



**EDUCATIONAL EFFECTIVENESS OF TRADITIONAL VS. GAME-BASED LEARNING:  
A COMPARATIVE STUDY**

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**ABSTRACT**

The recent rapid development of educational technology has dramatically changed the pedagogical methods and practices that teachers and researchers have been critically analyzing in terms of the relative effectiveness of both traditional lecture-based instruction and game-based learning (GBL) in promoting the student achievement and engagement. With the growing role of digital tools in academic settings, the comparative effects of these tools on the educational outcomes have become an urgent concern in education research. This increasing discussion warrants stringent empirical research to inform instructional choices in a variety of learning situations. Current literature shows that there is substantive amount of research on the cognitive, affective and motivational aspect of both pedagogical methods; studies confirm that game-based learning has a greater engagement, motivation and skill to think on higher levels as compared to traditional methods which are still demonstrating their efficacy in structured delivery of knowledge as well as the performance in standardized assessment. The main aims of the study are to: (1) compare academic achievement of students in traditional teaching and learning in games; (2) to examine engagement, motivation and satisfaction in both teaching and learning; and (3) to find out which demographic and subject related variables will moderate the effectiveness of instruction. The research design of this study is a survey-based research design which will use structured questionnaires to 360 respondents. The results of data analysis showed that GBL students had significantly higher mean scores on all three constructs, that is, Academic Performance (M = 3.91 vs. 2.93), Engagement and Motivation (M = 3.67 vs. 3.11), and Contextual Moderators (M = 3.96 vs. 2.90). The d effect sizes of Cohen were very large (0.745 to 1.280). These results refute the original hypothesis that traditional instruction is still superior in terms of knowledge retention, and indicate that an integrated pedagogical model can provide the most educational outcomes across different learner profiles.

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## 1. Introduction

In the twenty-first century, there has been a fundamental change in the very landscape of the educational process, which has been triggered, in the first place, by the rapid technological development and the further digitization of the academic environment. One of the most significant changes in modern pedagogy is the invention and extensive use of game-based learning (GBL) - a way of teaching that uses the motivational design of games to present the learning content of the curriculum and to develop skills (Mayer, 2019). With the growing number of educational institutions in the world struggling with the problem of decreasing student engagement rates, increasing levels of academic disengagement and the pressing need to develop higher-order cognitive competencies, GBL has acquired a lot of scholarly and institutional interest as a viable alternative to traditional lecture-based, textbook-driven instruction. The global market in game-based learning is expected to increase to USD 26.3 billion by 2026, reflecting an institutional adoption of digitally-mediated pedagogical innovation as never previously witnessed (Market.us, 2026).

The basis of formal education delivered by teachers over centuries is traditional instruction, which is characterized by the teacher-centered mode of delivery, passive mode of reception, standardized methods of assessment and the linear progression through the content of the curriculum (Cuban, 2013). The success of its widespread use over the years is attributed to the following strengths that have been documented: structure content delivery, predictable assessment frameworks, scalability to large cohorts, and compatibility with national examination systems. However, critics have long-decried that traditional pedagogy does not fully represent the motivational, social and creative aspects of learning, especially to learners in digital-native generations who live in richly interactive media spaces that are not necessarily classroom-based (Prensky, 2001). Structurally under activated behavioral, cognitive and emotional engagement as key mediators of academic success was influentially identified by Fredricks, Blumenfeld and Paris (2004).

Game-based learning, in contrast, places the learner in the role of an active agent within an environment that is structured in such a way that it elicits the following characteristics: intrinsic motivation, perseverance despite challenge, collective problem-solving and immediate feedback all of which are identified as features critical for deep learning and knowledge transfer (Gee, 2003). K-12 and higher education Digital GBL platforms (e.g., Kahoot!, Minecraft: Education Edition, Quizizz, and purpose-built serious games) have spread rapidly throughout the K-12 and higher education sectors, driven by pandemic-related accelerated educational technology adoption and institutional recognition of engagement-centered pedagogy (Plass, Homer, and Kinzer, 2015). In a landmark three-level meta-analysis, Xu and Dai (2026) that integrated 1,029 effect sizes of participants in 193 randomized or quasi-randomized trials found that the game-based learning resulted in a high positive effect on the learning outcomes ( $d = 0.871$ ) a finding that significantly enhanced the evidentiary base of the adoption of GBL across educational levels.

A comprehensive meta-analysis of GBL based on Kahoot! has been performed by Özdemir (2025) and he has documented significant beneficial effect on student attention, participation, and their immediate memory of knowledge. In a meta-analysis, Anggoro et al. (2025) established the significant effectiveness of game-based learning in enhancing higher order thinking skills in mathematics, more specifically at levels of application and synthesis. Baltezarević and Baltezarević (2025) reported that digital GBL learning environments generated better performance on knowledge transfer activities than did traditional instruction, with Safitri et al. (2025) reporting consistent GBL benefits in science education competency development. At the same time, a 2026 systematic review of gamification in undergraduate nursing education (International Medical Education) - synthesizing 48 studies across various countries - confirmed that gamification strategies significantly outperformed traditional teaching methods on learning outcomes, motivation, and engagement, but found that there was a significant heterogeneity that could be attributed to implementation context.

In spite of these changes, the evidence base is still missing some important gaps. Majority of the existing comparative research is performed at the Western or East Asian educational setting which limits generalizability to the South Asian educational setting where availability of resources, the size of the classes, and the culture of pedagogy have significantly different levels of resource availability,

classroom sizes, and pedagogical culture. In addition, the majority of research investigates a relatively narrow set of outcome variables - they either study academic achievement or engagement, or they rarely combine both in a single study, with moderators of demographic factors. The current research fills these gaps by involving a multi-construct survey-based comparative analysis with a demographically diverse group of participants in an Indian undergraduate institutional setting using a validated 21-item Likert-scale instrument with good reliability ( $\alpha = 0.946$ ).

## 2. Review Of Literature

### 2.1 Theory Underlying Game-Based Learning

The whole basis of game-based learning lies in a number of solid theoretical traditions, which jointly explain both the motivational and cognitive benefits of game-based learning over traditional instruction. Most famously linked with Vygotsky (1978) and Piaget (1952), constructivist learning theory is based on the idea that learners build knowledge through active engagement with their environment as opposed to passive consumption of the information relayed to them - a premise which game mechanics inherently instantiate. The flow theory (Csikszentmihalyi, 1990) is a complementary theory that identifies a psychological state of deep effortless engagement that arises when the task challenge is precisely matched with learner competence - a state that well-designed games actively engineer through adaptive difficulty scaling. Self-Determination Theory (Deci and Ryan, 2000) also sheds some light on the motivational benefits of GBL as it explains how games can satisfy the three basic psychological needs of autonomy, competence, and relatedness which underlie the phenomenon of intrinsic motivation.

Gee (2003) presented 36 principles of good game design which he argues are a natural extension of best practices in the learning science. Plass et al. (2015) designed an integrated model of game-based learning that synthesizes the cognitive, motivational, affective, and socio-cultural dimensions, which can be used to design and evaluate GBL interventions. In more recent work, Li and Zhang (2025) have generalized the constructivist analysis of GBL to informal learning environments in museums, showing that game-based constructivist environments result in better conceptual transfer and retention than direct information presentation. All these theoretical underpinnings can be expected to yield better engagement and motivation results compared to traditional instruction and possibly also better cognitive results.

### 2.2 Empirical Results of GBL Effectiveness: Meta-Analytic Results

Recent syntheses based on meta-analytic techniques have greatly reinforced the empirical literature on GBL. The most rigorous to date is the three-level meta-analysis by Xu and Dai (2026) which combined 1,029 effect sizes of 193 randomized or quasi-randomized trials that occurred over a ten-year period. The results of this study showed that the game-based learning had a high positive effect on the learning outcomes ( $d = 0.871$ ), whereas gamification, which is a similar, but different, strategy involving the implementation of game elements in non-game activities has a medium-positive effect ( $d = 0.754$ ). They are as large as the effect sizes reported in the current GBL meta-analytic literature, and much larger than the effect sizes previously estimated.

Previous earlier meta-analyses of foundations had estimated smaller effects. Synthesizing 77 studies, Wouters, van Nimwegen, van Oostendorp, and van der Spek (2013) found that serious games yielded significantly more learning gains than traditional instruction ( $d = 0.29$ ) and more motivation ( $d = 0.26$ ) with effects moderated by collaborative play and instructional supplementation. Clark, Tanner-Smith, and Killingsworth (2016) conducted a review of 69 studies and found that GBL has significant positive effects on learning ( $g = 0.33$ ) and engagement ( $g = 0.37$ ) with variability due to the quality of the game design. This large difference between these prior estimates and the 2026 Xu and Dai meta-analysis  $d$  of 0.871 is due to both advances in the quality of GBL design over the intervening decade and the more sophisticated nature of GBL implementation in educational institutions.

A systematic review (48 studies synthesizing) dedicated to gamification in undergraduate nursing education (International Medical Education, 2026) found that gamification strategies in undergraduate nursing education (interactive quizzes, escape rooms, serious games, and digital badges) always outperformed the traditional teaching approach in terms of learning outcomes,

motivation, engagement, and knowledge retention. The review however reported that the heterogeneity of effects was high, with the outcomes varying significantly by the level of implementation fidelity and alignment of instructional design and prior experience of the learner with a gamified environment.

### **2.3 Subject-Specific GBL Research: 2025 Findings**

In 2025, domain-specific GBL research has resulted in a rich body of evidence that contextualizes these meta-analytic findings. Anggoro et al. (2025) meta-analyses in mathematics education and demonstrate that game-based learning significantly enhanced higher-order thinking skills in students, with effects particularly strong with conceptual application tasks that fit within the levels three and above of the Bloom taxonomy. A systematic review and qualitative synthesis of GBL in mathematics education as conducted by Meylani (2025) as specifically examining the contribution of GBL to Sustainable Development Goal 4 (Quality Education) found consistent benefits of GBL across multiple domains of competency, with the strongest effects observed in problem-solving and collaborative reasoning. In a comparison between digital and non-digital GBL in mathematics classrooms, Xiang, Zhang, Liu, Wang, and Shang (2025) concluded that both modalities enhanced knowledge acquisition in comparison with traditional instruction, and intrinsic motivation and cognitive load were found as critical mediating variables.

In a systematic review of science education, Safitri et al. (2025) found that GBL has a consistent impact on enhancing student competencies in affective, cognitive, and psychomotor domains, with the strongest effects in applied laboratory-based settings. Baroud and Aljarmi (2025) showed that the combination of flipped classroom methodology and game-based learning in teaching chemistry produced a better conceptual understanding than the traditional teaching method, which uses lecture-based teaching. The article by Szilágyi, Palencsar, Korei and Torkok (2025) investigated the non-digital GBL among students of computer science at the university, learning about improper integrals, and found that card game-based learning resulted in significant improvement of attitudes and learning outcomes compared to standard instruction.

In education, Liu and Alotaibi (2025) discovered that serious games-based learning resulted in significant gains in vocabulary development, self-compassion and intrinsic motivation among English as a Foreign Language learners. Chang et al. (2025) showed that dialogic game-based learning scaffolded the historical causal thinking of high school students more effectively than the conventional historical teaching, with collaborative game play facilitating the building of arguments and evaluating evidence skills. Lai and Hu (2025) are able to study the larger integration of GBL into formal history education, and record both the pedagogical potential and implementation challenges, including teacher professional development needs and assessment alignment. In Slattery et al. (2025) systematic review of research studying the impact of Minecraft-based learning on children, adolescents, and young adults, significant positive effects were found on the cognitive, academic, motivational, and social outcomes.

### **2.4 Traditional Instruction: Strengths that are long lasting and shortcomings that have been documented**

Although the evidence in favor of GBL is quite overwhelming, the traditional lecture-based instruction still has well-documented benefits, which the modern literature constantly addresses. Direct instruction - typified by direct teacher modelling, guided practice, and structured feedback - has been consistently shown to be effective in the acquisition of foundational knowledge at both ability levels (Rosenshine, 2012). The pioneering synthesis of more than 800 meta-analyses by Hattie (2009) found direct instruction to be among the highest-leverage instructional strategies with an effect size of  $d = 0.59$ . Scalability, less technology reliance, and compatibility with standardized examination formats that remain predominant in formal educational assessment in all parts of the globe, are also practical benefits of traditional methods.

The shortcomings of conventional teaching, however, are in equal measure also well-documented. Bligh (2000) proved that, the attention of students significantly reduces after ten to fifteen minutes of continuous lecture with retention decreasing rapidly without active processing strategies. A review by Prince (2004) of both active and passive evidence on active versus passive learning found

that active methods yielded consistently better long-term retention, conceptual understanding and motivational outcome. In a study which is directly comparative in nature, Baltezarević and Baltezarević (2025) found that, although traditional methods appeared to be stronger in terms of initial recall in a standardized test, GBL students performed better in terms of transfer tasks, which require a student to apply his knowledge in unfamiliar situations - a dissociation which has far-reaching implications in the context of modern education, which currently tends to place a greater emphasis on transferable competencies, rather than on the recall of facts.

Sharma et al. (2025) investigated the contribution of theory-based curriculum guides to the process of teacher acceptance and integration of educational games, finding that structured pedagogical support had a significant positive effect on teacher self-efficacy and willingness to use GBL - and that the traditional-versus-GBL comparison is not an academic game alone but a practical challenge that requires institutional investment in teacher professional development. In an assessment of Minecraft as a GBL system on the achievement of STEM outcomes, Singh and Sun (2025) found significant advantages of gaming experience and social presence which translated into significant learning outcomes, highlighting the social and collaborative aspects of GBL that are systematically under-utilized by a traditional instruction system.

Collectively these findings lead to the view that the question that contemporary educators need to ask is not whether GBL outperforms traditional instruction in aggregate, but how best to integrate the two approaches across particular areas of content, the profiles of learners, and the institutional context.

## **2.5 Moderating Variables in GBL Effectiveness**

Another similarity between the older and more recent literature on GBL is that the effectiveness is significantly moderated by contextual variables. Schiele et al. (2025) investigated GBL in preschool literacy development in resource-heterogeneous settings, and found that prior access to digital literacy and home technologies significantly moderated learning gains, which have implications of equity in resource-heterogeneous settings. According to Rye, Sousa, and Sousa (2025), the best results of GBL can be achieved when the mechanisms of the game react to various learning styles and aptitudes, implying that a good fit between instructional methods and learner profile can be a key determinant of outcome quality. It was determined by Gill et al. (2025) that the relationship between GBL reward structures and knowledge acquisition is fully mediated by behavioral engagement - with direct instructional design implications.

Al-Hassan et al. (2025) investigated digital GBL in early childhood mathematics, which found that the technology-enhanced interactive environment generated significant gains in cognitive skills, but that implementation quality, in particular, teacher facilitation competence, moderated results significantly. Yulia et al. (2025) discovered that educational learning media based on games could significantly boost learning interest of elementary students, but they noted that availability of physical resources (development of devices, connectivity) was a binding constraint in the under-resourced school environment. All these moderating effects are important to highlight the fact that the GBL-versus-traditional comparison cannot be resolved based on broad generalizations; instead, the instructional decisions must be informed by keen consideration of the learner demographics, subject context, available resources and teacher preparedness.

## **2.6 Research Gaps to be addressed by the current research**

Despite the extensive amount of evidence discussed in the previous paragraphs, the current research fills in a number of significant research gaps. First, most of the existing comparative studies are based on the West or East Asian setting, making it difficult in generalizability to the educational contexts of South Asia. Second, the majority of studies only study a narrow set of outcomes - usually either academic achievement or engagement - but seldom both together with demographic moderators within the same instrument. Third, survey-based designs that indicate multi-construct student perceptions also do not get sufficiently represented in comparison with narrow experimental designs. Fourth, there are few in the international GBL literature, studies specifically targeting the Indian undergraduate population, which is one of the largest and most rapidly-technological transforming higher education systems in the world. All four gaps are directly addressed in the

present study, which is a multi-construct, survey-based, comparative study with an Indian undergraduate sample.

### 3. Research Objectives

The research is informed by three main research objectives:

Objective 1: To compare academic performance and knowledge retention of students in traditional instruction and game-based learning.

Objective 2: To compare student engagement, motivation and learning satisfaction in both teaching strategies.

Objective 3: To determine subject-specific and demographic influences that moderate the effectiveness of each instructional strategy.

Such objectives are operationalized with the following hypotheses of research:

H1: GBL students will record very high academic performance and knowledge retention scores, as compared to students taught through traditional instruction.

H2: GBL students will associate with high scores of engagement, motivation, and satisfaction compared to traditional instruction students.

H3: The variables of demography and context will have a major mediating impact in the relationship between instructional method and learning outcomes.

## 4. Research Methodology

### 4.1 Research Design

The research design that is used in this study is a quantitative and cross-sectional study which involves a survey design to compare the student perceptions of instructional effectiveness under two pedagogical conditions: traditional instruction (TI) and game-based learning (GBL). Comparative designs based on survey are suitable when the research purpose is to entrap self-reported perceptions and experiences across naturally occurring groups as opposed to experimentally manipulating treatment conditions (Creswell and Creswell, 2018). As the practical and ethical constraints of random assignment of students to pedagogical conditions in intact educational settings the most ecologically valid design of the research questions to be addressed is the non-experimental comparative design.

### 4.2 Sample and Sampling Procedure

The researchers used convenience sampling approach and selected the participants based on their undergraduate and postgraduate educational institutions, and various disciplines. The final analytical sample was 360 respondents of whom 270 (75.0%) had been put in game-based learning and 90 (25.0%) had experienced traditional instruction. The demographic composition is described in Table 1. Most of the respondents (77.8, n = 280) were aged between 19 to 22 years, which is in line with the sampling frame that is dominated by undergraduates. The sample consisted of 304 male respondents (84.4% of the total sample), and 56 female respondents (15.6% of total sample). The sample size was 346 (undergraduate) with 14 (postgraduate) completing the total sample. By discipline, 68.6% fell under 'Other' (n = 247), followed by Humanities (n = 52, 14.4%), Social Sciences (n = 38, 10.6%), STEM (n = 14, 3.9%), and Commerce/Business (n = 9, 2.5%).

**Table 1: Demographic Profile of Survey Respondents (N = 360)**

Characteristic	Category	n	%
Age Group	15 – 18	24	6.7%
	19 – 22	280	77.8%
	23 – 26	56	15.6%
Gender	Male	304	84.4%
	Female	56	15.6%

Characteristic	Category	n	%
Level of Study	Undergraduate	346	96.1%
	Postgraduate	14	3.9%
Instructional Method	Game-Based Learning (GBL)	270	75.0%
	Traditional Instruction	90	25.0%
Prior GBL Experience	Limited (1–2 courses)	215	59.7%
	Moderate (3–5 courses)	140	38.9%
	Extensive (5+ courses)	5	1.4%

### 4.3 Instrumentation

The purpose-developed, 27-item structured questionnaire, composed of six profile items and 21 five-point Likert-scale attitudinal items were used to collect data. The Likert items were grouped in three constructs in accordance to the three research objectives of the study namely Construct A: Academic Performance and Knowledge Retention (items A1–A7); Construct B: Student Engagement, Motivation, and Satisfaction (items B1–B7); and Construct C: Contextual Moderators such as Subject Domain and Demographic Variables (items C1–C7). The reverse-scored, pre-analysis item B5 which measured boredom as a reverse measure of engagement was reverse-scored before the analysis such that higher scores are a consistent indicator of more positive perceptions across all the items.

The five categories of responses were between 1 (Strongly Disagree) and 5 (Strongly Agree). Construct A items were developed by systematic review of validated scales of the GBL literature and literature on educational psychology, Construct B items were developed by operationalization of the tri-dimensional engagement framework (Fredricks et al., 2004) and Construct C items were developed based on existing moderator frameworks in the GBL meta-analytic literature. The questionnaire was presented online using Google Forms with a specific instructional page where the respondents were required to complete and identify their given method first before proceeding, thus reducing the effect of method-attribution error.

### 4.4 Reliability and Validity

The internal consistency reliability was determined by the use of the Cronbach's alpha ( $\alpha$ ) per construct and the instrument as a whole. Findings showed good-to-excellent reliability: Construct A ( $\alpha = 0.906$ ), Construct B ( $\alpha = 0.738$ ), Construct C ( $\alpha = 0.896$ ), the entire 21-item instrument ( $\alpha = 0.946$ ). These values have met or even surpassed the recommended scale of  $1/3 = 0.70$  of research tools as proposed by Nunnally (1978) and the overall scale approaches the superior designation of  $1/3 = 0.70$  of research instruments (George and Mallery, 2003). Systematic item-to-objective mapping with clear theoretical justification as to why a particular item should be included in the study was used to establish content validity to ensure that all the constructs have their conceptual areas well covered.

### 4.5 Data Analysis Strategy

Data were analyzed using the following sequential strategy: (1) descriptive statistics (means, standard deviations) were computed regarding each item and construct under the condition of each instructional method; (2) independent-samples t-tests were carried out to test statistically significant differences between GBL and TI groups in terms of each construct mean score; (3) Cohen's d effect sizes were computed to assess practical significance; (4) Cronbach's alpha coefficients confirmed the reliability of the instruments used; and (5) cross-tabulations were conducted to examine the demographic distribution of each of the instructional method conditions. Python 3.12 with the SciPy and pandas libraries were used to perform all the analyses. The statistical significance was measured on the traditional level of  $\alpha = 0.05$  denoted as 0.05.

## 5. Data Analysis And Results

### 5.1 Construct A: Academic Performance and Retention of knowledge

Table 2 shows descriptive statistics of Construct A items by instructional method stratified by instructional method. In all of the seven items, GBL students reported higher means of all items compared to TI students, with the largest means difference observed between conceptual understanding (A1), information recall (A2), and concept application (A3).

**Table 2: Construct A: Item-Level Descriptive Statistics by Instructional Method (N = 360)**

Item	Description	GBL M	GBL SD	Trad M	Trad SD	Diff
A1	Conceptual understanding	3.93	0.97	2.73	1.12	+1.20
A2	Information recall	3.93	0.98	2.73	1.09	+1.19
A3	Concept application	3.99	0.95	2.79	1.10	+1.20
A4	Academic performance	3.89	0.99	3.08	1.05	+0.81
A5	Exam preparedness	3.86	1.01	3.17	0.98	+0.69
A6	Depth of learning	3.91	0.96	2.96	1.08	+0.96
A7	Content organisation	3.87	0.99	3.06	1.05	+0.82
Construct A Mean	All 7 items	3.91	0.86	2.93	0.92	+0.98

The construct-level mean for GBL respondents ( $M = 3.91$ ,  $SD = 0.86$ ) was significantly higher than for TI respondents ( $M = 2.93$ ,  $SD = 0.92$ ),  $t(358) = 9.185$ ,  $p < .001$ , Cohen's  $d = 1.121$ . Following the conventions of Cohen (1988),  $d = 1.121$  is an extremely large effect size, which means that the difference between the perceptions of academic performance of GBL and TI students is not only statistically significant, but has a practical value as well. The largest item-level differences were found to be in A1, A2, and A3 ( $\Delta \approx 1.20$ ) whereas the smallest one was in A5 (exam preparedness,  $\Delta = 0.69$ ) suggesting that GBL benefits are greater at the levels of Bloom taxonomy associated with understanding and application than when at the levels of examination-oriented recall. These results affirm Hypothesis 1.

### 5.2 Construct B: Student Engagement, Motivation, and Satisfaction.

Table 3 shows results of Construct B with B5 reversed-scoring across all reports, such that all item means are the same in terms of directional interpretation: higher scores correspond to higher positive engagement-related outcomes.

**Table 3: Construct B: Item-Level Descriptive Statistics by Instructional Method (N = 360)**

Item	Description	GBL M	GBL SD	Trad M	Trad SD	Diff
B1	Active engagement	3.81	1.03	2.96	1.08	+0.85
B2	Motivation to learn	3.96	0.97	3.03	1.07	+0.93
B3	Enjoyment	3.87	1.01	3.00	1.09	+0.87
B4	Sense of accomplishment	3.87	1.02	3.04	1.06	+0.82
B5	Boredom (reverse-scored)	3.71	1.09	2.44	1.21	+1.27
B6	Curiosity	3.97	0.96	3.13	1.06	+0.83

Item	Description	GBL M	GBL SD	Trad M	Trad SD	Diff
B7	Overall satisfaction	3.89	0.99	3.06	1.07	+0.84
Construct B Mean	All 7 items (B5 rev.)	3.67	0.70	3.11	0.86	+0.55

The construct-level mean for GBL respondents ( $M = 3.67$ ,  $SD = 0.70$ ) was significantly higher than for TI respondents ( $M = 3.11$ ,  $SD = 0.86$ ),  $t(358) = 6.099$ ,  $p < .001$ , Cohen's  $d = 0.745$  — a large effect. The largest difference ( $\Delta = 1.27$ ) was found with the reverse-scored boredom item (B5): TI students reported a pre-recording boredom mean of 3.56 (between Neutral and Agree), compared to 2.29 in the case of GBL students - meaningfully higher boredom means in traditional settings, which are consistent with classical observations of Attention decay during lectures by Bligh (2000). The motivation (B2,  $M = 0.93$ ) and, curiosity (B6,  $M = 0.83$ ) items also exhibited significant differences in line with the Self-Determination Theory prediction by Deci and Ryan (2000) that GBL environments are better able to fulfill autonomy and competence needs. These results attest Hypothesis 2.

**5.3 Construct C: Contextual Moderators** Table 4 will show Construct C results that will look at the perceived contextual and demographic moderating influences on instructional effectiveness.

**Table 4: Construct C: Item-Level Descriptive Statistics by Instructional Method (N = 360)**

Item	Description	GBL M	GBL SD	Trad M	Trad SD	Diff
C1	Subject appropriateness	4.04	0.94	2.63	1.20	+1.40
C2	Technology familiarity effect	4.02	0.94	2.73	1.15	+1.29
C3	Topic-level variation	3.87	1.02	3.04	1.09	+0.83
C4	Learning style fit	4.02	0.96	2.58	1.21	+1.44
C5	Background differences	3.96	0.97	3.11	1.09	+0.85
C6	Resource availability	3.89	1.02	3.14	1.11	+0.75
C7	Cross-level effectiveness	3.93	0.98	3.03	1.09	+0.90
Construct C Mean	All 7 items	3.96	0.76	2.90	1.03	+1.07

The construct-level mean for GBL respondents ( $M = 3.96$ ,  $SD = 0.76$ ) was significantly higher than for TI respondents ( $M = 2.90$ ,  $SD = 1.03$ ),  $t(358) = 10.480$ ,  $p < .001$ , Cohen's  $d = 1.280$  — the largest effect size observed in the study. GBL students also found their instructional approach to be much more contextually appropriate, more aligned with their learning styles (C4,  $\Delta = 1.44$ ) and subject area (C1,  $\Delta = 1.40$ ), and more sensitive to familiarity with technology (C2,  $\Delta = 1.29$ ). These results confirm Hypothesis 3 and are in line with the finding of Rye et al. (2025), that alignment of learning styles is a key moderator of GBL efficiency.

#### 5.4 Summary of Construct-level Results

**Table 5: Construct-Level Summary Statistics and Inferential Test Results (N = 360)**

Construct	GBL M (SD)	Trad M (SD)	T (358)	p	Cohen's d	$\alpha$
A: Academic Performance	3.91 (0.86)	2.93 (0.92)	9.185	< .001	1.121	0.906
B: Engagement & Motivation	3.67 (0.70)	3.11 (0.86)	6.099	< .001	0.745	0.738
C: Contextual Moderators	3.96 (0.76)	2.90 (1.03)	10.480	< .001	1.280	0.896
Overall (21 items)	3.85 (0.72)	2.98 (0.89)	8.923	< .001	1.099	0.946

On all three constructs and the entire 21-item measure, GBL respondents scored significantly higher than TI respondents, with effect sizes varying in size, ranging from large (Construct B:  $d = 0.745$ ) to very large (Construct C:  $d = 1.280$ ). The full-instrument Cronbach alpha of 0.946, confirms an excellent internal consistency that gives a good psychometric support to the validity of conclusions drawn on the basis of these data.

## 6. Discussion

### 6.1 Academic performance and retention of knowledge: Putting the Traditional Advantage to Test

The most interesting finding of this paper was the fact that the GBL students reported significantly high levels of perceptions of academic performance and knowledge retention (Construct A,  $d = 1.121$ ). This result is more consistent with the recent meta-analytic results - especially, the landmark three-level meta-analysis reporting  $d = 0.871$  of GBL on learning outcomes - than with the previous, more conservative estimates (Clark et al., 2016; Wouters et al., 2013). It states that the evidentiary terrain is swinging firmly in the favour of the cognitive, as well as motivational, advantages of GBL. The item-level trend of findings offers valuable detailing. The greatest GBL benefits were at the understanding and application levels of the taxonomy of Bloom (A1: conceptual understanding, A3: concept application,  $\Delta \approx 1.20$  for both) with the least benefit seen in A5 (exam preparedness,  $\Delta = 0.69$ ). This result of higher-order cognitive performance and examination preparedness is in line with the comparative finding of Baltezarević and Baltezarević (2025) that GBL students outperformed the students of traditional instruction on transfer tasks despite their similar performance on standardized tests. The implication is practically important: in case educational systems keep promoting the performance in the standardized examination as the main indicator of instructional effectiveness, they will run the risk of systematically underestimating the most valuable cognitive contributions by GBL. The systematic review by Meylani (2025) also highlighted the disproportionate advantages of GBL to problem-solving and collaborative reasoning - the competencies that are often underrepresented in standardized tests.

The greater-than-we-imagined GBL benefit in the current investigation is possibly attributable to a number of factors. To begin with, 40.3% of GBL respondents indicated moderate-to-extensive prior GBL experience, which implies that the sample was sufficiently digitally literate to take advantage of GBL cognitive affordances. Second, the platforms utilized (such as Kahoot! and gamified assessments) are rich in feedback and thus they contribute to the immediate correction of errors and the elaborative encoding recorded by Mayer (2019) as especially efficient when it comes to consolidating knowledge. Third, social and collaborative features of most GBL platforms - explicitly reported by Singh and Sun (2025) in the Minecraft context - could have triggered peer learning processes that enhance individual cognitive performance.

The construct-level result is also highly consistent with the recent three-level meta-analytic evidence, reported by Xu and Dai (2026), which demonstrates a pooled GBL effect size of  $d = 0.871$  on learning outcomes - which is significantly larger than the range of  $d = 0.29$  to  $0.33$  range reported in earlier meta-analyses (Clark et al., 2016; Wouters et al., 2013). The trend of increasing the

magnitude of meta-analytic effect estimates over time suggests that the quality of GBL implementation has improved significantly, and that more modern platforms and pedagogically sophisticated GBL designs are yielding meaningfully larger learning benefits than their more ancient counterparts. This is a theoretically consistent temporal trajectory of improving the effectiveness of GBL consistent with, but not in isolation of, the current evidence base.

## 6.2 Engagement, Motivation and Satisfaction: Confirming and Extending Previous Evidence

The high GBL advantage on Construct B ( $d = 0.745$ ) is consistent with the broader literature on the motivational effects of GBL in general (Liu and Alotaibi, 2025; Özdemir, 2025; Slattery et al., 2025) and with theoretical predictions of the Self-Determination Theory (Deci and Ryan, 2000) and Flow Theory (Csikszentmihalyi, 1990). The particularly high difference in boredom (B5,  $\Delta = 1.27$ ) is theoretically important: TI students boredom mean of 3.56 is significant and warrants further discussion: The average boredom of a typical traditional instruction student between the levels of disinterestedness and agreeableness is 3.56, which is a very significant number.

The Construct B finding is further contextualized by the systematic review of gamification in nursing education (International Medical Education, 2026), which reported consistent findings in motivational and engagement benefits of gamified methods based on 48 studies. Gill et al. (2025) established that behavioral engagement completely mediates the relationship between GBL reward structures and knowledge acquisition - a finding that unites the Construct A and Construct B results, by proposing that the performance advantage of GBL (Construct A) may be causally downstream of its advantage of engagement and motivation (Construct B). This mediation hypothesis is a significant aim to be achieved by future longitudinal studies.

The large difference in intrinsic motivation (B2,  $\Delta = 0.93$ ) has a specific long-lasting importance. One of the strongest predictors of deep learning, persistence and self-regulated study behavior in the educational environment is intrinsic motivation (Deci and Ryan, 2000). The fact that the GBL environment results in significantly higher intrinsic motivation suggests not only the better within-session performance but possibly also better long-term learning dispositions - outcomes that have implications not only to lifelong learning and career development in the short term, but also to long-term learning dispositions in general.

The enjoyment dimension (B3,  $\Delta = 0.87$ ) and the sense of accomplishment (B4,  $\Delta = 0.82$ ) also are worth attention due to the recent scholarship. A systematic review of the Minecraft-based learning by Slattery et al. (2025) reported that affective outcomes such as enjoyment, sense of achievement, and social connection were some of the most consistently observed and the largest benefits of the GBL across ages. Li and Zhang (2025) also highlighted the constructivist processes where museum game-based learning generates affective investment in learning that cannot be created in a passive setting. The ability of these theoretical processes to align with the empirical results of the present study enhance the belief in the effectiveness of the engagement advantage of GBL in various implementation settings. Most importantly, the overall satisfaction item (B7,  $\Delta = 0.84$ ) shows that GBL students had not only been more engaged in the teaching process but they were more satisfied with the overall learning experience - a perception that directly applies to student retention, course continuity rates, and overall institutional reputation in competitive higher education markets.

## 6.3 Contextual Moderators: The Biggest Effect of the Study

The fact that GBL advantage on Construct C ( $d = 1.280$ ) is substantively important indicates that this construct is the one having the largest effect. It shows that GBL students viewed their teaching method as significantly more subject-appropriate (C1,  $\Delta = 1.40$ ), more aligned with their learning styles (C4,  $\Delta = 1.44$ ), more responsive to familiarity with technology (C2,  $\Delta = 1.29$ ), and more sensitive to context of resources (C6,  $\Delta = 0.75$ ) than TI students did to traditional instruction. The reason behind these differences is that GBL platforms are inherently adaptive and interactive in nature, and thus are designed to respond to the individual learner characteristics in a way that cannot be done through the traditional lecture-based form of instruction.

Special attention should be paid to the technology familiarity item (C2). The high agreement by GBL students that prior technology familiarity has a positive influence on their engagement ( $M = 4.02$ ) indicates that they are aware of a real facilitating effect. This is directly relevant to the current

sample, which has a relatively high level of technology exposure (98.6% with at least limited prior GBL experience) which may have contributed to the stronger GBL effect in the current sample than would be expected in a less digitally-equipped population. This is a significant equity caveat that policymakers need to take into account when adopting large-scale use of GBL.

The cross-level effectiveness item (C7,  $\Delta = 0.90$ ) - which inquired whether the respondents thought their teaching practice would be equally effective at different grade levels - demonstrated a significant GBL advantage, which indicated that the GBL learners thought their instructional practice to be equally effective at other grade levels. This impression can be associated with the fact that GBL is much more scalable by nature, using adaptive difficulty and modularization of the content, as opposed to the more rigid and teacher-dependent format of traditional instruction.

## 7. Conclusion

This paper aimed to undertake a rigorous empirical comparison of traditional lecture-based instruction and game-based learning on three outcome measures of academic performance and knowledge retention, student engagement and motivation, and contextual moderating variables. The study results were based on a validated 21-item survey instrument administered to 360 respondents with the finding of consistent, statistically significant, and practically large benefits of GBL across all three constructs with a range of effect sizes ranging between  $d = 0.745$  (Construct B) and  $d = 1.280$  (Construct C). The results verify all three research hypotheses and add to the existing body of evidence on the effectiveness of the well-implemented GBL environments in education.

Perhaps the most important fact is that the study has found that GBL students reported significantly greater perceptions of academic performance and knowledge retention not merely engagement and motivation. Although the methodological limitations preclude the cause and effect arguments, the convergent evidence presented in the various domains of construct supported by the high instrument reliability ( $\alpha = 0.946$ ) argues that the beneficial effects of GBL in education may be more holistic than previous literature through the engagement literature has consistently underscored.

The paper also highlights the significance of the contextual moderators in determining GBL effectiveness. The perceived moderators of learning style fit, subject appropriateness, and previous exposure to technology proved to be especially powerful perceived moderators, which is consistent with the established theoretical frameworks and recent empirical literature. All these findings do reflect the fact that GBL is not a universal solution to instructional difficulties but instead a potent pedagogical instrument the effectiveness of which is significantly influenced by the quality of implementation, the characteristics of learners and the institutional context.

In prospect, the most promising direction hinted at by these findings will not be the wholesale substitution of conventional instruction by GBL but rather the development of evidence-based integrated pedagogical models that will capitalize on the structural clarity and assessment alignment advantages of conventional means and the motivational architecture, richness of feedback, and active engagement features of game-based environments. These model integrations, based on current empirical research, are the leading edge of instructional design applicable to educational situations in the twenty-first century.

## 8. Recommendations for Future Research

The findings and limitations of the present study provide several directions on future research. First, longitudinal designs, which would follow the same learners through phases of GBL and traditional instructions, would allow causal inference on within-subject changes in performance and engagement, which overcomes the cross-sectional nature of the current design. Second, mixed-methods research incorporating the survey-based methodology of this study and objective performance indicators, classroom observations and in-depth interviews with learners would help provide a more complete and triangulated view of the educational effects of GBL. Third, research studies that are specifically designed to determine the effectiveness of GBL in a variety of socioeconomic and geographic contexts, especially in under-resourced educational settings, would help to overcome the limitations of generalizability of the undergraduate, Indian institutional sample studied here. Fourth, studies that investigate the best proportion and sequencing of GBL and traditional instruction in integrated pedagogical models would specifically inform the creation of

evidence-based blended learning models.

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