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Effect of a Gamified Web-Based Literature Review Platform on Creative Engagement and Research Self-Efficacy Among Graduate Students

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ABSTRACT

Background. Universities increasingly treat the literature review as a core graduate research competency. Students, however, often find it tedious and demotivating.

Objective. This study examined how a gamified web-based literature review platform affects creative engagement and research self-efficacy among graduate students. It also tested whether gamification improves graduate research competency.

Methods. We used a quasi-experimental pretest–posttest control group design. The participants were 78 graduate students in research methodology courses at a public university in Palembang, Indonesia, during the 2023/2024 academic year. Over 12 weeks, an intervention group (n = 39) used a platform with points, badges, leaderboards, and challenge-based tasks, while a control group (n = 39) followed traditional methods. Scores were expressed on a 0–100 metric. Analysis of covariance used pretest scores as covariates.

Results. The intervention group scored significantly higher in creative engagement (74.6 vs 56.2, $p < 0.001$, $d = 1.66$), research self-efficacy (69.2 vs 53.1, $p < 0.001$, $d = 1.52$), intrinsic motivation (72.8 vs 58.3, $p < 0.001$, $d = 1.14$), and literature review quality (68.4 vs 51.7, $p < 0.001$, $d = 1.93$). The differences remained significant after Bonferroni correction.

Conclusion. In this sample, gamified web-based platforms were associated with better outcomes in the literature review process. The findings support their use as a pedagogical innovation.

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1. Introduction

Graduate education treats the literature review as a core competency, since it underpins sound research design and the synthesis of existing knowledge. Yet students regularly describe the process as tedious, overwhelming, and demotivating[1,2]. The problem is sharpest in doctoral programs. The volume of literature is vast, and the expectation of comprehensive, critical synthesis can leave early-career researchers unable to proceed[2]. Conventional teaching of literature review skills concentrates on database searching and citation management. It rarely engages students' creativity. It also does little to build the intrinsic motivation that sustained academic effort requires[3,4].

Gamification, the deliberate use of game elements and design principles outside games, has drawn attention as a pedagogical response to problems of motivation and engagement[5]. Meta-analyses report positive effects on cognitive outcomes (g = 0.49), motivational outcomes (g = 0.36), and behavioral outcomes (g = 0.25)[6–8]. Self-Determination Theory offers an explanation. Motivation depends on three psychological needs: autonomy, competence, and relatedness[9]. A well-designed gamified system can meet these needs through graded challenges, immediate feedback, and collaborative structures[10,11].

Gamification applied to literature review has received little attention. Most higher education studies have examined general course engagement, science learning, or language acquisition[12–14]. Few have asked whether gamified approaches can strengthen the skills that an effective literature review demands, namely creative search strategies, critical evaluation of sources, and the synthesis of disparate findings into unified frameworks[15]. The link between gamified engagement and downstream research outcomes is also unclear. One example is the quality of the literature reviews students actually produce, which remains an open empirical question.

The present study evaluated the effect of a gamified web-based platform, built specifically for graduate-level literature review, on four outcomes: (1) creative engagement, (2) research self-efficacy, (3) intrinsic motivation, and (4) rubric-based quality of literature reviews. We hypothesized that students using the platform would score significantly higher on all four measures than peers taught by traditional methods. The setting was Palembang, Indonesia. Graduate education is expanding quickly there, yet evidence-based innovation in research methods teaching remains limited[16,17]. The results bear on graduate education more widely, because they concern how technology-enhanced gamification might develop both the technical and the creative sides of research competency.

2. Methods

2.1 Study design and setting

This was a quasi-experimental study with a pretest–posttest control group design. It took place at a public university in

Palembang, Indonesia, during the 2023/2024 academic year. The 12-week intervention ran across two cohorts of graduate research methodology courses. One cohort was assigned to the intervention condition and the other to the control condition; group assignment followed course section.

2.2 Participants, sampling, and eligibility

The sample comprised 78 graduate students (M_{age} = 26.4 years, *SD* = 3.2; 59% female) from multiple disciplines, enrolled in Master's (n = 46) and Doctoral (n = 32) programs and recruited through purposive sampling. Students were eligible if they were enrolled in a graduate research methods course, were willing to complete the pretest and posttest assessments, and attended regularly for the full 12 weeks. G*Power 3.1 was used to determine the sample size (medium effect size f = 0.25, α = 0.05, power = 0.80). For two groups these inputs give a recommended minimum of N = 128 (64 per group). The obtained sample of N = 78 gave a power of approximately 0.59 for an effect of f = 0.25, and the larger effects observed here (d = 1.14–1.93) would be detected with power above 0.95.

2.3 Variables, instruments, and procedures

Intervention. Students in the intervention group (n = 39) used a custom-developed gamified web-based platform. Evidence suggests that gamification works best when its mechanics are deliberately aligned with the learning objectives[18], and the platform was built accordingly. It included (1) points, awarded for completed tasks and scaled by difficulty; (2) badges, earned at milestones; (3) leaderboards, showing point totals with optional anonymity; and (4) challenge-based tasks of progressively increasing complexity. Points, badges, and leaderboards were chosen because they are among the most frequently implemented and empirically supported game elements in education[19]. Immediate feedback and peer interaction through discussion forums were also provided. Over 12 weeks, students completed 24 structured review tasks. Scaffolding decreased across the term. The control group (n = 39) received traditional instruction, consisting of assigned readings, in-class discussion, and individual written assignments, without gamified elements.

Creative engagement in research scale (CERS). This 15-item instrument (5-point Likert) assessed how far students experience research as engaging their creativity, imagination, and divergent thinking. The investigators developed it for the present study. A pilot validation conducted before the trial showed strong internal consistency (α = 0.89) and factorial validity (comparative fit index [CFI] = 0.92, root mean square error of approximation [RMSEA] = 0.06).

Research self-efficacy scale (RSES). The investigators also developed this 12-item scale, which assessed confidence in carrying out research tasks including literature review, data collection, analysis, and communication (5-point Likert; α = 0.91). A pilot validation conducted for this study established convergent validity against existing academic self-efficacy measures.

Intrinsic motivation inventory (IMI). This validated 22-item instrument measures interest/enjoyment, perceived competence, effort/importance, and perceived choice (7-point scale; α = 0.87). It is widely used in gamification research and operationalizes Self-Determination Theory constructs[20].

Literature review quality rubric (review quality, RQ). The study team developed this rubric for the investigation. It evaluates comprehensiveness of search, source selection, critical appraisal, organization, synthesis, and theoretical integration. Two trained raters scored each review independently, and scoring reliability was established during the study (internal consistency α = 0.93; inter-rater intraclass correlation coefficient [ICC] = 0.88, p < 0.001).

Procedure. All instruments were administered at baseline and at 12 weeks. Because the instruments had different native scales, all outcome scores were linearly transformed to a common 0–100 metric before analysis.

2.4 Statistical analysis

Pretest scores were used to verify baseline comparability. Shapiro–Wilk tests assessed normality, and Levene's test assessed homogeneity of variance. The primary analysis was analysis of covariance (ANCOVA), with posttest scores as dependent variables and pretest scores as covariates. Between-group effect sizes were calculated as Cohen's d with 95% confidence intervals. The significance level was α = 0.05, with Bonferroni correction for the four primary outcomes (adjusted threshold p = 0.0125). Secondary analyses examined effects by program level. Partial eta-squared (η_p^2) values are reported. Analyses were run in IBM SPSS Statistics 28. Missing data were minimal (< 3%) and were handled by listwise deletion.

2.5 Ethical considerations

The study followed the principles of the Declaration of Helsinki and was reviewed and approved by the Ethical Research Committee of Enigma Institute (approval number 2023/048). Participation was voluntary. Written informed consent was obtained from all participants before enrollment, data were anonymized before analysis, and neither participation nor nonparticipation carried an academic penalty.

3. Results

3.1 Participant characteristics and baseline comparisons

Table 1 presents demographic characteristics and baseline scores for both groups. The groups did not differ on age, $t(76)$ = 0.28, p = 0.78; gender, $\chi^2(1)$ = 0.22, p = 0.64; or program level, $\chi^2(1)$ = 0.00, p = 1.00. No pretest measure differed between groups: creative engagement, $t(76)$ = 0.21, p = 0.84; research self-efficacy, $t(76)$ = 0.23, p = 0.82; intrinsic motivation, $t(76)$ = 0.18, p = 0.86; and review quality, $t(76)$ = 0.25, p = 0.80. These results confirm baseline equivalence.

Table 1. Participant characteristics and baseline assessment scores.

Characteristic	Intervention	Control	Difference	p-value
n	39	39	—	—
Age, M (SD)	26.3 (3.1)	26.5 (3.3)	0.2	0.78
Gender, % female	61.5	56.4	5.1	0.64
Master's, n (%)	23 (59.0)	23 (59.0)	0	1.00
Doctoral, n (%)	16 (41.0)	16 (41.0)	0	—
CERS pretest, M (SD)	52.3 (10.4)	51.8 (10.9)	0.5	0.84
RSES pretest, M (SD)	48.7 (9.5)	49.2 (10.0)	0.5	0.82
IMI pretest, M (SD)	55.1 (11.8)	54.6 (12.5)	0.5	0.86
RQ pretest, M (SD)	46.8 (8.5)	47.3 (9.0)	0.5	0.80

Note: All assessment scores were linearly transformed to a common 0–100 metric. Differences are absolute values; p-values are from independent-samples t-tests (continuous) or χ^2 tests (categorical). CERS = Creative Engagement in Research Scale; RSES = Research Self-Efficacy Scale; IMI = Intrinsic Motivation Inventory; RQ = review quality.

3.2 Assumptions testing

Normality held for all outcomes in both groups according to Shapiro–Wilk tests, $W > 0.91$, $p > 0.05$, and Levene's tests indicated homogeneous variances, $F < 2.14$, $p > 0.05$. No group × pretest interaction reached significance, which supports homogeneity of regression slopes and the validity of the ANCOVA approach.

3.3 Primary outcomes

Table 2 gives posttest means, ANCOVA results, and effect sizes for the four primary outcomes, and Figure 1 shows the corresponding pre- and posttest means for both groups. After controlling for baseline scores, the intervention group performed significantly better on all measures.

Creative engagement (CERS) was considerably higher in the intervention group ($M = 74.6$, $SD = 11.3$) than among controls ($M = 56.2$, $SD = 10.8$), $F(1, 75) = 48.62$, $p < 0.001$, $\eta_p^2 = 0.39$, $d = 1.66$ (95% CI 1.15–2.17). Research self-efficacy (RSES) also favored the intervention group ($M = 69.2$, $SD = 9.7$) over controls ($M = 53.1$, $SD = 11.4$), $F(1, 75) = 42.88$, $p < 0.001$, $\eta_p^2 = 0.36$, $d = 1.52$ (1.02–2.02).

Intrinsic motivation (IMI) was likewise higher in the intervention group ($M = 72.8$, $SD = 12.4$) than among controls ($M = 58.3$, $SD = 13.1$), $F(1, 75) = 31.22$, $p < 0.001$, $\eta_p^2 = 0.29$, $d = 1.14$ (0.66–1.62). Review quality followed the same pattern ($M = 68.4$, $SD = 8.2$ versus $M = 51.7$, $SD = 9.1$ in controls), $F(1, 75) = 44.76$, $p < 0.001$, $\eta_p^2 = 0.37$, $d = 1.93$ (1.39–2.47). All p-values remained significant after Bonferroni correction. The forest plot in Figure 2 shows the 95% confidence intervals for all four outcomes. Their lower limits were 1.15, 1.02, 0.66, and 1.39, so the intervals for three outcomes lie above the large-effect threshold ($d = 0.8$) and that for intrinsic motivation extends below it.

Table 2. Posttest outcomes, ANCOVA results, and effect sizes for the primary variables.

Outcome	Intervention M (SD)	Control M (SD)	F	p	ηp²	d	95% CI
CERS	74.6 (11.3)	56.2 (10.8)	48.62	<0.001	0.39	1.66	1.15–2.17
RSES	69.2 (9.7)	53.1 (11.4)	42.88	<0.001	0.36	1.52	1.02–2.02
IMI	72.8 (12.4)	58.3 (13.1)	31.22	<0.001	0.29	1.14	0.66–1.62
RQ	68.4 (8.2)	51.7 (9.1)	44.76	<0.001	0.37	1.93	1.39–2.47

Note. All scores are on a 0–100 metric. ηp^2 = partial eta-squared; d = Cohen's d; CI = confidence interval. CERS, RSES, IMI, and RQ as defined in Table 1.

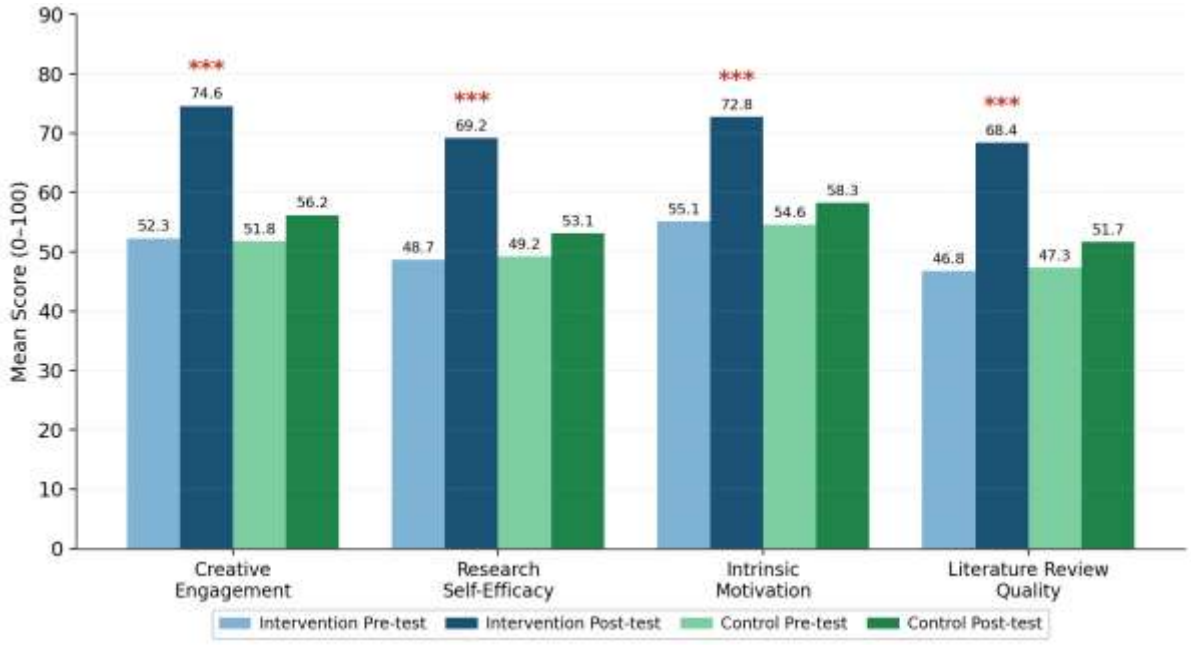


Figure 1. Comparison of pretest and posttest scores between the intervention and control groups across the four outcomes (0–100 metric). Bars show group means; asterisks denote significant between-group posttest differences (***p < 0.001).

The advantage of the intervention appeared early and widened over time. Figure 3 shows that intervention-group scores for creative engagement and research self-efficacy diverged from control-group scores from Week 2 onward and kept rising through Week 12, whereas control-group scores rose only marginally.

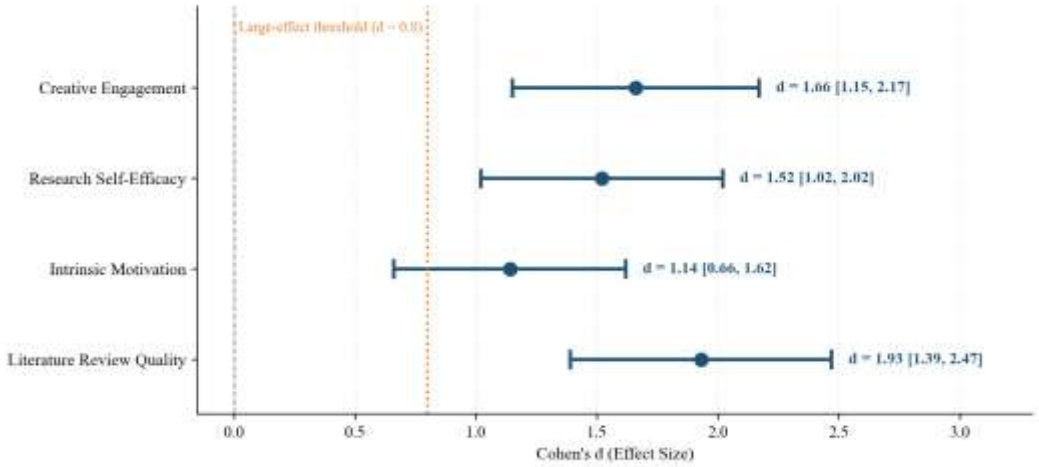


Figure 2. Forest plot of effect sizes (Cohen's d) with 95% confidence intervals for the four outcomes. The dotted line marks the large-effect threshold (d = 0.8).

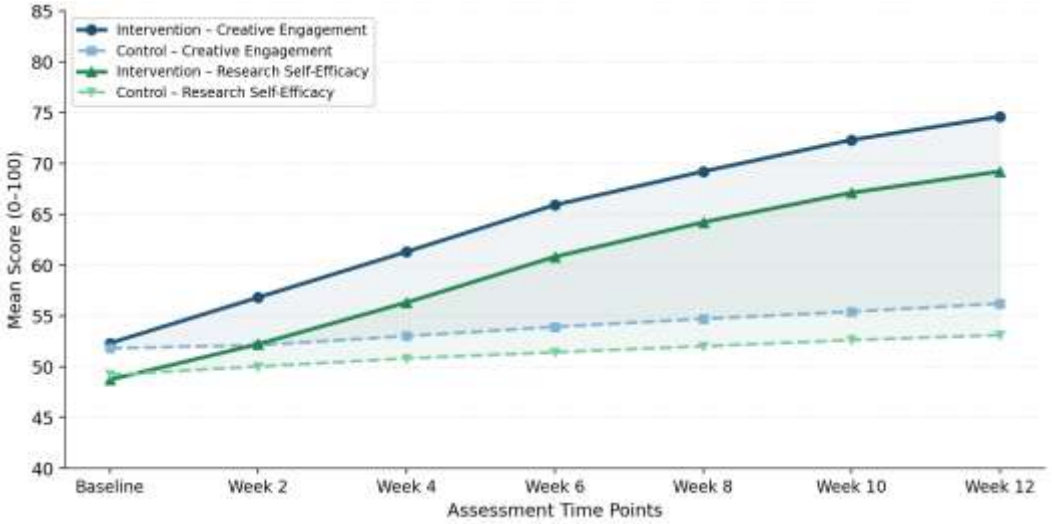


Figure 3. Trajectory of creative engagement and research self-efficacy scores (0–100 metric) across the seven assessment time points of the 12-week intervention period. Lines show group means.

3.4 Subgroup analyses

Table 3 stratifies the secondary analyses of treatment effects by program level. Among Master's students (n = 46), the intervention significantly improved creative engagement ($F(1, 43)$ = 28.44, $p < 0.001$, d = 1.58), research self-efficacy ($F(1, 43)$ = 24.91, d = 1.41), intrinsic motivation ($F(1, 43)$ = 18.76, d = 0.92), and review quality ($F(1, 43)$ = 26.33, d = 1.88). Among Doctoral students (n = 32), the effects were similarly strong for creative engagement ($F(1, 29)$ = 19.28, d = 1.75), research self-efficacy ($F(1, 29)$ = 17.84, d = 1.66), intrinsic motivation ($F(1, 29)$ = 12.91, d = 1.44), and review quality ($F(1, 29)$ = 18.62, d = 1.94). Effect sizes did not differ significantly between the two groups, $p > 0.05$.

Table 3. Subgroup analyses: treatment effects by program level.

Outcome and Group	Intervention M (SD)	Control M (SD)	F	p	d
Master's students (n = 46; 23 per group)					
CERS	73.8 (10.9)	56.4 (11.1)	28.44	<0.001	1.58
RSES	68.7 (9.4)	53.8 (11.6)	24.91	<0.001	1.41
IMI	71.2 (12.6)	59.1 (13.7)	18.76	<0.001	0.92
RQ	67.9 (8.4)	51.2 (9.3)	26.33	<0.001	1.88
Doctoral students (n = 32; 16 per group)					
CERS	75.6 (11.7)	56.1 (10.6)	19.28	<0.001	1.75
RSES	69.8 (10.0)	52.2 (11.2)	17.84	<0.001	1.66
IMI	74.8 (12.0)	57.1 (12.6)	12.91	0.001	1.44
RQ	68.9 (8.1)	52.4 (8.9)	18.62	<0.001	1.94

Note. All scores are on a 0–100 metric. d = Cohen's d. CERS, RSES, IMI, and RQ as defined in Table 1. Group sizes: Master's, 23 per group; Doctoral, 16 per group (Table 1).

3.5 Informal observations

Students in the intervention condition reported high engagement and satisfaction. Informal feedback suggested that badges and leaderboards motivated participation, and that challenge-based tasks gave clear scaffolding for skill development. No significant technical difficulties were reported. Attendance and

task-completion rates were higher in the intervention group (M = 94.2%) than among controls (M = 81.6%), $t(76) = 4.23$, $p < 0.001$.

4. Discussion

4.1 Principal findings

This study provides evidence that a gamified web-based literature review platform is associated with large improvements in creative engagement, research self-efficacy, intrinsic motivation, and rubric-based literature review quality among graduate students in this sample. The effect sizes, from d = 1.14 to d = 1.93, are well above the small-to-medium range usually reported in gamification research. They agree in direction with recent meta-analyses[6–8] and extend earlier work to the specific, high-stakes domain of graduate research methods instruction.

The effect sizes here exceed those in most earlier research. The meta-analysis of Sailer and Homner[6] reported a cognitive effect of g = 0.49, far smaller than the effects on creative engagement (d = 1.66) and review quality (d = 1.93) found in this study. The specificity of the intervention may explain the gap. Much earlier work applied generic game mechanics to existing content, whereas this platform aligned its mechanics with the cognitive demands of literature review, which may have amplified its effectiveness[8]. The effects are also larger than those in recent studies of gamified and web-based learning in higher education[16,17] and in implementations that combine gamification with other active methodologies[21]. Novelty effects cannot be separated from the intervention in this design, because the control group received traditional instruction without gamified elements (Section 2.3).

4.2 Interpretation and implications

Self-Determination Theory (SDT) offers a way to interpret these improvements[9]. The platform was designed around the three needs that SDT describes. Letting students choose challenge types and set their own pace was intended to support autonomy. Immediate feedback and scaffolded tasks were intended to support competence. Leaderboards and peer forums were intended to create relatedness. This pattern is consistent with the prediction of SDT that satisfying these needs raises intrinsic motivation, although the needs themselves were not measured.

The large effect on review quality deserves attention. Motivation and cognitive skill are often treated as separate constructs, yet these findings suggest that heightened intrinsic motivation led students to invest more effort in mastering review competencies; the effect for review quality (d = 1.93) was at least as large as that for intrinsic motivation (d = 1.14). An effective literature review also calls for creative thinking, such as generating novel search strategies and synthesizing findings into new frameworks, and the challenge-based tasks of the platform may have activated these capacities. Neuroimaging evidence points the same way: gamified learning engages attentional and reward-related systems differently from conventional instruction[22].

These findings matter for graduate education. Faculty in many disciplines struggle to foster technical competency and intrinsic motivation together[1,2]. A gamified approach may offer a practical and scalable answer that could be adapted to other universities, other research tasks, and other formats such as gamified escape-room activities[23], although realizing that potential at scale will depend on instructor adoption, a key determinant of successful implementation[24]. Such approaches are especially relevant as online and remote graduate instruction continues to expand[25]. The engagement benefits of well-designed game elements are also not unique to education: comparable effects appear in other domains, including online brand communities[26], which underscores their broad motivational potency.

4.3 Strengths and limitations

The study has several strengths: a design suited to the educational context, with baseline equivalence testing and covariate-adjusted analyses; multiple outcome measures, both self-report and a rater-scored rubric, which reduce reliance on self-report alone; power that was adequate for the large effects observed; instruments with reported pilot reliability and factorial validity; and a 12-week duration long enough to observe meaningful change. It also has limitations. Assignment was non-randomized and followed intact course sections, so instructor, schedule, and cohort effects cannot be separated from the intervention, and selection bias is possible. The CERS, RSES, and rubric were developed by the investigators, and the informal feedback was not collected systematically. The setting was a single city, which limits generalizability. There was no follow-up beyond 12 weeks and no assessment of downstream effects on thesis chapters, and the study did not isolate which gamification mechanics worked best.

Future research. Future studies should examine whether the effects persist at 6- and 12-month follow-ups, track thesis completion and publication outcomes, use randomized designs, and compare different configurations of gamification mechanics. Qualitative work on how gamified instruction shapes research identity, together with analyses of individual-difference moderators such as goal orientation and gaming preferences, would show for whom gamified instruction benefits most.

5. Conclusion

This quasi-experimental study offers evidence that a gamified web-based platform is associated with considerably higher creative engagement, research self-efficacy, intrinsic motivation, and literature review quality among graduate students. The effects are large. They hold across Master's and Doctoral students and persist after correction for multiple comparisons. Universities that want research-ready graduates should attend to the affective and motivational side of research methods training, and gamified learning systems deserve further evaluation as components of graduate research methods curricula.

Declaration

Artificial Intelligence Use Statement

No generative artificial intelligence tool was used to write or revise the text, analyze the data, create images, or generate any other scholarly content of this manuscript.

Author Contribution Statement

Conceptualization, D.V.I.; methodology, D.V.I. and D.R.; formal analysis, D.V.I.; investigation, D.V.I.; data curation, D.V.I.; writing – original draft, D.V.I.; writing – review and editing, D.V.I. and D.R.; supervision, D.R.; project administration, D.V.I. All authors read and approved the final manuscript.

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Conflict of Interest / Competing Interests

The authors declare that they have no competing financial or non-financial interests related to this work.

Ethics Approval and Consent to Participate

The study was approved by the Ethical Research Committee of Enigma Institute (approval number 2023/048) and followed the principles of the Declaration of Helsinki. Written informed consent was obtained from all participants before enrollment.

Consent for Publication

Not applicable. No identifiable personal information is reported.

Data Availability Statement

The data supporting the findings of this study are available from the corresponding author on reasonable request.

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None.

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