Digital Game-Based Learning Interventions on Cognitive, Metacognitive, and Affective-Motivational Learning Outcomes in School: A Meta-Analysis. *Review of Educational Research*, *94*(2), 193-227. https://doi.org/10.3102/00346543231167795

Blasko, D. G., Lum, H. C., White, M. M., & Drabik, H. B. (2014). Individual differences in the enjoyment and effectiveness of serious games. In *Psychology, pedagogy, and assessment in serious games* (pp. 153-174). 10.4018/978-1-4666-4773-2.ch008

Borenstein, M., Hedges, L. V., Higgins, J. P. T., & Rothstein, H. R. (2010). A basic introduction to fixed-effect and random-effects models for meta-analysis. *Research Synthesis Methods, 1*(2), 97–111. https://doi.org/10.1002/jrsm.12

Boer, P. S. (2017). *The role of goal orientation in enhancing adaptability by using serious gaming* (Master's thesis, University of Twente).

Cheah, I., Shimul, A. S., & Phau, I. (2022). Motivations of playing digital games: A review and research agenda. Psychology & Marketing, 39, 937–950. https://doi.org/10.1002/mar.21631

Chen, C. H., & Chang, C. L. (2024). Effectiveness of AI-assisted game-based learning on science learning outcomes, intrinsic motivation, cognitive load, and learning behavior. *Education and Information Technologies*, *29*(14), 18621-18642. https://doi.org/10.1007/s10639-024-12553-x

DeCoster, J. (2004). *Meta-analysis notes*. http://www.stat-help.com

DeShon, R. P., & Gillespie, J. Z. (2005). A Motivated Action Theory Account of Goal Orientation. *Journal of Applied Psychology, 90*(6), 1096-1127. https://doi.org/10.1037/0021-9010.90.6.1096

Dierdorff, E. C., Surface, E. A., & Brown, K. G. (2010). Frame-of-reference training effectiveness: Effects of goal orientation and self-efficacy on affective, cognitive, skill-based, and transfer outcomes. *Journal of Applied Psychology*, *95*(6), 1181. https://doi.org/10.1037/a0020856

Dweck, C. S. (1986). Motivational processes affecting learning. *American Psychologist, 41*(10), 1040–1048. https://doi.org/10.1037/0003-066X.41.10.1040

Elliot, A. J., & Dweck, C. S. (1988). Goals: An approach to motivation and achievement. *Journal of Personality and Social Psychology, 54*(1), 5–12. https://doi.org/10.1037/0022-3514.54.1.5

Elliot, A. J., & McGregor, H. A. (2001). A 2 × 2 achievement goal framework. *Journal of Personality and Social Psychology, 80*(3), 501–519. https://doi.org/10.1037/0022-3514.80.3.501

Erhel, S., & Jamet, E. (2016). The effects of goal-oriented instructions in digital game-based learning. *Interactive Learning Environments*, *24*(8), 1744–1757. https://doi.org/10.1080/10494820.2015.1041409

Evans, J. (2010). *A study of the relationship between goal orientation and performance in a military serious game* (Doctoral dissertation, University of Central Florida).

Facchino AP, Marchetti D, Colasanti M, Fontanesi L and Verrocchio MC (2025) The use of serious games for psychological education and training: a systematic review. Front. Educ. 10:1511729. doi: 10.3389/feduc.2025.1511729

Fantozzi IC, Schiraldi MM (2025). "Bridging education and industry: university challenges and serious games for professional skill development". *The TQM Journal*, Vol. ahead-of-print No. ahead-of-print. https://doi.org/10.1108/TQM-12-2024-0511

Garcia-Marquez, C., & Bauer, K. N. (2021). An examination and extension of the theory of gamified learning: The moderating role of goal orientation. *Simulation & Gaming, 52*(4), 407–434. https://doi.org/10.1177/1046878120958741

Garris, R., Ahlers, R., & Driskell, J. E. (2017). Games, motivation, and learning: A research and practice model. In *Simulation in aviation training* (pp. 475-501). Routledge.

Girard, C., Ecalle, J. and Magnan, A. (2013), Serious games as new educational tools: how effective are they? A meta-analysis of recent studies. *Journal of Computer Assisted Learning*, 29: 207-219. https://doi.org/10.1111/j.1365-2729.2012.00489.x

Hodges, G. W., Flanagan, K., Lee, J., Cohen, A., Krishnan, S., & Ward, C. (2020). A quasi-experimental study comparing learning gains associated with serious educational gameplay and hands-on science in elementary classrooms. *Journal of Research in Science Teaching*, *57*(9), 1460-1489. https://doi.org/10.1002/tea.21661

Hornberger, B., & Rangu, S. (2020) Designing Inclusion and Exclusion Criteria. 3–13. https://repository.upenn.edu/crp/1

Kaplan, A., & Maehr, M. L. (2007). The contributions and prospects of goal orientation theory. *Educational psychology review*, *19*(2), 141-184. https://doi.org/10.1007/s10648-006-9012-5

Karimov, A., Saarela, M., & Kaerkkaeinen, T. (2024). Serious games in science and mathematics education: a scoping umbrella review. *International Journal of Serious Games*, *11*(4), 3-20. https://doi.org/10.17083/ijsg.v11i4.765

KoIb, D.A. 1984. Experiential learning: Experience as the source of learning and development. Englewood CKfB, NJ: Prentice-Hall.

Kolb, A. Y., & Kolb, D. A. (2005). Learning styles and learning spaces: Enhancing experiential learning in higher education. *Academy of management learning & education*, *4*(2), 193-212.

Kolb, A. Y., & Kolb, D. A. (2009). Experiential learning theory: A dynamic, holistic approach to management learning, education and development. *The SAGE handbook of management learning, education and development*, *7*(2), 42-68.

Krath, J., Schürmann, L., & Von Korflesch, H. F. (2021). Revealing the theoretical basis of gamification: A systematic review and analysis of theory in research on gamification, serious games and game-based learning. *Computers in human behavior*, *125*, 106963. https://doi.org/10.1016/j.chb.2021.106963

Lameras, P., Arnab, S., Dunwell, I., Stewart, C., Clarke, S. and Petridis, P. (2017), Essential features of serious games design in higher education: Linking learning attributes to game mechanics. *Br J Educ Technol*, 48: 972-994. https://doi.org/10.1111/bjet.12467

Liu, S., & Liu, M. (2020). The impact of learner metacognition and goal orientation on problem-solving in a serious game environment. *Computers in Human Behavior*, *102*, 151-165. 10.1016/j.chb.2019.08.021

Luijt, M. (2020). *Framing in serious gaming: the effects of initial instruction and prior gaming experience on learning outcomes and motivation* (Master's thesis).

Mayer, R. E. (2019). Thirty years of research on online learning. *Applied Cognitive Psychology*, *33*(2), 152-159.

Meline, T. (2006). Selecting studies for systemic review: Inclusion and exclusion criteria. *Contemporary issues in communication science and disorders*, *33*(Spring), 21-27.

Methley, A.M., Campbell, S., Chew-Graham, C. *et al.* PICO, PICOS and SPIDER: a comparison study of specificity and sensitivity in three search tools for qualitative systematic reviews. *BMC Health Serv Res* **14**, 579 (2014). https://doi.org/10.1186/s12913-014-0579-0

Michael, D. R., & Chen, S. L. (2005). *Serious games: Games that educate, train, and inform*. Muska & Lipman/Premier-Trade. 1592006221.

Nietfeld, J. L. (2020). Predicting transfer from a game-based learning environment. *Computers & Education, 146*, 103780. https://doi.org/10.1016/j.compedu.2019.103780

Page, M. J., McKenzie, J. E., Bossuyt, P. M., Boutron, I., Hoffmann, T. C., Mulrow, C. D., ... & Moher, D. (2021). The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. *bmj*, *372*. https://doi.org/10.1136/bmj.n71

Ratan, R. A., & Ritterfeld, U. (2009). Classifying serious games. In *Serious games* (pp. 10-24). Routledge.

Ritterfeld, U., Cody, M., & Vorderer, P. (Eds.). (2009). *Serious games: Mechanisms and effects*. Routledge.

Robins, R. W., & Pals, J. L. (2002). Implicit self-theories in the academic domain: Implications for goal orientation, attributions, affect, and self-esteem change. *Self and identity*, *1*(4), 313-336. https://doi.org/10.1080/15298860290106847

Sanchiz, M., Gimenes, M., & Lambert, E. (2024). Learning With Board Games: Interplay of Context and Students' Prior Knowledge. *Journal of Experimental Education*. https://doi.org/10.1080/00220973.2024.2414025

Schuller, B. W., Dunwell, I., Weninger, F., & Paletta, L. (2013). Serious gaming for behavior change: The state of play. *IEEE pervasive computing*, *12*(3), 48-55. 10.1109/MPRV.2013.54

Shaw, R., Bong, J. Y., Sperano, I., & Andruchow, R. (2026). Integration of a digital serious video game into an online first-year post-secondary biology course. *Heliyon*, *12*(5).

Soriano-Sánchez, J. G., López, R. Q., & Rodríguez, D. A. (2026). The Impact of Game-Based Learning on Motivation, Self-Efficacy, and Academic Achievement in the Natural Sciences: A Meta-Analysis. *Education Sciences*, *16*(1), Article 122. https://doi.org/10.3390/educsci16010122

Super, J. F., Betts, T. K., Keller, H., & Humphreys, J. R. (2020). Simulation game outcomes: A multilevel examination of knowledge sharing norms, transactive memory systems, and individual learning goal orientations. *Simulation & Gaming*, *51*(6), 830-858. https://doi.org/10.1177/1046878120943251

Susi, T., Johannesson, M., & Backlund, P. (2007). Serious games: An overview.

Syal, S., & Nietfeld, J. L. (2020). The impact of trace data and motivational self-reports in a game-based learning environment. *Computers & Education*, *157*, 103978. https://doi.org/10.1016/j.compedu.2020.103978

Tapingkae, P., Panjaburee, P., Hwang, G. J., & Srisawasdi, N. (2020). Effects of a formative assessment-based contextual gaming approach on students' digital citizenship behaviours, learning motivations, and perceptions. *Computers & Education*, *159*, 103998. https://doi.org/10.1016/j.compedu.2020.103998

Tene T, Vique López DF, Valverde Aguirre PE, Cabezas Oviedo NI, Vacacela Gomez C and Bellucci S (2025) A systematic review of serious games as tools for STEM education. Front. Educ. 10:1432982. doi: 10.3389/feduc.2025.1432982

VandeWalle, D., Cron, W. L., & Slocum Jr, J. W. (2001). The role of goal orientation following performance feedback. *Journal of applied psychology*, *86*(4), 629.

Vandewalle, D., Nerstad, C. G., & Dysvik, A. (2019). Goal orientation: A review of the miles traveled and the miles to go. *Annual Review of Organizational Psychology and Organizational Behavior*, *6*(1), 115-144. https://doi.org/10.1146/annurev-orgpsych-041015-062547

Veroniki, A. A., Hutton, B., Stevens, A., McKenzie, J. E., Page, M. J., Moher, D., ... & Tricco, A. C. (2025). Update to the PRISMA guidelines for network meta-analyses and scoping reviews and development of guidelines for rapid reviews: a scoping review protocol. *JBI evidence synthesis*, *23*(3), 517-526. https://doi.org/10.11124/JBIES-24-00308

Wong, Y. L., Bothma, T., & Smith, A. (2024). Effects of Meaningful Choices in Serious Games for Meaningful Learning. *International Journal of Serious Games*, *11*(3), 71-87. https://doi.org/10.17083/ijsg.v11i3.745

Yu, Z. G., Gao, M. L., & Wang, L. F. (2021). The Effect of Educational Games on Learning Outcomes, Student Motivation, Engagement and Satisfaction. *Journal of Educational Computing Research*, *59*(3), 522-546, Article 0735633120969214. https://doi.org/10.1177/0735633120969214

Zuhri, S., Hidayat, S., Fadlullah, F., & Adam, S. (2025). The Impact of Educational Games on Learning: Systematic Review of Literature and Field Studies. *Al-Tarbawi Al-Haditsah: Jurnal Pendidikan Islam*, *10*(2), 231-257. https://doi.org/10.24235/tarbawi.v10i2.20045