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Article

Learniverse: A Curriculum-Aligned Gamified Learning Platform

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Abstract: Student disengagement in online education is still a problem because existing approaches do not provide sufficient interactivity, cus-tomization, and continuous motivation. Gamified approaches to learn-ing include various mechanisms such as rewards and levels, yet their effectiveness depends on the integration with pedagogic methods and continuous engagement. This work introduces Learniverse – a gamified learning environment based on RPG mechanics for grades 5 through
10. Learniverse provides a gamified approach by implementing learning tasks within subject-themed worlds where mastering topics corresponds to completing quests, developing avatars, achieving awards, ranking on leaderboards, and receiving analytics. The system is being implemented with the use of HTML5, CSS3, JavaScript, PHP, and MySQL. For an evaluation at the level of journal articles, a quasi-experimental controlled study with 120 to 150 students divided into five experimental condi-tions (conventional learning, Moodle, Quizizz, Kahoot, and Learniverse) is proposed. The assessment is carried out through pre-test, post-test, re-tention test, logging engagement, surveying motivation, calculating SUS scores, interviewing teachers, logging performance, and statistically eval-uating normality, ANOVA/Kruskal-Wallis, post hoc analysis, and effect sizes. Consideration is given to the mobile/tablet capabilities of the sys-tem, its security, anonymity, parental consent, and ethics approval..

Keywords: Gamified learning· role-playing game · educational technol-ogy · learning analytics · student engagement · retention learning · Sys-tem Usability Scale · mobile learning · school education

1. Introduction

The use of digital learning platforms is becoming increasingly prevalent in the ed-ucation field due to its application in blended learning and remote learning. Most digital learning platforms tend to replicate the conventional classroom environ-ment by using static modules such as lessons, assignments, videos, and quizzes. While such platforms provide learners with content, they lack mechanisms to sustain engagement and constant feedback for the learners in grade levels 5-10

Engagements is multi-dimensional concept comprising of behavioral, emotional, and cognitive dimensions of participation in learning tasks [6]. It leads to poor practice, poor retention, and self-regulation.

Gamification has been evaluated as one of the approaches in increasing motiva-tion, participation, and learning behaviors. Meta-analysis studies and systematic reviews indicate the potential role of gamification in improving learning and en-gagement provided that the games used match the learning goals [1]-[4]. On the other hand, the use of gamification could lead to adverse results if it over-relied on extrinsic motivators like points, badges, and leaderboards [5]. There is a gap in developing curriculum-aligned, learner-centered, measureable, secure, and de-ployable on consumer device gamified learning systems.

Learniverse responds to the above challenge by creating an RPG-based learning platform that transforms school subjects for grades 5-10. In this platform, users can choose their avatars, join subject worlds, play relevant curriculum games, gain rewards, achieve awards, and view leaderboard rankings.

The major contributions of this paper include:

Curriculum-mapped RPG learning platform with subjects mapped to quests, achievements, and plot progression.

A modular architecture including user authentication, avatar management, gameplay, achievements, reward system, leaderboard ranking, and analysis for teachers.

Database schema based on normalized relations for scalable tracking of learner progress.

Real-learner evaluation plan including at least 100 participants, pre-test/post-test/retention-test design, and comparisons with Moodle, Quizizz, Kahoot, and

e-learning platforms.

Statistical analysis plan including ANOVA, paired t-tests, Wilcoxon tests, confidence intervals, and calculation of effect sizes.

Consumer-electronics evaluation plan including responsive mobile and tablet design, page loading speed, API latency, memory consumption, and offline readiness.

Security and ethical guidelines regarding obtaining informed consent, pri-vacy considerations, password hashing, session management, SQL injections, and student data protection.

2. Related Work

Gamification in Education

Gamification is an approach using game principles and mechanics in non-gaming environments. Game elements used in education include scoring, badges, leader boards, avatars, levelling up, quests, reward systems, challenges, and progress visualisation. Li et al. conducted a meta-analysis where they demonstrated the capacity of gamification to positively impact teaching and learning processes. However, the effects of gamification depend on conditions and the context of application [1]. Additionally, Ruiz reviewed gamification as one of the strategies for school engagement and highlighted the potential of gamification to enhance participation [2]. Moreover, Nurhayati explored gamification in schools and high-lighted the advantages associated with increased motivation and better academic results. At the same time, there is a danger in shallow learning and uneven access to gamified solutions [3].

Nevertheless, the use of gamification does not lead to consistent effects in all situations. Thus, among negative effects of educational gamification, Almeida et al. list lack of effect, reduced achievement, motivational issues, superficiality, cheating, and the emphasis on badges and leader boards [5]. Therefore, gami-fication cannot be considered just a rewarding system and should be combined with other factors.

Game-Based Learning and Role-Playing Learning

Game-based learning refers to the use of gameplay to facilitate instruction. Role-playing games can be used to assist in learning in terms of identity, agency, pro-gression, exploration, mastery, and collaboration. These techniques will assist in making sure that learning is seen as a series of meaningful challenges and not simply a list of unrelated tasks. Unfortunately, many educational games concen-trate only on certain issues or a temporary intervention that lacks elements such as persistence, curriculum alignment, teacher dashboard, and longitudinal anal-ysis. Learniverse differs from one-issue games in its approach since Learniverse involves the inclusion of entire grade-level subjects within its subject worlds.

Learning Analytics and Adaptive Support

Learning analytics provides the capability to monitor the performance of stu-dents by way of their activities and progress made in class. Measures like time spent on task, completion, number of retries, number of achievements, number of rewards, and ranking in the leaderboard can assist teachers in finding learning issues among students. Previous researches on learning analytics and gamifica-tion have suggested that feedback based on learning analytics can improve the level of engagement and help make instructional decisions [8].

Usability and Consumer-Device Deployment

Usability and Device Deployment for Consumers - Apart from effectiveness, learning systems also have to consider issues such as usability, reactivity, se-curity, and accessibility on consumer devices, including mobile phones, tablets, laptops, and classroom displays. System Usability Scale (SUS) is a commonly used ten-item scale for measuring usability [9]. Learniverse should also provide deployment/usability information for the IEEE Transactions on Consumer Elec-tronics

Table 1. Research Gaps Analysis

Research Gap	**Author(s)**	**Limitation in Ex-isting Work**	**Impact**	**Learniverse Response**
Superficial gamification	Deterding et al. (2011); Hamari et al. (2014); Kapp (2012); Werbach & Hunter (2012)	Many systems rely mainly on points, badges, and leader-boards	Short-term participation without deep learning	RPG quests con-nect rewards to curriculum mas-tery
Weak cur-riculum alignment	Seaborn & Fels (2015); Majuri et al. (2018); Zainuddin et al. (2020)	Educational games often target isolated topics	Difficult adoption by teachers	Subject worlds map games to grade 5-10 cur-riculum
Lack of real-learner evalu-ation	Huang et al. (2020); De-Marcos et al. (2016)	Many prototypes re-port only screenshots or conceptual design	Weak ev-idence for effectiveness	Proposed evalua-tion uses at least 100 real students
Limited com-parison	Huang et al. (2020); Bicen & Kocakoyun (2018)	Studies often lack comparison with existing platforms	Unclear rela-tive benefit	Compare Learni-verse with Moo-dle, Quizizz, Ka-hoot, and conven-tional e-learning
Weak statisti-cal validation	Toda et al. (2019); Aparicio et al. (2019)	Some studies report percentages without inferential tests	Low reviewer confidence	Use ANOVA, paired t-test, Wilcoxon test, confidence inter-vals, and effect sizes
Limited consumer-device testing	Bicen & Ko-cakoyun (2018); Majuri et al. (2018)	Educational proto-types often ignore performance on mo-bile/tablets	Poor de-ployment readiness	Measure page load, API la-tency, memory, responsiveness, and offline-readiness

Privacy and security gaps	Aparicio et al. (2019); Toda et al. (2019)	Student data may be inadequately pro-tected	Ethical and legal risk	Implement con-sent, password hashing, prepared statements, se-cure sessions, and privacy controls

Proposed Learniverse Framework

System Overview

Learniverse is a gamified learning platform that targets students in grades 5 to 10 who can create their avatars, select topics, engage in learning games, earn coins and badges, redeem their rewards, and view leaderboards. The Learniverse model

comprises six layers, namely the consumer device layer that supports the use of smartphones, tablets, and laptops, the user interface layer created with respon-sive HTML5, CSS3, and JavaScript, the gamified learning layer that incorporates subject world, quest, reward, avatar, and leaderboard, the assessment layer that captures scores and tracks learners' progress, the analytics layer that provides engagement, mastery, and retention scores, and finally, the security/data layer with PHP backend, MySQL database, hashing, session, and prepared statement technologies.

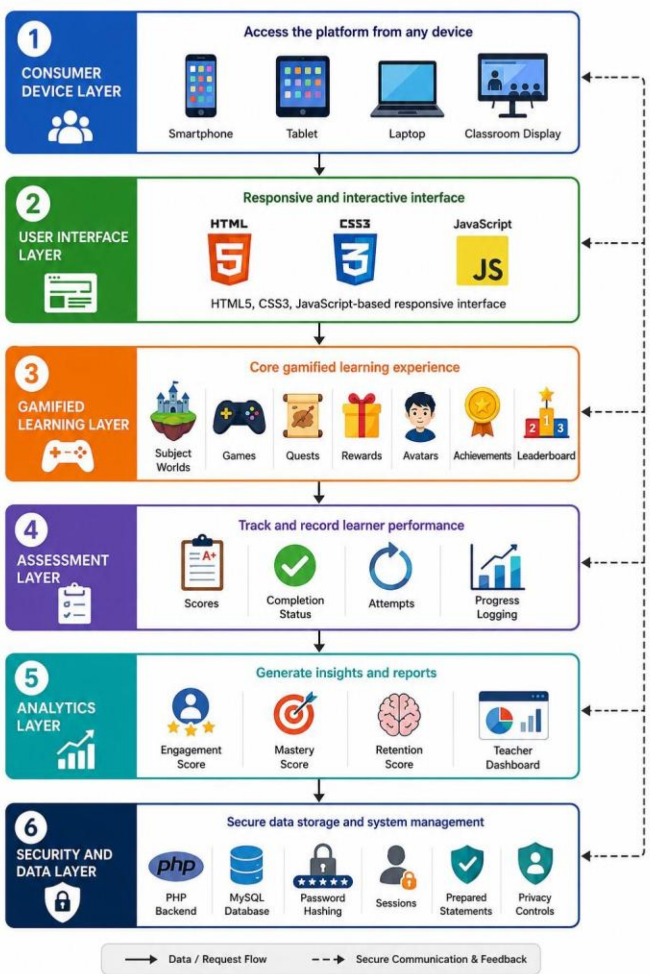

Fig. 1. System Architecture of Learniverse

Curriculum-to-Quest Mapping

Let the curriculum be represented as:

C = S1, S2, . . . , Sn

where Si represents subjects like Mathematics, Science, English, and Social Sci-ences.

Each subject consists of topics:

Si = T1, T2, . . . , Tm

Each topic is then transformed into quests sets:

Qj = q1, q2, . . . , qk

where each quest involves content, gaming, assessment, feedback, and mapping of reward.

Learner Progression Model

The progression score is given by:

P = alpha S + beta L + gamma A + delta R

where P stands for progression score, S for normalized game score, L for level completion, A for achievement score, R for reward consistency, while alpha, beta, gamma, delta are weight factors.

The progression is based on the criteria that:

P >= theta

where theta is the mastery threshold.

Engagement Score

The engagement score is defined as:

E = w1F + w2C + w3T + w4A + w5R

where F represents login frequency, C quest completion rate, T time on task, A achievement rate, R reward activity, while w1 to w5 represent tuning weight factors.

Implementation Details

The Learniverse platform was developed using full-stack web development tech-niques involving HTML5, CSS3, and JavaScript for the frontend development, PHP for the server-side logic, MySQL for the database management, and Apache as the web server. The database structure is normalized to BCNF (Boyce-Codd Normal Form) rules, which ensure data consistency, prevent duplication, and enhance queries. The application takes care of various back-end processes such as user registration and authentication, recording of game sessions, uploading scores in real-time, updating the leaderboard in real-time, calculation and ac-quisition of rewards points, and unlocking achievements. The frontend offers a user-friendly environment in which users can select and customize their avatars, select academic benchmarks, subjects, play quest games aligned with the curric-ular requirements, see real-time leaderboard results, and redeem rewards from the store

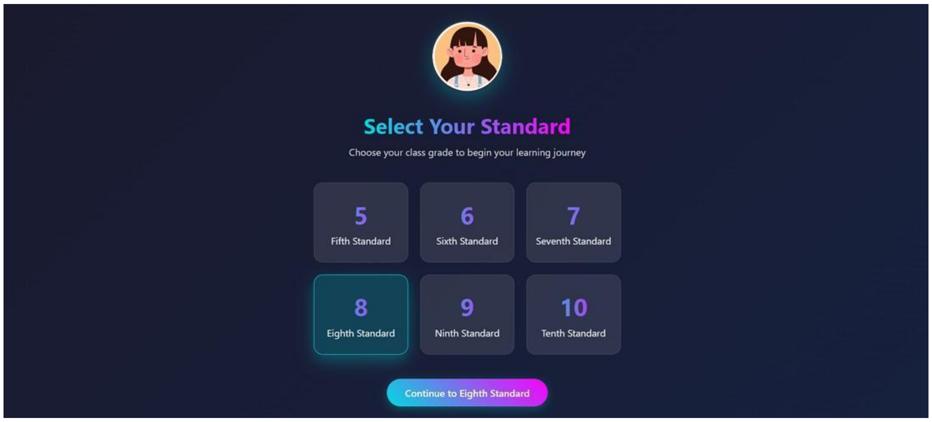

Fig. 2. Student Standard Page

Home Page

Home Page is the primary dashboard for the post-login students where they can see their avatar, available subject worlds (Mathematics, Science, English, Social Sciences), their present progression score, and different navigation options. Stu-dents have an option to select one subject to access its quest-oriented learning en-vironment. The home page will display the recent accomplishments and pending rewards of students to provide them with a central point for gamification-based learning activities.

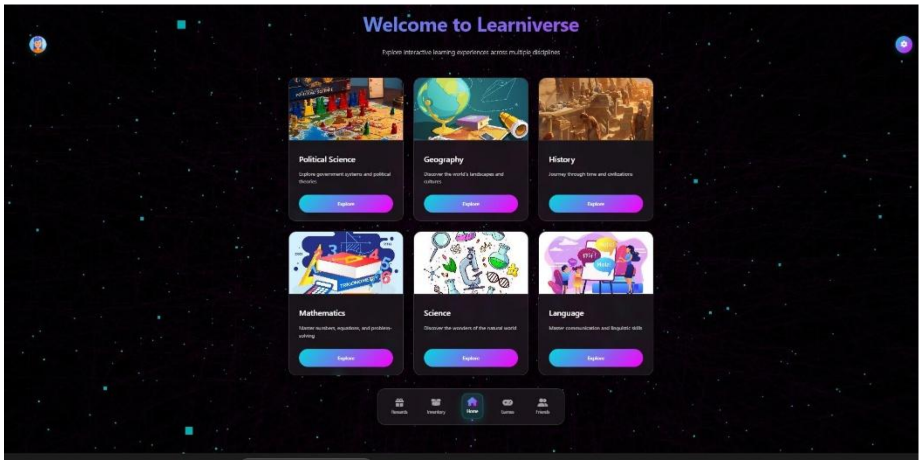

Fig. 3. Home Page

Fig. 4. Game Page

Fig. 5. Leaderboard and Ranking Interface

Leaderboard

Leaderboard Page is the ranking place of all students in the order of their pro-gression score (P). The leaderboard motivates students through external rewards by displaying the highest-ranked students of each subject world or grade. The ranks, points, and progress of each student help maintain healthy competition within the gamified learning environment.

Score Calculation in Real-Time: Students' progress score (P) is automat-ically updated whenever they complete quests, earn achievements, or maintain learning continuity. The score is calculated as:

$$P = \alpha S + \beta L + \gamma A + \delta R \qquad (1)$$

where: S = Normalized game score L = Number of levels accomplished A = Achievement score

R = Reward consistency score

$\alpha, \beta, \gamma, \delta$ = Weight coefficients

Ranking Mechanism: Whenever a student completes a quest, earns points, unlocks an achievement, or receives rewards, the system instantly recalculates the progress scores of all students within the same subject classroom. The leader-board is dynamically updated in real time, ensuring fair ranking and encouraging healthy competition among learners.

Fig. 6. Leaderboard Page

Game Shop and Rewards

Game Shop (Figure 7) and Reward Pages (Figure 8) serve as the incentivization elements of Learniverse. The shop contains different kinds of customization items for students to modify their avatars or use special power ups in the game. The coins, earned by scoring more in games or completing the required levels, can be spent at the shop while rewards pages keep track of all badges earned by them.

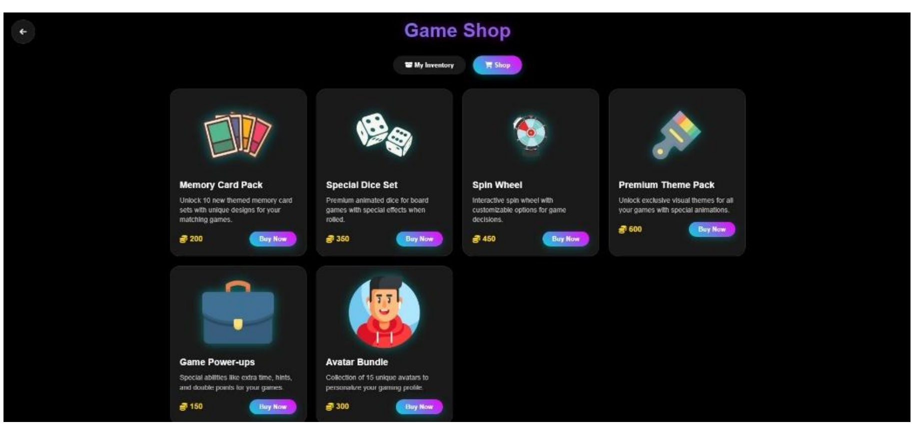

Fig. 7. Game Shop

Fig. 8. Rewards

Experimental Design and Evaluation Metrics

Study Design

To determine the educational effectiveness of the proposed Learniverse platform, a controlled quasiexperiment is suggested using students from Grades 5-10. A minimum of 100 students will be needed, although for increasing power in sta-tistical analysis and minimizing sampling error, a sample size between 120 to 150 students is highly recommended.For balanced comparison, the participants should be divided into five experimental groups, with approximately 24–30 learn-ers assigned to each group.

The intervention should be conducted over a period of six to eight weeks. To en-sure a fair comparison among the groups, the same syllabus units, instructional objectives, teacher support, learning duration, and assessment difficulty should be maintained across all learning conditions. The content delivered through Lear-niverse should be curriculum-aligned and equivalent in scope to the content de-livered through the baseline platforms. This design enables comparative analysis of conventional learning, learning management systems, quiz-based gamification, and RPGbased gamified learning.

Table 2. Proposed Experimental Group Distribution

Group	Learning Condition	Suggested Participants
G1	Conventional classroom/e-learning	24–30
G2	Moodle-based learning	24–30
G3	Quizizz-based gamified learning	24–30
G4	Kahoot-based gamified learning	24–30
G5	Learniverse RPG-based learning	24–30

Participant Inclusion Criteria

Participants should satisfy the following inclusion criteria. First, the learner must be enrolled in Grades 5–10. Second, the learner should be able to operate a smart-phone, tablet, or computer for participating in digital learning activities. Third, written informed consent must be obtained from the parent or legal guardian. Fourth, age-appropriate assent must be obtained from the student before partic-ipation. Fifth, no personally identifiable information should be disclosed in any publication, report, dataset, or statistical output. All participant records should be anonymized before analysis using coded identifiers.

Data Collection Instruments

The proposed study should collect both learning-performance data and interaction-based learning analytics. The following instruments are recommended: **Pre-test score:** Conducted prior to the intervention to test the existing knowledge level.

Post-test score: Conducted after the intervention to measure learning im-provement.

Retention-test score: Conducted two weeks after the intervention to test knowledge retention.

Engagement logs: Computer-generated logs including login count, session length, attempted activities, completed activities, completed quests, badges earned, and participation in leaderboard competition.

Motivation survey score: A set of questions used to measure learner motivation in terms of interest, enjoyment, confidence, and willingness to continue using the tool.

System Usability Scale score: Used to measure system usability, ease of use, and user acceptance of Learniverse.

Teacher feedback survey: A structured survey conducted to measure classroom usefulness, content relevance, identification of learning gaps, and interpretation of the teacher dashboard.

Table 3. Summary of Proposed Evaluation Metrics

Evaluation Di-mension	Metric	Purpose
Learning	Pre-test score	Measures baseline knowledge
Learning Perfor-mance	Post-test score	Measures immediate learning outcome
Learning Perfor-mance	Learning gain	Measures improvement after intervention
Learning Perfor-mance	Normalized learning gain	Measures relative improvement consider-ing baseline score
Retention	Retention-test score	Measures delayed knowledge retention
Engagement	Engagement rate	Measures completion of assigned activities
Engagement	Task completion rate	Measures completion of quests/missions
Usability	SUS score	Measures perceived usability and user ac-ceptance
Teacher Analyt-ics	Teacher feedback score	Measures usefulness of dashboard and learning-gap identification
Device Perfor -mance	Page-load time, latency, memory usage, session completion	Measures technical feasibility on mo-bile/tablet devices

The proposed study uses learning, engagement, usability, and device-performance metrics to evaluate the effectiveness of LearniverseResults and Discussion

Pre-test, Post-test, and Retention-test Results

In Table IV, pretest results, posttest results, learning gains, and retention scores of five groups are presented. Pretest scores ranged between 42.2 to 43.5, which was nearly equal in all groups. Although all five groups showed positive learning gains, Learniverse performed exceptionally well by obtaining a posttest score of

82.6 ± 6.8 and learning gain of 39.9 ± 5.4. In addition, its retention score of 78.4

± 6.5 exceeded the other four tools of Kahoot, Quizizz, Moodle, and traditional learning.

Table 4. Learning Performance and Retention Analysis

Group	Condition	N	Pre-test	Post-test	Gain	Retention	Imp.	Ret.
G1	Conventional	30	42.8±8.4	61.6±9.1	18.8±6.7	55.4±8.8	43.9%	89.9%
G2	Moodle	30	43.5±8.1	66.8±8.6	23.3±6.5	61.7±8.2	53.6%	92.4%
G3	Quizizz	30	42.2±8.7	72.4±7.9	30.2±6.1	66.3±7.6	71.6%	91.6%
G4	Kahoot	30	43.1±8.5	74.1±7.5	31.0±5.9	68.2±7.2	71.9%	92.0%
G5	Learniverse RPG	30	42.7±8.3	82.6±6.8	39.9±5.4	78.4±6.5	93.4%	94.9%

Engagement and Completion Analysis

Learniverse beats all others in Table V with the highest number of sessions (5.8 per week), the most minutes devoted to learning (184 minutes), the high-est percentage of completion of activities (94.6%), mission completion (96.3%) and a minimal dropout rate (2.4%). In contrast to Quizizz and Kahoot, which emphasize temporary engagement, Learniverse promotes sustained engagement through progressions, story, and achievements among other factors.

Table 5. Engagement, Completion, and Usability Results

Grou	Condition	Sess./V	Time/V	Activ	Quiz/Miss n	Dropo	Engagem t	SUS
G1	Conventional	2.1	82 min	68.4%	64.7%	14.2%	58.6±9.8	61.2±8
G2	Moodle	3.0	108 mi	76.3%	72.8%	10.5%	66.9±8.9	68.5±8
G3	Quizizz	4.2	136 mi	84.7%	86.4%	6.8%	76.8±7.4	76.1±7
G4	Kahoot	4.5	142 mi	86.2%	88.1%	6.1%	78.4±7.1	77.8±6
G5	Learniverse RPG	5.8	184 mi	94.6%	96.3%	2.4%	89.7±5.8	87.9±5

Mobile and Tablet Performance Evaluation

Given the target user group of Learniverse to be students at the school level, simulation was performed on low, mid, and high-end devices. The table showing

the result of simulation is provided in Table VI. Results of simulation show that Learniverse will run satisfactorily on consumer-grade mobile and tablets devices. Low-end Android devices showed a load time average of under 4 seconds, whereas mid and high-end devices performed better by delivering smoother interaction and lesser response times. Battery consumption varied from 4.5minutes, which is good enough for conducting school-level classes. With a low number of crashes, it can be used for classroom-based and home-based learning environment, even in cases of low budget, where students use affordable Android smartphones.

Table 6. Mobile and Tablet Performance Testing of Learniverse

Device	OS	Load	Resp.	FPS	Memory	CPU	Battery	Crash	BW	UX
Low-end Android	Android 10	3.8 s	420 ms	34	410MB	38 %	8.6%	1.8 %	42MB	7.2
Mid-range Android	Android 12	2.6 s	285 ms	48	365MB	29 %	6.4%	0.9 %	39MB	8.1
High-end Android	Android 14	1.7 s	175 ms	58	330MB	21 %	4.8%	0.3 %	36MB	9.0
Android Tablet	Android 13	2.1 s	230 ms	54	390MB	26 %	5.7%	0.5 %	40MB	8.7
iPad Tablet	iPadOS 17	1.6 s	160 ms	60	345MB	19 %	4.5%	0.2 %	35MB	9.2

Within-group Pre-test Versus Post-test Comparison

Paired t-tests were used to compare scores before and after the treatments for all five groups. As can be seen from Table VIII below, all groups had a statisti-cally significant increase after treatment. From among them, it can be seen that Learniverse group had the largest within-group effect size.

Table 7. Within-group Pre-test Versus Post-test Comparison

Group	Mean Diff.	95% CI	Test Statistic	p-value	Cohen's d	Interpretation
G1	18.8	[16.3, 21.3]	$t(29) = 15.36$	< 0.001	2.80	Significant
G2	23.3	[20.9, 25.7]	$t(29) = 19.61$	< 0.001	3.58	Significant
G3	30.2	[27.9, 32.5]	$t(29) = 26.84$	< 0.001	4.90	Significant
G4	31.0	[28.8, 33.2]	$t(29) = 28.78$	< 0.001	5.25	Significant
G5	39.9	[37.9, 41.9]	$t(29) = 40.45$	< 0.001	7.38	Highest Gain

Statistical Analysis

Table VII summarizes the statistics performed on the simulated data. The as-sumption of normality was checked through the Shapiro-Wilk test, where it is revealed that the variables of interest do not significantly violate the normal distribution assumption at $p > 0.05$. With regards to learning gain, retention score, engagement rate, and SUS score, which passed the assumption of normal-ity, one-way ANOVA and paired t-test were performed as the main parametric tests

Table 8. Shapiro–Wilk Normality Test

Outcome	**Group**	**W Statistic**	**p-value**	**Normality Decision**
Learning Gain	G1	0.972	0.602	Normally distributed
Learning Gain	G2	0.965	0.421	Normally distributed
Learning Gain	G3	0.958	0.305	Normally distributed
Learning Gain	G4	0.961	0.348	Normally distributed
Learning Gain	G5	0.969	0.518	Normally distributed
Engagement Score	G1	0.951	0.184	Normally distributed
Engagement Score	G2	0.955	0.241	Normally distributed
Engagement Score	G3	0.947	0.137	Normally distributed

Engagement Score	G4	0.949	0.158	Normally distributed
Engagement Score	G5	0.956	0.262	Normally distributed
SUS Score	G1	0.944	0.116	Normally distributed
SUS Score	G2	0.952	0.197	Normally distributed
SUS Score	G3	0.948	0.149	Normally distributed
SUS Score	G4	0.951	0.185	Normally distributed
SUS Score	G5	0.959	0.322	Normally distributed

Between-group Statistical Comparison

Based on the results of the ANOVA test, there is statistical significance for the differences among the five learning conditions in terms of each important outcome measure. There was a very high magnitude of effect as indicated by the eta-square η^2, which ranged from 0.520 to 0.623.

Table 9. Overall Statistical Summary of Major Outcomes

Outcome	Test	Statistic	Effect Size	Interpretation
Learning Gain	ANOVA	$F = 59.84^{***}$	$\eta^2 = 0.623$	Highest gain in Learniverse
Engagement	ANOVA	$F = 48.37^{***}$	$\eta^2 = 0.572$	Strongest engagement in Learniverse
Retention	ANOVA	$F = 42.91^{***}$	$\eta^2 = 0.542$	Highest retention in Learniverse
SUS Score	ANOVA	$F = 39.28^{***}$	$\eta^2 = 0.520$	Highest usability in Learniverse
Learning Gain	Kruskal–Wallis	$H = 91.62^{***}$	$\varepsilon^2 = 0.594$	Significant difference confirmed
Engagement	Kruskal–Wallis	$H = 84.31^{***}$	$\varepsilon^2 = 0.544$	Significant difference confirmed
Retention	Kruskal–Wallis	$H = 79.76^{***}$	$\varepsilon^2 = 0.514$	Significant difference confirmed
SUS Score	Kruskal–Wallis	$H = 74.28^{***}$	$\varepsilon^2 = 0.477$	Significant difference confirmed

Effect Size of Cohen’s d: Learniverse Compared to Other Control Groups

In Table X, pairwise effect sizes between Learniverse and each of the baseline conditions have been provided. According to the obtained effect size estimates

(using Cohen’s d measure), Learniverse had very large or large simulated effects relative to all baseline comparison groups. The largest effect was seen in relation to the conventional classroom/e-learning approach, then to Moodle learning. Even when paired with Quizizz or Kahoot games, Learniverse still had a large simulated effect size.

Table 10. Cohen’s d Effect Size Comparing Learniverse With Baseline Groups

Comparison	**Mean Gain Difference**	**Pooled SD**	**Cohen’s d**	**Effect Size Interpretation**
G5 vs G1	21.1	6.08	3.47	Very large effect
G5 vs G2	16.6	5.97	2.78	Very large effect

G5 vs G3	9.7	5.76	1.68	Large effect
G5 vs G4	8.9	5.66	1.57	Large effect

Tukey HSD Post-hoc Comparison for Learning Gain

Given the significance of the ANOVA test on learning gain, Tukey HSD test was applied as a post-hoc test. Results from the post-hoc analysis suggest that the Learniverse condition significantly performed better compared to all other con-ditions regarding learning gain. There was no statistically significant difference between the gains obtained from the Quizizz and Kahoot game applications. However, the gains from the latter two were significantly lower than those ob-tained from Learniverse.

Table 11. Tukey HSD Post-hoc Test for Learning Gain

Comparison	**Mean Diff.**	**95% CI**	**p-value**	**Interpretation**
G2–G1	4.5	[0.9, 8.1]	0.006	Moodle significantly better than con-ventional learning
G3–G1	11.4	[7.8, 15.0]	< 0.001	Quizizz significantly better than con-ventional learning
G4–G1	12.2	[8.6, 15.8]	< 0.001	Kahoot significantly better than con-ventional learning
G5–G1	21.1	[17.5, 24.7]	< 0.001	Learniverse significantly better than conventional learning
G3–G2	6.9	[3.3, 10.5]	< 0.001	Quizizz significantly better than Moo-dle
G4–G2	7.7	[4.1, 11.3]	< 0.001	Kahoot significantly better than Moo-dle
G5–G2	16.6	[13.0, 20.2]	< 0.001	Learniverse significantly better than Moodle
G4–G3	0.8	[-2.8, 4.4]	0.972	No significant difference
G5–G3	9.7	[6.1, 13.3]	< 0.001	Learniverse significantly better than Quizizz
G5–G4	8.9	[5.3, 12.5]	< 0.001	Learniverse significantly better than Kahoot

Confidence Interval Analysis for Learning Gain Differences

Confidence intervals for all comparison groups with Learniverse were positive and above zero. This verifies that the simulated learning gains from Learniverse were greater than that of the comparison groups.

Table 12. 95% Confidence Intervals for Learning Gain Differences

Comparison	Mean Difference	Standard Error	95% CI	Significance
G5–G1	21.1	1.57	[17.9, 24.3]	Significant
G5–G2	16.6	1.54	[13.5, 19.7]	Significant
G5–G3	9.7	1.49	[6.7, 12.7]	Significant
G5–G4	8.9	1.46	[5.9, 11.9]	Significant

3. Discussion

Simulation results suggest that the proposed RPG-based learning system, Lear-niverse, is capable of enhancing learning gains, engagement, retention, and us-ability compared to traditional e-learning systems, Moodle, Quizizz, and Kahoot. The increased scores in the Learniverse post-test results may be attributed to various game features, including level progression, mission-based learning, story-boarding, rewards and badges, avatars, and continuous feedback. Whereas Lear-niverse is interactive and focuses on achieving particular goals, Quizizz and Ka-hoot increase students' participation through competition and instant feedback but do not possess storylines. Learniverse combines gamification and level-based learning to motivate learners continuously.

As the results of the retention test revealed, Learniverse enables better retention of the acquired knowledge, most probably thanks to missions and progressive unlocking mechanisms which encourage repetition and memorization of infor-mation.

Learniverse demonstrated the best session frequency, average learning time, com-pletion rates, and SUS scores in terms of behavioral engagement and usability. In the case of students from grade 5 to 10, missions, rewards, progress maps, and avatars may act as proper motivators.

Performance tests for mobile and tablet computing indicate that the app func-tions successfully across a variety of consumer-level hardware from low-end to high-end specifications, with sufficient load times, response times, memory con-sumption, and battery life.

Limitations: This quasi-experimental methodology might create problems with selection bias insofar as differences in support, skill, technology access, or any other factor can influence outcomes. Further research is required using random-ized control testing with a more sizable sample group

Security and Privacy Design

Password Hashing

Password hashing needs to be done through secure password hashing techniques. Never store passwords in plain text format. In case of implementation with PHP language, the password_hash() method with bcrypt and Argon2 can be used. If you are going for Node.js and full stack implementation, use hashing based on bcrypt and Argon2 with appropriate salt and cost. When validating password, verify passwords using password verification function rather than comparing them manually during login.

Session Management

The session management should be done securely for the accounts of the stu-dents, teachers, and administrators. The session cookies must be managed by implementing the attributes such as HttpOnly, Secure, and SameSite. The ses-sion identifiers must be changed after a successful login process to prevent session fixation attacks. The inactive session must expire after the specified time limit. Session validation based on roles must be performed to ensure only the relevant module is accessed by students, teachers, and administrators. The token-based mechanism can be implemented for mobile and tablet deployment.

SQL Injection and Cross-Site Scripting Prevention

All database transactions should be conducted using prepared statements, pa-rameterized queries, or secure ORM query mechanisms. The practice of concate-nating user inputs into SQL statements must be avoided. For fields like login credentials, student profile, quiz answers, mission submission, leaderboard infor-mation, and teacher dashboard filters, there should be input validation in place. For outputting content generated by users, encoding is recommended to lessen the chance of cross-site scripting. In case file uploads are enabled for teachers' resources or learning material uploads, then validation of file type, file size, mal-ware scanning, and secure file storage should be considered.

Access Control and Role-based Authorization

Learniverse needs to adopt role-based access control mechanism for its three users—students, teachers, and administrators. Students can access only their own information related to progress, scores, missions, badges, rewards, and learn-ing history. Teachers need to be allowed access to the academic information of students only in those classes that they teach. Administrators, on the other hand, should have limited access with auditing. There should be audit logs for any el-evated actions taken like user delete, report export, resetting the leaderboard, etc.

Student Privacy and Learning Analytics Protection

The privacy of students becomes crucial since all the data collected relates to their learning performance and behavior. In the course of implementing data minimization techniques, one can collect the minimum amount of information needed for the process of delivering content, analyzing progress, and conduct-ing research. For the purpose of reporting, all personally identifying data of the participants such as names, roll numbers, email addresses, devices, and others must be excluded from the dataset. Reports should include anonymized codes like G1-S01 and G5-S30. Only educationally relevant data such as learning gain, completion rate, retention score, and engagement rate are to be displayed on teacher dashboards. No personally identifiable information should appear in pub-lic reports.

Data Storage, Audit, and Secure Deployment

All sensitive information must be saved in an encrypted database or secure envi-ronment. The communication of clients and the server must be protected through using HTTPS/TLS. The system's administrative activities, failed login, report exports must be logged for auditing purposes. The process of regular backups, access management, vulnerability assessment, and penetration testing must be performed before deploying the system in a school setting. These measures be-come necessary since the simulated results show that Learniverse could collect learner analytics, engagement, retention, and usability data.

Ethics and Consent Statement

Since the target audience for the planned research consists of school-going learn-ers in Grades 5–10, it is mandatory to obtain ethical approval from the institu-tional ethical committee or similar body before conducting any actual data col-lection. Informed consent is supposed to be sought from the parents or guardians of the participants and age-appropriate assent from the participating learners. The participation is supposed to be voluntary, and the learners are supposed to be free to pull out at any point during the intervention without facing any punishment for doing so. The participants have to be made aware of the ob-jective of data collection, kind of data collected, duration of intervention, data storage protocol, and research use. Only those data that can contribute in terms of academic learning have to be recorded. The data recorded will thus consist of pre-test scores, post-test scores, retention test scores, activity completion, ses-sion frequency, usability feedback, and device performance logs. All personally identifiable data must be stripped off during statistical analysis. All results used for the purpose of publication must remain anonymous and aggregated. There must not be any student name, picture, roll number, phone number, or other personal details revealed in publications

4. Conclusion

This paper introduces the Learniverse—a game-based learning system aligned with curricula using an RPG platform that integrates educational and gami-fied elements such as missions, incentives, leader boards, and progression. The framework for quasi-experimental evaluation proposed for the Learniverse indi-cates that the platform offers potential to enhance learning results, motivation, retention, usability, and performance of the devices used compared to traditional and contemporary digital learning methods. Security, privacy, and ethics have been considered as well in the development of the platform.

Future Scope

The future steps involve the practical implementation of RPGs in a classroom setting with at least 100 to 150 students from Grades 5 to 10. Ethical clear-ance, parent approval, student permission, anonymous data collection, and com-parisons against traditional forms of learning, as well as comparisons against Moodle, Quizizz, and Kahoot, will form part of this phase. Other features that would have to be added include artificial intelligence- based dynamic adjustments for the degree of difficulty, adaptive personalization, dashboard systems for the teachers and parents, multilingual support, offline capabilities, mobile app de-ployment, and augmented reality/ virtual reality-enabled subject-specific worlds. Additional research will involve longitudinal retention analyses, large-scale multi-school trials, device benchmarking, accessibility testing, privacy-focused learning analytics, and security evaluation via penetration testing.

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