International Journal of Computer Engineering and Technology (IJCET)
Volume 16, Issue 3, May-June 2025, pp. 1-13, Article ID: IJCET_16_03_001
Available online at https://iaeme.com/Home/issue/IJCET?Volume=16&Issue=3
ISSN Print: 0976-6367; ISSN Online: 0976-6375; Journal ID: 5751-5249
Impact Factor (2025): 18.59 (Based on Google Scholar Citation)
DOI: https://doi.org/10.34218/IJCET_16_03_001

AN EFFECTIVE WAY FOR AI ENHANCED GAME BASED LEARNING

Akshay Poudel [1], Ujjwal Chadhary [2], Shivam Mahrolia [3], Akshay Pundir [4], Nitin Goyal [5]

[1] R.D Engineering College, Ghaziabad, Uttar Pradesh, India.
[2] R.D Engineering College, Ghaziabad, Uttar Pradesh, India.
[3] R.D Engineering College, Ghaziabad, Uttar Pradesh, India.
[4] R.D Engineering College, Ghaziabad, Uttar Pradesh, India.
[5] Associate Professor, R.D Engineering College, Ghaziabad, Uttar Pradesh, India.

ABSTRACT

In Today's Modern World Game-Based Learning has emerged as a promising educational approach that leverages children's natural love for games to enhance their educational outcomes. As digital technologies become increasingly integrated into children's lives, understanding how game elements and game-based learning can be used for effective learning becomes critical. This research analyses the positive effects of game-based education which follows narrative-centered learning theory and problem-solving practices on academic achievement for children in school. This research presents the design and implementation of an AI-powered web-based system that presents the children with a diverse selection of educational games across multiple subjects, enabling them to select games aligned with their interests and academic needs.

The core innovation of our system lies in its integrated artificial intelligence (AI) module, which continuously monitors each child's gameplay performance and learning progress and their weak areas. AI analyses this performance data from children to

generate comprehensive and individualized reports for parents and teachers, highlighting strengths and weaknesses and areas for improvement, and their learning curve.

Based on these insights, the system recommends specific games to make children engage in their weaker subject areas, thereby personalizing the learning journey and supporting mastery-based progression. Initial assessment indicates that this method not only enhances student interest and enjoyment but also allows for more efficient and data-based interventions by teachers and parents.

Keywords: Game-Based Learning, Artificial Intelligence, Adaptive Learning, Personalized Learning

Cite this Article: Akshay Poudel, Ujjwal Chadhary, Shivam Mahrolia, Akshay Pundir, Nitin Goyal. (2025). An Effective Way for AI Enhanced Game Based Learning. *International Journal of Computer Engineering and Technology (IJCET)*, 16(3), 1-13.

https://iaeme.com/MasterAdmin/Journal_uploads/IJCET/VOLUME_16_ISSUE_3/IJCET_16_03_001.pdf

1. INTRODUCTION

In today's era of computers, teachers find it more difficult than ever before to grasp and sustain the interest of young students. Conventional teaching techniques often find it hard to engage the interest of children, who are naturally drawn towards activities that are enjoyable, fun and interactive.

Game-Based Learning (GBL) has emerged as an attractive solution for early childhood education, leveraging the motivational power of games to drive cognitive, social and emotional development and make learning fun and effective.

While Game-based learning (GBL) has been proven to improve learning, current systems have not yet had the ability to personalize the learning experience or react to the unique child needs. Emerging advances in artificial intelligence offer new tools for bridging the gaps through the ability to monitor student progress, provide immediate feedback, and change educational content in real time. Combining AI with game-based environments is a likely potential to boost engagement while providing focused learning paths that foster personal development and mastery.

This study demonstrates the creation and testing of an AI-powered, web-based learning platform integrating a mixed collection of subject-specific games and top- level analytics. The

platform enables children to select games on various topics, while an integrated AI engine continuously tracks performance, generates

in-depth progress reports for parents and teachers and recommend specific games to address each child's unique learning needs. By integrating adaptive learning algorithms, customized feedback, and game-like experiences, this platform can potentially transform early education—making learning more fun, accessible, and effective for every child.

A distinctive feature of our system is its provision for AI-enabled speech recognition, which provides children with the means to navigate the platform using basic voice commands. This feature is immensely useful for young students or dyslexic users as it breaks down access barriers and allows for independent learning by just saying which type of games they want to play, or which subject they are interested in. Through the incorporation of modern trends in learning technology—adaptable learning algorithms, real-time analytics, and mobile responsiveness—into time-tested pedagogic practices, our system has the mission to motivate children and develop a passion for learning that will last a lifetime. The present study investigates the impact of our system on the cognitive development, motivation, and academic performance of children.

Specifically, it delves into the way the adaptive learning system of the platform and personalized feedback mechanisms facilitate any mastery and motivation of the subject. Via quantitative performance data and qualitative feedback from the users, this research aims to provide insights on the effectiveness of gamification, artificial intelligence, and secure user authentication in preschool education, ultimately delivering a template for subsequent education technologies designed to support and encourage young pupils.

2. LITERATURE REVIEW

A. AI's Role in Modern EdTech

Recent breakthroughs show that the AI-driven systems are smarter and outperform the static digital tools:

- **MATHia** (Carnegie Learning): 28% higher algebra scores through step-by-step scaffolding (Koedinger et al., 2020)
- **Duolingo ABC**: 40% faster literacy gains via speech recognition (Settles et al., 2022)
- **Our Innovation**: Combines these approaches with secure learner profiles enabling longitudinal progress tracking

B. Personalized Feedback and Adaptive Learning Paths

One of the major strengths of game-based learning is the immediacy of feedback, which is crucial for young children to see their progress and areas that need improvement. Personalized, immediate feedback supports the development of a growth mindset and motivates children to overcome obstacles (Dweck, 2006). Our System uses adaptive learning algorithms that examine each child's performance and dynamically adapt game difficulty so that learning is challenging but attainable. This adaptive strategy, combined with a personalized user profile and login system, opens the door for a highly individualized but still secure learning experience.

C. Comparative Analysis

Comparison Criteria	Paper 1 [10]	Paper 2 [5]	Paper 3 [7]
Title	Game-Based Learning Using Web Technologies	Engaging Students in the Learning Process with Game-Based Learning: The Fundamental Concepts	Game-Based Learning: A Review on the Effectiveness of Educational Games
Type of Study	System design and implementation	Conceptual/theoretical review	Systematic literature review
Main Focus	Developing and implementing a specific web-based game system called "UniGame" for university students	Exploring fundamental concepts and theoretical foundations of game-based learning	Analysing empirical evidence of educational game effectiveness
Theoretical Foundations	Collaborative learning, game-based learning	Narrative-centred learning theory, problem-solving theory, engagement theory	Comprehensive analysis of game elements and their effectiveness
Methodology	System development with evaluation through think-aloud user testing	Literature review/conceptual analysis	Systematic review of 22 empirical studies from 998 initially identified papers
Primary Game Type	Web-based role-playing game with team structures	Digital and non-digital educational games	Various game types across empirical studies

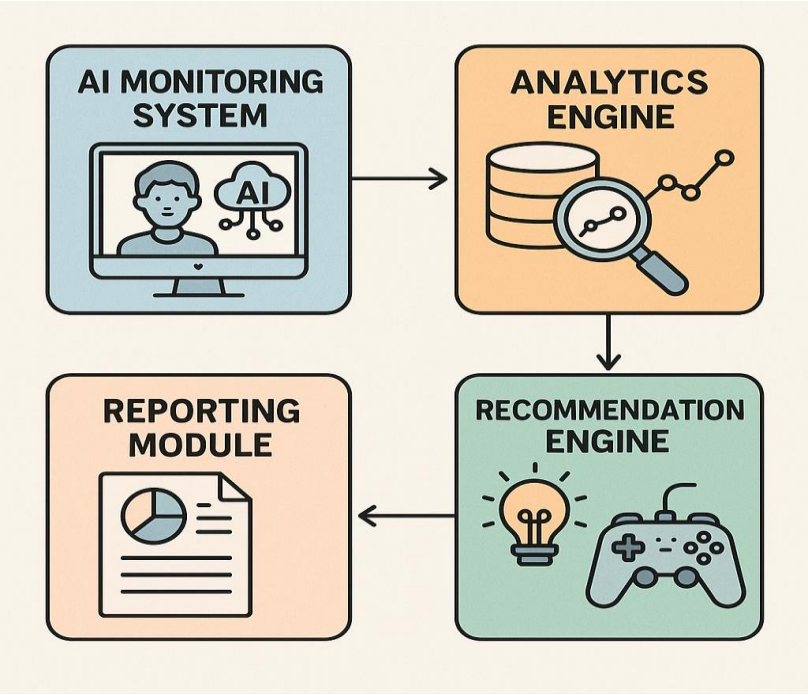
Educational Domain	University-level education, focus on social skills and collaborative learning	Primarily English language teaching with broader educational applications	Multiple domains (math, science, history, geography)
Game Elements Analysed	Communication tools, team spaces, chip allocation, virtual conference areas	Fun, rules, goals, interactivity, feedback, problem-solving, narrative	Interactivity, feedback, competition, content, affective agents, music, display systems
Key Benefits Identified	Enhanced communication skills, teamwork, project management, soft skills development	Increased engagement, coordination, creativity, problem-solving skills	Motivational benefits, potential cognitive gains (domain-specific)
Implementation Structure	Three-tier architecture (thin client, middleware, storage layer)	Not specified - focuses on theoretical aspects	Reviews various implementation approaches across studies
Technical Details	ASP.NET, Flash Communication Server, SQL Server, XML-based theme system	Not applicable - conceptual focus	Not applicable - review focus
Main Limitations	High equipment costs, technical expertise required	Screen time concerns, equipment costs, potential for bias	Inconsistency in research methodologies, lack of standardized game definitions
Unique Contribution	XML-based theme description standard for teacher customization	Comprehensive analysis of teachers' perceptions and game-growth mindset connection	Analytical framework for evaluating game effectiveness research

3. RESEARCH METHODOLOGY

A. System Architecture and Functionality

Our system makes up a complete learning platform that contains a wide array of games on various subjects. The platform is made with some major components:

- **Game Repository**: A tightly curated group of educational games by subject, level, and objectives. These games use established game-based learning practices to make effective, entertaining learning experiences.
- **AI Monitoring System**: A unified artificial intelligence framework that continuously monitors and evaluates student performance on all games and subjects. It gathers information on completion rates, accuracy levels, time taken, difficulty levels, and other related factors.
- **Analytics Engine**: An advanced analysis infrastructure that analyzes performance data to recognize patterns, strengths, weaknesses, and trends of learning by each student.
- **Reporting Module:** An automated module that produces in-depth reports for parents and teachers, analyzing student progress, points of strength and weakness, and offering specific improvement recommendations.
- **Recommendation Engine:** An AI-driven system that recommends games to meet specific learning needs, designing a tailored learning pathway for every student.

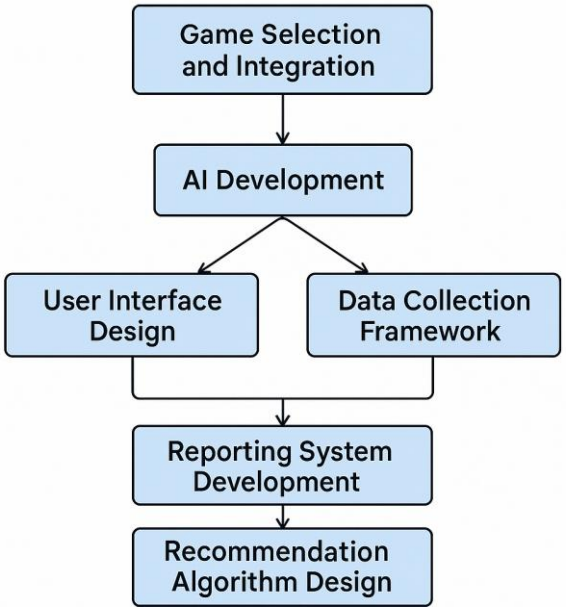


The key innovation of our system lies in the closed cycle of feedback that it establishes among assessment, reporting, and focused intervention. In contrast to other educational games platforms, which merely provide sets of games, our system proactively steers the learning process based on ongoing analysis of performance.

B. Methodological Approach

Our process comprises several stages:

- **Game Selection and Integration**: Selecting and integrating excellent learning games, aligning them with accepted curriculum standards across different subjects.
- **AI Development:** Designing and training machine learning models to precisely determine student performance, recognize learning habits, and suggest proper recommendations.
- **UI Interface Design:** Creating a simple, intuitive interface that kids love, coupled with transparent navigation and visibility on progress.
- **Data Collection Framework:** Developing extensive data collection systems that gather meaningful performance metrics without impacting gaming experience.
- **Reporting System Development:** Building automated reporting feature that converts raw performance data into understandable, actionable information for parents and teachers.
- **Recommendations Algorithm Design:** Designing advanced algorithms that map recognized learning needs to suitable game suggestions.



C. Evaluation Framework

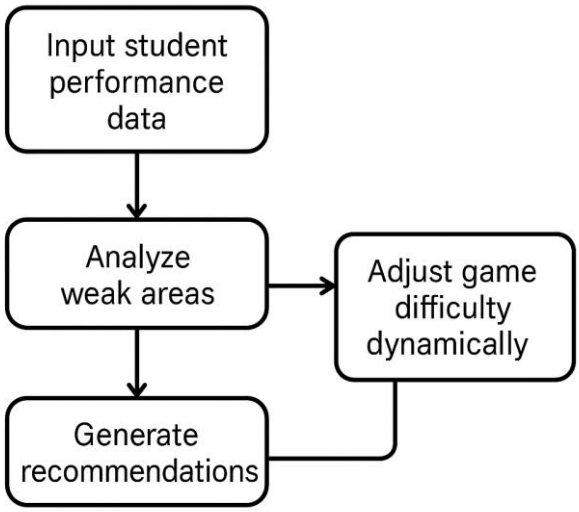
To evaluate the performance of our system, we will have an evaluation plan that consists of:

- **Learning Outcomes**: Monitoring subject mastery and skill development progress over time.
- **Engagement Metrics**: Measuring time spent on the platform, usage frequency, and completion rates.
- **User Satisfaction**: Gathering feedback from children, parents, and teachers on system usability and perceived value.
- **Recommendation Effectiveness**: Measuring the extent to which the AI-recommended content meets the determined learning needs.
- **Report Utility**: Measuring the ways in which teachers and parents use the reports and whether they translate into useful interventions.

Here is the Pseudocode for AI Enhanced Game-Based Learning System that:

- Tracks student performance,
- Identifies weak areas,
- Recommends games to address those weaknesses,
- Adjusts game difficulty dynamically.

```
Initialize student_profile for each student
Initialize game_database with games tagged by subject and difficulty

FOR each student_session:
  student = get_current_student()
  selected_game = student.select_game(game_database)

  WHILE game_not_completed:
    present_game(selected_game, current_difficulty)
    record_performance(student, selected_game, current_difficulty)
    feedback = evaluate_performance(student, selected_game)

    IF feedback == "excellent":
      increase_difficulty(selected_game)
    ELSE IF feedback == "poor":
      decrease_difficulty(selected_game)
    ELSE:
      maintain_difficulty(selected_game)

  update_student_profile(student, selected_game, performance_metrics)

  weak_areas = analyze_performance(student_profile)
  generate_report(student, weak_areas)

  recommended_games = recommend_games(game_database, weak_areas)
  present_recommendations(student, recommended_games)

  notify_parents_and_teachers(student, report)

END FOR
```



4. COMPARATIVE ANALYSIS AND FUTURE DIRECTION

A. Comparison with Existing System

Our system is distinct from other game-based learning systems in several important ways:

- **Broad Subject Coverage**: While other systems concentrate on individual subjects, our system covers a range of curriculum topics, offering a more integrated learning experience.
- **AI-Based Personalization**: While other systems provide simple adaptivity, our system uses advanced AI algorithms to develop highly personalized learning paths.
- **Stakeholder Integration**: By sending in-depth reports to parents and teachers, our system closes the gap between school and home learning environments.
- **Closed-Loop Learning**: The ongoing loop of assessment, reporting, and targeted suggestions creates a self-improving learning system that dynamically reacts to student needs.

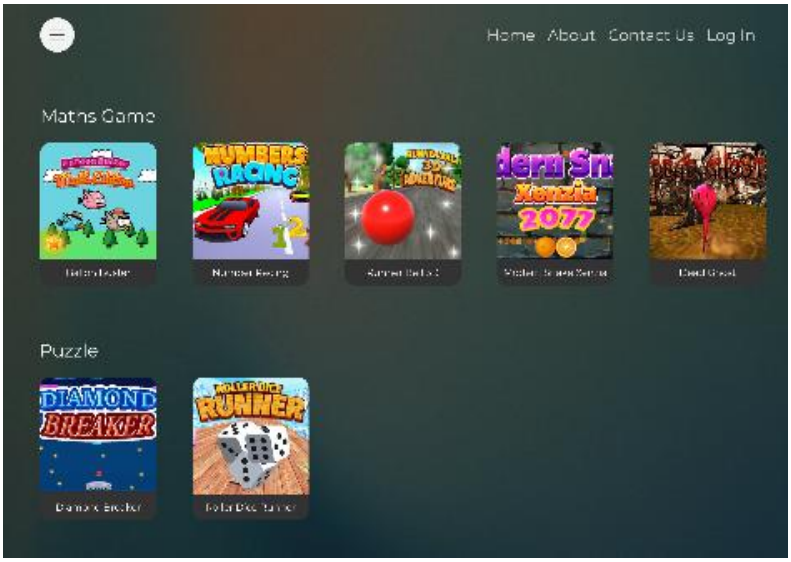
B. Future Research and Development

Future development on this system might be investigated:

- **Integration of Other AI Technologies**: Adding natural language processing and computer vision to evaluate more sophisticated learning tasks.

- **Enhanced Stakeholder Features**: Creating teacher tools for incorporating the platform into classroom activity and curriculum design.
- **Collaborative Learning Features:** Incorporating multiplayer and team-based games to support social learning and collaboration.
- **Longitudinal Studies**: Performing long-term research on the long-term effects of the system on learning behaviors and educational outcomes.

C. User Interface Design



The dashboard shows games that are available based on the subject. This is the Sample Website that we are developing for our system, we are extending it. It supports various types of games based on the subject.

This is a Car Racing Game, the player need to select one of the four options, there is only one of them that is correct, when the player select the correct option, the car will accelerate forward.

This is the ballon buster game, in which the bird must pop, one of the four ballon, that contains the correct answer of the question posed in the top.

by opting for the proper option, the bird will continue to move forward.

D. Graphs

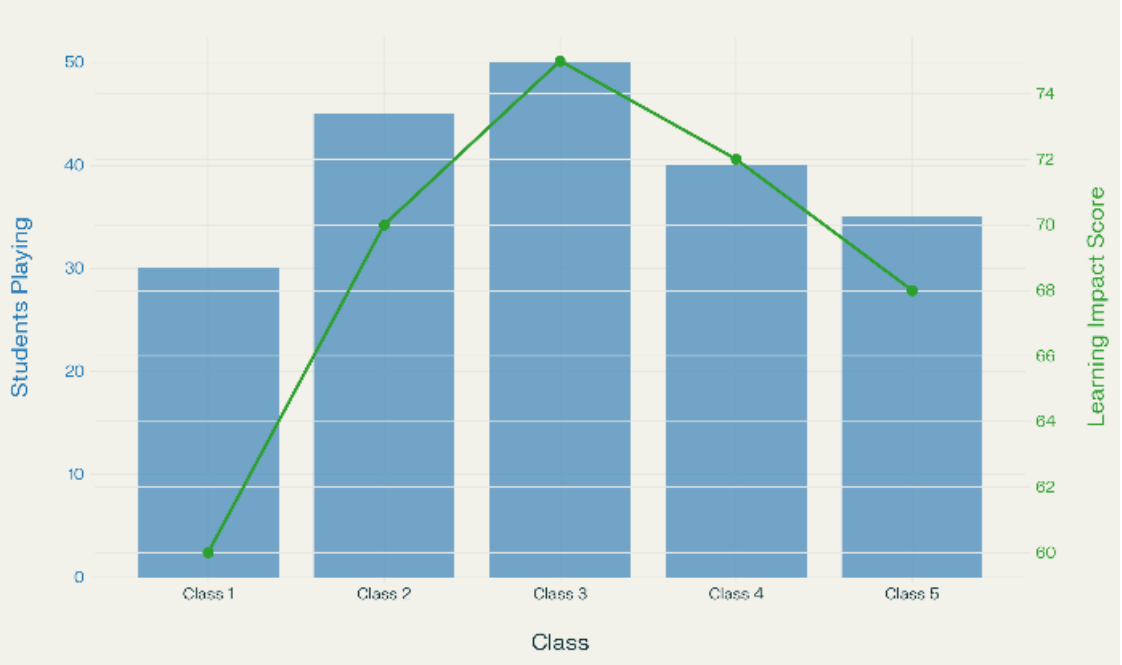


Figure. Game Participation and Learning Impact Across Classes 1–5

Game Play and Learning Effect demonstrated in the graph:

A. **Class 3** reported the most participation, with 50 students playing, and recorded the greatest learning impact score of 75.

B. **Class 2** and Class 4 also showed strong participation (45 and 40 students, respectively) and high learning impact scores (70 and 72).

C. **Class 1** The class with the lowest involvement(30 students) and the lowest learning impact value (60).

A positive correlation is seen between student numbers engaged with the game-based system and the learning impact value, which suggests that higher levels of engagement with the system are related to larger benefits in learning outcomes.

5. CONCLUSION

Our artificial intelligence-powered game-based learning platform is an important leap in education technology by putting together the fun factor of learning games and the personalization feature of artificial intelligence. By developing a system that not only makes learning fun but also continuously tracks progress and offers targeted interventions, we fill a very important void in educational strategies in place today.

The combining of AI-based assessment, reporting, and recommendation capabilities produces an end- to-end learning environment that serves the needs of all constituents in the educational process. It offers students stimulating, individualized learning experiences; parents, visibility in their children's academic achievement; and teachers, rich data to drive instruction in the classroom.

As educational technology advances, this method of AI-augmented game-based learning can revolutionize the way children learn, making education more effective, interactive, and responsive to individual needs.

REFERENCES

[1] Manar S. Alotaibi. Game-based learning in early childhood education: a systematic review and meta-analysis. Front. Psychol. Sec. Media Psychology. (2024) Volume 15

[2] Asli Cekmis, Mert Karakaya. Digital game-based learning in architecture education: Consolidating visual design principles in freshmen. JOURNAL of DESIGN for RESILIENCE in ARCHITECTURE and PLANNING. (2024). Vol. 5 No. 2

[3] Pablo Andrés Ortiz de Zaldumbide & Gül Akcaova. The Concept of Game Based Learning Shaping the present and Future of Learning. (2024). Version 1. SURF

[4] Meet Ashokkumar Joshi. Adaptive Learning Through Artificial Intelligence. International Journal of Innovative Research in Science, Engineering and Technology, (2023). Vol. 4, Issue 4, 001-002

[5] Adipat, S., Laksana, K., Busayanon, K., Asawasowan, A., & Adipat, B. Engaging students in the learning process with game-based learning: The fundamental concepts. International Journal of Technology in Education (IJTE), (2021). 4(3), 542-552. https://doi.org/10.46328/ijte.169

[6] W.- Koedinger, K. R. et al. Scaling up learning engineering toward STEM education. Science, (2020). 370(6516), 399–404.

[7] Vandercruysse, S., Vandewaetere, M., & Clarebout, G. Game based learning: A review on the effectiveness of educational games. In M. M. Cruz–Cunha (Eds.), Handbook of Research on Serious Games as Educational, Business, and Research Tools (pp. 628–647). (2012) Hershey, PA: IGI Global.

[8] Cepeda, N. J. et al. Distributed practice in verbal recall tasks. Psychological Science (2006). 17(3), 249–259.

[9] Dweck, C. S. Mindset: The New Psychology of Success. Random House (2006).

[10] Christos Bouras, Vaggelis Igglesis, Vaggelis Kapoulas, Ioannis Misedakis, Department of Computer Engineering and Informatics, University of Patras and Research Academic Computer Technology Institute. GAME-BASED LEARNING USING WEB TECHNOLOGIES.

Citation: Akshay Poudel, Ujjwal Chadhary, Shivam Mahrolia, Akshay Pundir, Nitin Goyal. (2025). An Effective Way for AI Enhanced Game Based Learning. International Journal of Computer Engineering and Technology (IJCET), 16(3), 1-13.

Abstract Link: https://iaeme.com/Home/article_id/IJCET_16_03_001

Article Link:
https://iaeme.com/MasterAdmin/Journal_uploads/IJCET/VOLUME_16_ISSUE_3/IJCET_16_03_001.pdf

✉ **editor@iaeme.com**