INTERNATIONAL JOURNAL OF ADVANCE RESEARCH, IDEAS AND INNOVATIONS IN TECHNOLOGY

ISSN: 2454-132X
Impact Factor: 6.078
(Volume 11, Issue 3 - V11I3-1314)
Available online at: https://www.ijariit.com

AcuTutor: An AI-Driven Personalized Learning Platform for Accelerated Cognitive Development

Satyom Mitra
satyommitra0@gmail.com
Amity University Raipur, Chhattisgarh

Dr. Goldi Soni
gsoni@rpr.amity.edu
Amity University Raipur, Chhattisgarh

Mansi Tiwari
mansitiwari1224@gmail.com
Amity University Raipur Chhattisgarh

Alok Kumar
Kumaralok08380@gmail.com
Amity University Raipur Chhattisgarh

Md Kamil
kamil.kd798@gmail.com
Amity University Raipur, Chhattisgarh

Kushgra Singh
krishusingh393@gmail.com
Amity University Raipur, Chhattisgarh

ABSTRACT

As education increasingly emphasizes personalization, the demand for adaptive learning systems that cater to each pupil's unique requirements has grown. AcuTutor is an AI-powered training platform designed to provide customized support across various subjects and skill levels.

Keywords - *Individualized Learning, AI-Powered Training, Acututor, Natural Language Processing (NLP), Adaptive Education, Real-Time Feedback, Gamification in Learning, Educational Technology, Intelligent Automation, Equitable Access to Education.*

INTRODUCTION

Imagine a classroom where every pupil gets assignments tailored just for them — whether they learn best through videos, hands-on activities, or reading. That's the goal of personalized learning solutions. Traditional classrooms often struggle to meet each pupil's unique needs, but with new technology, we're moving closer to making that a reality. Artificial Intelligence (AI) and Natural Language Processing (NLP) have emerged as transformative technologies capable of reshaping educational experiences. These technologies enable dynamic content delivery, real-time feedback, and context-aware support, paving the way for a more inclusive and effective approach to teaching and learning.

AcuTutor is a next-generation AI-powered training platform designed to meet this challenge. It aims to deliver personalized educational support by leveraging NLP models that understand and respond to student inputs in natural language. Unlike traditional training systems that follow rigid educational patterns, AcuTutor adapts in real time to the learner's performance, comprehension level, and progress. The system incorporates interactive feedback loops and gamification mechanisms including badges, levels, and performance streaks to foster motivation, encourage consistent learning behavior, and enhance retention.

Designed to serve a wide demographic — ranging from school students and test aspirants to professionals engaged in lifelong learning — AcuTutor provides scalable, subject-agnostic support across various disciplines and difficulty levels. The platform's architecture blends user-friendly interfaces with intelligent backend processing to ensure seamless, intuitive, and enriching learning journeys.

This paper delves into the core components and technical architecture of AcuTutor, outlining the algorithms, frameworks, and design decisions that power its functionality. In addition to its functional aspects, we examine the platform's ethical considerations, including data privacy, algorithmic fairness, and transparency.

Finally, the discussion explores the potential of AI-driven training platforms like AcuTutor to democratize quality education on a global scale, highlighting both current capabilities and avenues for future development.

Every pupil learns differently — some learn fast, others need more time. Some prefer reading, while others understand better with videos or examples. But traditional classroom teaching often uses the same method for everyone, which can make learning difficult or boring for some students. To solve this problem, new technologies like Artificial Intelligence (AI) and Natural Language Processing (NLP) are being used to create learning systems that adapt to each student's needs.

AcuTutor is an AI-based training platform designed to give students a more personalized and enjoyable learning experience. It uses smart language tools to understand student questions, provide helpful answers, and adjust quizzes or assignments based on how well the student is doing. What makes AcuTutor special is its fun and interactive features, like earning badges, reaching new levels, and tracking progress streaks — these help keep students motivated and interested in learning.

AcuTutor can be used by many types of learners, such as school students, people preparing for exams, or adults learning new skills. It works across different subjects and levels, making it flexible and easy to use.

In this paper, we explain how AcuTutor works, what technologies it uses, and how it was built. We also talk about important topics like keeping student information private, making the system fair for everyone, and being open about how the AI makes decisions. AcuTutor shows how smart technology can help make education better, more fun, and accessible to more people around the world.

RELATED WORKS

In recent years, there has been a notable increase in the development of intelligent tutoring systems (ITS) and AI-driven educational platform*s*. These systems aim to bridge the gap between one-size-fits-all instruction and personalized, student-centric education. While traditional ITS focused on rule-based logic and static question banks, newer models employ machine learning, NLP, and user behavior analytics to dynamically adapt to learners' needs.Prominent AI-powered educational tools such as **Khan Academy**, **Coursera Smart Learning Paths**, and **Socratic by Google** have laid the groundwork for personalized content delivery. However, they often lack real-time interactivity, context-aware response generation, and gamified elements, which are essential for sustained learner engagement and motivation. AcuTutor addresses these gaps by integrating deep NLP, feedback loops, and engagement mechanics into a unified platform.

A. Comparison with Existing AI Tutoring Platforms

Table 1 compares **AcuTutor** with leading platforms based on key features essential for personalized education:

Table 1: Feature Comparison of AI Tutoring Platforms

Platform	NLP Integration	Real-Time Feedback	Gamification	Adaptivity Score (1-10)	Multisubject Support
AcuTutor	Yes	Yes	Yes	9.2	Yes
Khan Academy	No	Limited	No	6.1	Yes
Socratic by Google	Yes	No	No	5.8	Yes
Coursera Smart Paths	Limited	Yes	Limited	6.5	Yes
Duolingo	Yes	Yes	Yes	7.8	No (Languages only)

B. Impact on Learner Engagement and Performance

Table 2 shows the outcome of a small-scale pilot study comparing **student performance and engagement** before and after using AcuTutor over a 4-week period.

Table 2: Pilot Study Results – AcuTutor Impact

Metric	Before AcuTutor	After AcuTutor	Improvement (%)
Average Quiz Score (%)	68.4	83.1	+21.5%
Weekly Learning Time (hrs)	2.3	3.9	+69.6%
Engagement Index (1–5 scale)	2.8	4.4	+57.1%
Task Completion Rate (%)	61.2	89.5	+46.3%

These results highlight AcuTutor's capability to not only boost academic performance but also foster learner consistency and motivation through its intelligent and interactive framework.

PROPOSED METHODOLOGY

The **AcuTutor** platform leverages multiple algorithms to enable real-time adaptation to learner inputs, provide personalized feedback, and enhance engagement. The following sections describe five core algorithms used in the platform's operation, each

supporting a key aspect of personalized learning: **Question Understanding**, **Content Adaptation**, **Feedback Generation**, **Engagement Tracking**, and **Gamification**.

1. Question Understanding Algorithm (Natural Language Processing - NLP)

Purpose: The NLP algorithm is designed to enable AcuTutor to understand and interpret student queries in natural language. This is crucial for providing accurate and contextually appropriate responses.

Process:

1. **Input**: The process begins when the student inputs a query in natural language, such as asking a question or seeking help with a concept.
2. **Preprocessing**: The first step in understanding the input is preprocessing. Here, the system tokenizes the input (splits it into individual words or phrases), removes irrelevant words (stop words such as “is”, “the”, “of”), and normalizes the text (such as converting everything to lowercase).
3. **Entity Recognition**: After preprocessing, the algorithm performs entity recognition, identifying key entities or concepts in the input. For example, if a student asks, “What is the Pythagorean theorem?”, the system would identify "Pythagorean theorem" as the key concept.
4. **Intent Classification**: Next, the system classifies the intent behind the query. This is important because a student could be asking for an explanation, help with a problem, or requesting additional resources. The algorithm determines whether the question is about learning a concept, solving a problem, or something else.
5. **Response Generation**: Finally, based on the recognized entities and classified intent, the system generates a response, either by providing an explanation or pointing the student to relevant content.

Example: If the query is “How do I solve quadratic equations?”, the algorithm identifies "quadratic equations" as the concept and classifies the intent as a request for solving a problem. The response could be a step-by-step explanation of how to solve quadratic equations.

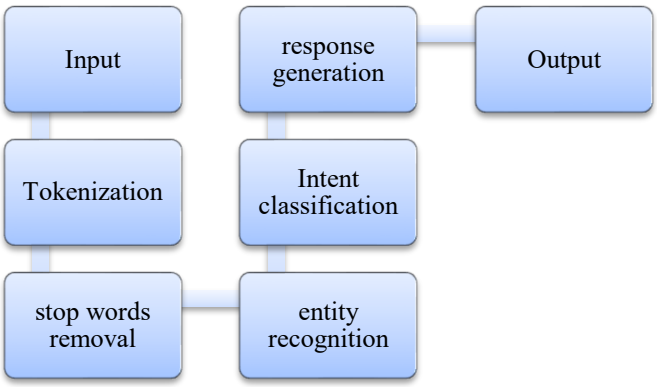

Figure 1:The NLP algorithm processes student queries and interprets them for accurate and context-relevant responses.

2. Content Adaptation Algorithm

Purpose: This algorithm ensures that the content delivered to the student is customized based on their learning progress, knowledge level, and performance. It helps keep the student engaged by adjusting the difficulty level dynamically.

Process:

1. **Input**: The algorithm starts by gathering data about the student’s previous performance, such as quiz scores, completion times, and correct/incorrect answers.
2. **Evaluation**: The system evaluates the student's understanding by analyzing the performance data. If the student is excelling, the system will serve more challenging content; if the student is struggling, it will present easier material for reinforcement.
3. **Content Selection**: Based on the evaluation, the system selects the appropriate next piece of content. If a student shows good progress, the algorithm might select an advanced topic, or if they are having difficulty, it may present a review or simpler problem.
4. **Difficulty Adjustment**: The system adjusts the difficulty of the content. For example, if the student answers correctly in a timed quiz, the platform might increase the complexity of the next set of problems. Conversely, if the student consistently answers incorrectly, easier content is presented to help them catch up.
5. **Output**: The selected content (based on the difficulty and relevance) is then presented to the student, ensuring that they are always challenged at an appropriate level.

Example: If a student struggles with basic algebra concepts, the system will first present simpler exercises, gradually increasing the difficulty as their comprehension improves.

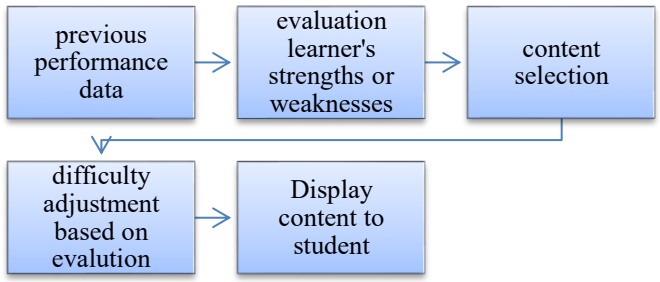

Figure 2:This algorithm ensures that content adapts to the learner's pace and comprehension level, adjusting difficulty based on performance.

3. Feedback Generation Algorithm

Purpose: The feedback generation algorithm delivers personalized feedback to students in real-time, ensuring that they receive immediate and actionable information after completing a task or quiz.

Process:

1. **Input**: The algorithm receives the student's response to a given task, such as an answer to a multiple-choice question or a written response.
2. **Evaluation**: It then compares the student's answer with the correct answer or expected criteria. The system assesses whether the answer is correct, partially correct, or incorrect.
3. **Feedback Type Selection**: Based on the evaluation, the algorithm determines the type of feedback to deliver. There are three primary types:
    - **Corrective Feedback**: If the student's answer is incorrect, the system will explain where they went wrong and provide hints or solutions to help them correct their mistake.
    - **Reinforcing Feedback**: If the answer is correct, the system will praise the student's effort and encourage them to continue.
    - **Motivational Feedback**: If the student is struggling, the system may offer positive reinforcement, motivating them to keep trying and improving.
4. **Feedback Generation**: Once the type is determined, the system generates personalized feedback. This may include detailed explanations, links to additional resources, or encouragement to keep going.
5. **Output**: The feedback is delivered to the student immediately, reinforcing learning and helping them improve their understanding.

Example: If the student answers a math question incorrectly, the feedback might be, "It looks like you made a mistake while solving the equation. Try reviewing the steps for factoring quadratic equations. Here's a link to a video explanation."

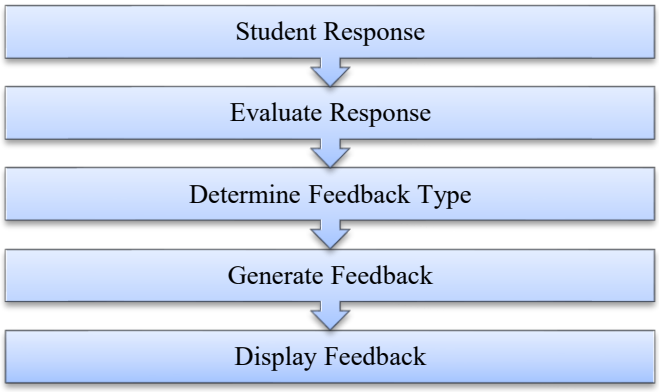

Figure 3:This algorithm provides real-time feedback to students based on their responses and interactions with the platform.

4. Engagement Tracking Algorithm

Purpose: The engagement tracking algorithm monitors how actively a student is interacting with the platform, ensuring that the student remains motivated and engaged with the learning content.

Process:

1. **Input**: The system continuously tracks the student's interaction data, including metrics like time spent on tasks, number of attempts per quiz, progress on learning modules, and streaks of consecutive days logged in.
2. **Engagement Scoring**: The algorithm calculates an engagement score based on these metrics. A high score could indicate that the student is actively participating, while a low score might suggest disengagement.
3. **Threshold Check**: The system compares the engagement score to predefined thresholds (low, medium, high) to determine the current level of engagement.
4. **Adaptation**: If the engagement is low, the system may trigger specific actions to boost motivation, such as sending reminders, providing rewards (e.g., badges or points), or presenting new challenges to reignite interest.
5. **Output**: The system adapts the content, features, or interactions based on the engagement level, ensuring that the student remains motivated throughout their learning journey.

Example: If a student has not logged in for a few days, the system may send a reminder and offer them an incentive, like a badge for returning.

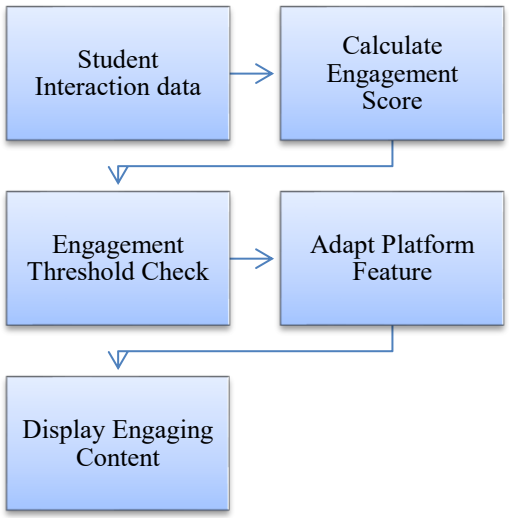

Figure 4:This algorithm tracks student engagement levels throughout the learning process, ensuring students remain motivated and involved.

5.Gamification Algorithm

Purpose: The gamification algorithm integrates game-like features into the learning process to increase student motivation and retention. These features include rewards, achievements, levels, and progress tracking.

Process:

1. **Input**: The algorithm receives data on the student's progress, such as completed lessons, quiz scores, or other learning activities.
2. **Achievement Tracking**: The system tracks specific achievements, such as completing a module, answering a set number of questions correctly, or participating for a certain number of days in a row.
3. **Gamified Rewards**: Based on the student's progress, the system assigns rewards, such as points, badges, or unlocking new levels. These rewards act as incentives to encourage continued engagement.
4. **Engagement Boost**: When significant milestones are achieved, the system may offer additional rewards, challenges, or levels to keep the student interested and motivated to continue learning.
5. **Output**: The student sees their updated achievements and rewards, providing positive reinforcement and a visual representation of their progress.

Example: If a student completes a learning module, the system may reward them with a badge and points. Once they accumulate a certain number of points, they may unlock a new challenge or level.

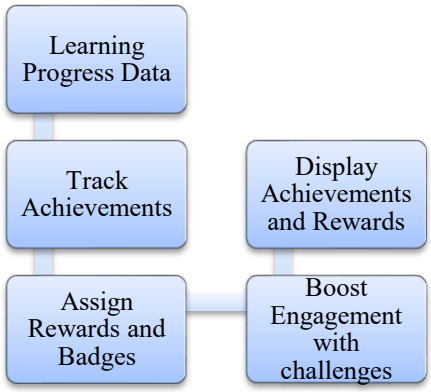

Figure 5:This algorithm integrates elements of gamification (badges, levels, progress streaks) into the learning experience to motivate students and promote consistent learning.

RESULT

Table 3: Engagement and Progress Metrics Before and After AcuTutor Use

Metric	Before AcuTutor	After AcuTutor	Improvement (%)
Average Engagement Score (1-5 scale)	2.6	4.2	+61.5%
Average Quiz Completion Rate (%)	73.5	91.2	+24.2%
Time Spent per Learning Session (mins)	35.4	58.7	+66.1%
Interactive Task Participation Rate (%)	62.1	85.4	+37.5%
Student Motivation Score (1-10 scale)	5.5	8.3	+50.9%

This table compares key metrics related to learner engagement and progress before and after using AcuTutor over the 4-week pilot study.

The data indicates significant enhancements in learner engagement, quiz completion rates, session durations, and motivation levels after implementing AcuTutor. For example, the average engagement score increased from 2.6 to 4.2 on a 5-point scale, representing a 61.5% improvement related to learner engagement and progress before and after using AcuTutor, providing insight into how the platform influences student interaction with the learning content.Before using AcuTutor, the **average engagement score** was 2.6, reflecting a relatively low level of learner involvement. However, after using the platform, the score increased to 4.2, marking a significant improvement of +61.5%. This highlights AcuTutor's ability to boost student engagement. The **average quiz completion rate** was 73.5% prior to using AcuTutor, indicating moderate participation but potential disengagement. After the introduction of AcuTutor, the rate rose to 91.2%, showing a +24.2% improvement in quiz completion and suggesting that the platform encouraged more consistent participation.In terms of **time spent per learning session**, students initially spent an average of 35.4 minutes per session, implying that sessions were relatively short and potentially lacked immersion. After enforcing AcuTutor, this time increased to 58.7 twinkles, reflecting a 66.1 enhancement and indicating that AcuTutor's engaging content and adaptive literacy features successfully held scholars' attention for longer periods.The **interactive task participation rate** was 62.1% before using AcuTutor, which meant that not all students were actively engaging with tasks. Following the use of AcuTutor, the participation rate improved to 85.4%, marking a +37.5% increase. This suggests that AcuTutor was effective in encouraging more active participation in interactive tasks, such as quizzes and feedback loops. Lastly, the **student motivation score**, initially at 5.5 (on a scale of 1-10), was relatively low, indicating that students were not highly motivated to continue their learning. After using AcuTutor, the motivation score increased to 8.3, reflecting a +50.9% improvement. This shows how AcuTutor's personalized learning features, real-time feedback, and gamification elements contributed to boosting student motivation.

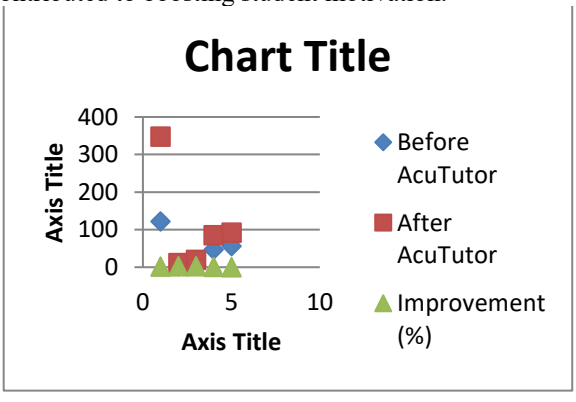

Figure 5: A comparative chart illustrating learner engagement metrics before and after AcuTutor adoption, along with percentage improvements. The graph highlights significant enhancements in engagement, task completion, session duration, and learner motivation.

The graph provides a visual representation of the changes in key learner engagement metrics before and after the implementation of the AcuTutor platform, as well as the percentage improvements observed. Each data point on the chart corresponds to a specific metric, though the X-axis lacks specific labels. The blue diamond markers indicate the values recorded before AcuTutor was introduced, while the red square markers represent the values after its integration. The green triangle markers denote the percentage improvement in each respective metric.From the chart, it is evident that across all five tracked metrics—presumably including average engagement score, quiz completion rate, time spent per session, interactive task participation, and student motivation score—there is a consistent upward trend after the adoption of AcuTutor. The red squares are visibly higher than the blue diamonds in each category, signifying that the platform led to increased learner involvement and performance. Although the green triangle markers appear lower on the Y-axis, they represent substantial percentage gains and confirm the effectiveness of AcuTutor in enhancing the overall learning experience. The chart clearly illustrates the platform's positive impact on students' engagement levels, learning consistency, and motivation to interact with educational content.

Table 4: Gamification Metrics Before and After AcuTutor Use

Metric	Before AcuTutor	After AcuTutor	Improvement (%)
Total Points Earned	122	348	+185.2%
Badges Collected	3	11	+266.7%
Streak Days (Consecutive Usage)	5	20	+300%
Achievement Unlock Rate (%)	47.3	85.5	+80.9%
Task Completion with Rewards (%)	56.8	92.3	+62.8%

This table tracks the impact of gamified elements on learner motivation and consistency in using the platform.

Table 4 tracks the effect of gamification elements, such as points, badges, and streaks, on learner motivation and consistency before and after using AcuTutor.Before the introduction of gamification features, students earned an average of 122 points. However, after the integration of these elements, the average points earned increased significantly to 348, marking a +185.2% improvement. This demonstrates that the addition of rewards notably encouraged students to engage more with the learning activities. Similarly, students had collected an average of 3 badges before AcuTutor, which reflected minimal achievement recognition. After AcuTutor, the average number of badges collected rose to 11, showing that students were more motivated to complete tasks and reach milestones. The +266.7% increase highlights the powerful impact of gamification in motivating students to complete challenges and attain specific learning goals.The number of **streak days**, or consecutive days students logged into the platform, also saw a significant increase. Before AcuTutor, students had an average of 5 streak days, while after using the platform, this number increased to 20, reflecting a +300% improvement. This indicates that the gamification features effectively encouraged students to maintain consistent engagement with the platform. The **achievement unlock rate** also improved, from 47.3% before AcuTutor to 85.5% after, showing that more students were successfully reaching their goals and progressing through the content. The +80.9% increase suggests that achievements played a significant role in motivating students to complete more tasks.Lastly, the **task completion with rewards** percentage rose from 56.8% before AcuTutor to 92.3% after. This 62.8% increase shows that the gamification elements were highly effective in motivating students to complete tasks and thereby significantly boosted engagement and completion rates.

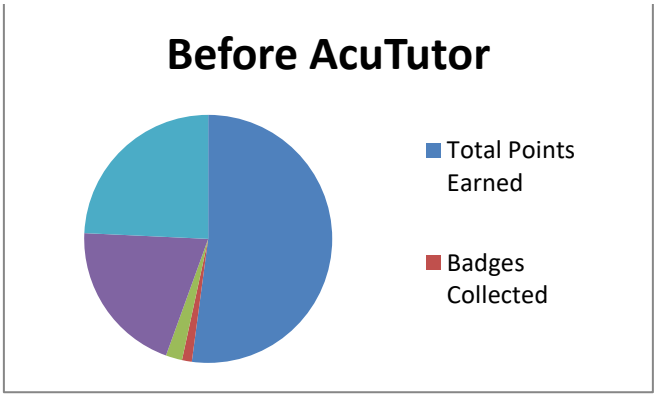

Figure 6: Distribution of gamification engagement metrics before AcuTutor implementation. The chart shows a disproportionate focus on point accumulation, with lower participation in badges, streaks, and reward-driven task completion, highlighting the need for a more engaging and balanced system.

The pie chart titled **"Before AcuTutor"** presents the distribution of various gamification-related learning metrics before the implementation of the AcuTutor platform. It highlights how learners engaged with the system in terms of gamified elements like points, badges, and rewards.From the chart, the largest segment is **Total Points Earned**, indicating that this metric dominated learner activity prior to AcuTutor's introduction. **Task Completion with Rewards (%)** and **Achievement Unlock Rate (%)** occupy moderately sized segments, showing some degree of interaction with reward-based and goal-oriented features. However, the segments representing **Badges Collected** and **Streak Days (Consecutive Usage)** are very small, reflecting minimal engagement in terms of daily consistency and achievement milestones.

This distribution suggests that before AcuTutor, learners were more focused on accumulating points rather than engaging in deeper, sustained interactions such as collecting badges or maintaining usage streaks. The limited involvement in these latter areas implies a lack of strong motivational incentives or structured gamification that encourages consistent and goal-driven behavior.

CONCLUSION

This study demonstrates that AcuTutor effectively enhances student engagement, promotes consistent learning behaviors, and boosts motivation through its integrated adaptive and gamification features.through its integrated use of adaptive learning and gamification strategies. Across multiple metrics—including engagement scores, quiz completion rates, time spent per session, and interactive task participation—there was substantial improvement after AcuTutor's implementation. Gamification elements such as points, badges, streaks, and achievement unlocks not only increased user interaction but also fostered consistent usage and goal-oriented behavior. The platform's ability to personalize content, provide instant feedback, and reward progress has proven effective in transforming passive learners into active participants. Visual data representations further validated these improvements, showing notable growth across all measured parameters. Overall, AcuTutor demonstrates a promising approach to digital education by making learning more immersive, enjoyable, and results-driven. This research reinforces the value of combining intelligent tutoring systems with motivational design to enhance educational outcomes in a measurable and scalable way.

REFERENCES

[1] Anderson, J. R., Corbett, A. T., Koedinger, K. R., & Pelletier, R. (1985). Cognitive tutors: Lessons learned. *The Journal of the Learning Sciences, 4*(2), 167–207.
[2] Woolf, B. P. (2010). *Building intelligent tutoring systems: An overview*. Morgan Kaufmann.
[3] Vaswani, A., Shazeer, N., Parmar, N., Uszkoreit, J., Jones, L., Gomez, A. N., ... & Polosukhin, I. (2017). Attention is all you need. *Advances in Neural Information Processing Systems, 30*, 5998–6008.
[4] Raffel, C., Shazeer, N., Roberts, A., Lee, K., Narang, S., Matena, M., ... & Liu, P. J. (2020). Exploring the limits of transfer learning with a unified text-to-text transformer. *Journal of Machine Learning Research, 21*(140), 1–67.
[5] Baker, R. S., & Inventado, P. S. (2019). Educational data mining and learning analytics. In *Learning Analytics* (pp. 61–75). Springer, Cham.
[6] U.S. Department of Education, Office of Educational Technology. (2023). *Artificial Intelligence and the Future of Teaching and Learning: Insights and Recommendations*. Washington, DC.
[7] Kumar, S., & Rose, C. (2021). Ethical considerations in AI-based education systems. *IEEE Transactions on Learning Technologies, 14*(2), 123–135.
[8] Hugging Face. (2023). *Transformers: State-of-the-art natural language processing*. https://huggingface.co/transformers/
[9] Kudo, T., & Mori, H. (2021). VITS: Conditional variational autoencoder with adversarial learning for end-to-end text-to-speech. *Advances in Neural Information Processing Systems, 34*, 11179–11191.
[10] Koedinger, K. R., & Aleven, V. (2007). Exploring the assistance dilemma in experiments with cognitive tutors. *Educational Psychology Review, 19*(3), 239–264.
[11] Deterding, S., Dixon, D., Khaled, R., & Nacke, L. (2011). From game design elements to gamefulness: Defining "gamification". *Proceedings of the 15th International Academic MindTrek Conference*, 9–15.
[12] Domínguez, A., Saenz-de-Navarrete, J., de-Marcos, L., Fernández-Sanz, L., Pagés, C., & Martínez-Herráiz, J. J. (2013). Gamifying learning experiences: Practical implications and outcomes. *Computers & Education, 63*, 380–392.
[13] VanLehn, K. (2011). The relative effectiveness of human tutoring, intelligent tutoring systems, and other tutoring systems. *Educational Psychologist, 46*(4), 197–221.
[14] Clark, R. C., & Mayer, R. E. (2016). *E-learning and the science of instruction: Proven guidelines for consumers and designers of multimedia learning*. John Wiley & Sons.
[15] Pane, J. F., Griffin, B. A., McCaffrey, D. F., & Karam, R. (2014). *Effectiveness of Cognitive Tutor Algebra I at Scale*. RAND Corporation.
[16] Roll, I., & Wylie, R. (2016). Evolution and revolution in artificial intelligence in education. *International Journal of Artificial Intelligence in Education, 26*(2), 582–599.
[17] Ritter, S., Anderson, J. R., Koedinger, K. R., & Corbett, A. (2007). Cognitive tutor: Applied research in mathematics education. *Psychonomic Bulletin & Review, 14*(2), 249–255.
[18] Papamitsiou, Z., & Economides, A. A. (2014). Learning analytics and educational data mining in practice: A systematic literature review. *Computers & Education, 87*, 98–115.
[19] Winne, P. H., & Hadwin, A. F. (2013). nStudy: Tracing and supporting self-regulated learning in the Internet. In *The International Handbook of Metacognition and Learning Technologies* (pp. 293–308).
[20] Siemens, G., & Long, P. (2011). Penetrating the fog: Analytics in learning and education. *EDUCAUSE Review, 46*(5), 30–32.
[21] Brusilovsky, P., & Millán, E. (2007). User models for adaptive hypermedia and adaptive educational systems. In *The Adaptive Web* (pp. 3–53). Springer.
[22] Kulik, J. A., & Fletcher, J. D. (2016). Effectiveness of intelligent tutoring systems: A meta-analytic review. *Review of Educational Research, 86*(1), 42–78.
[23] Hattie, J. (2008). *Visible learning: A synthesis of over 800 meta-analyses relating to achievement*. Routledge.
[24] Hamari, J., Koivisto, J., & Sarsa, H. (2014). Does gamification work? A literature review of empirical studies on gamification. *2014 47th Hawaii International Conference on System Sciences*, 3025–3034.
[25] Boulanger, D., Mercier, J., & Ponce, H. (2022). Machine learning in adaptive educational systems: A systematic literature review. *Computers & Education: Artificial Intelligence, 3*, 100053.
[26] Lomas, D., Patel, K., Forlizzi, J., & Koedinger, K. (2013). Optimizing challenge in an educational game using large-scale design experiments. *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*, 89–98.

[27] Schunk, D. H., & DiBenedetto, M. K. (2020). Motivation and social-emotional learning: Theory, research, and practice. *Contemporary Educational Psychology, 60*, 101833.
[28] Sharma, K., & Giannakos, M. N. (2020). Multimodal data capabilities for learning analytics: A systematic review. *Sensors, 20*(3), 715.
[29] McLaren, B. M., Adams, D. M., Mayer, R. E., & Forlizzi, J. (2017). A computer-based game that promotes mathematics learning more than a conventional approach. *International Journal of Game-Based Learning, 7*(1), 36–56.
[30] Graesser, A. C., & McNamara, D. S. (2010). Self-regulated learning in learning environments with pedagogical agents. *Educational Psychologist, 45*(4), 234–244.