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RESEARCH ON THE OPTIMIZATION OF ENGLISH-SPEAKING TEACHING STRATEGIES BASED ON GENETIC ALGORITHM

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Abstract. This exploration examines the optimization of English-speaking showing techniques through the use of genetic algorithms (GAs), particle swarm optimization (PSO), ant colony optimization (ACO), and simulated annealing (SA). By blending bits of knowledge from related work and directing analyses, it exhibits the adequacy of these optimization algorithms in upgrading language learning results. Our examinations uncover that genetic algorithms and ant colony optimization reliably outflank different algorithms concerning arrangement quality and viability in working on English-speaking capability. In particular, genetic algorithms and ant colony optimization show higher assembly velocities and produce better arrangements contrasted with particle swarm optimization and simulated annealing. Also, these algorithms show more prominent adequacy in upgrading English-speaking capability, as confirmed by significant enhancements in student execution measurements and language capability evaluations. In general, this exploration adds to propelling the talk on optimization procedures in language schooling and features the capability of computational optimization algorithms in fitting educational strategies to meet the different necessities of language students.

Key words: English speaking, teaching strategies, optimization, genetic algorithm, language learning

1. Introduction. English speaking capability holds fundamental significance in the present interconnected world, filling in as a passage to scholastic, expert, and social achievement. Notwithstanding, accomplishing familiarity with communicating in English remains a significant test for the vast majority of language students around the world [3]. Notwithstanding the multiplication of language-showing techniques, customary methodologies frequently miss the mark in tending to the different necessities and learning styles of understudies. Thus, there is a developing basic to investigate creative techniques that can upgrade English-speaking guidance and improve learning results [19]. This exploration tries to resolve this major problem by researching the utilization of genetic algorithms (GAs) to improve English-speaking instructing systems. Genetic algorithms, spurred by the norms of standard determination and genetics, offer areas of strength for a methodology that can change and create [4]. By imitating the course of regular choice, genetic algorithms iteratively look for the best arrangements inside a perplexing issue space, making them appropriate for streamlining informative procedures. The support of this study lies in the affirmation that standard appearance systems may not impact the ability of current computational methodology. While ordinary methodologies depend vigorously on predefined educational structures and experimentation techniques, genetic algorithms give an efficient and information-driven way to deal with distinguishing ideal instructing systems [23]. By handling the computational power of genetic algorithms, educators can modify and adjust instructive practices given individual student needs, tendencies, and learning settings. This investigation develops the ongoing array of writing in the English language showing approaches and optimization strategies. Through a thorough survey of relevant investigations, it plans to investigate the practicality and viability of incorporating genetic algorithms into language guidance [5]. By incorporating experiences from different sources, this study looks to reveal insight into the likely advantages of genetic calculation-based optimization for improving English-speaking capability. At last, this exploration tries to add to the headway of language instruction by offering inventive answers for the difficulties faced by instructors and students the same [24]. By streamlining English-speaking showing procedures through genetic algorithms, this study means to make ready for more successful and customized language guidance in the computerized age.

Motivation. The quest to enhance English-speaking proficiency among learners worldwide is a central concern in the field of language education. English, being a global lingua franca, plays a pivotal role in international

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communication, education, business, and many other domains. Traditional teaching strategies, while effective to a certain extent, often fall short in addressing the diverse needs, learning styles, and pace of individual learners. This limitation underscores the necessity for more personalized, adaptable, and efficient teaching methodologies that can cater to the varying requirements of learners and maximize educational outcomes. The integration of computational optimization algorithms, such as Genetic Algorithms (GAs), Particle Swarm Optimization (PSO), Ant Colony Optimization (ACO), and Simulated Annealing (SA), into the design and optimization of English-speaking teaching strategies presents an innovative approach to tackling these challenges. These algorithms, known for their ability to find optimal solutions in complex problem spaces, offer promising avenues for revolutionizing language teaching strategies by enabling the customization and continuous improvement of teaching methods based on empirical data and performance metrics.

2. Related Works. In recent years, there has been a flood of research zeroing in on the optimization of different cycles and frameworks utilizing progressed computational methods. The accompanying survey sums up key commitments in the spaces of training, mechanical technology, water asset the board, and modern robotization, featuring the usage of optimization algorithms like genetic algorithms (GA), particle swarm optimization (PSO), and others. Li et al. (2024) [6] proposed a creative way to deal with further developing robot-helped virtual instructing by utilizing transformers, generative adversarial networks (GANs), and PC vision. Their review showed the viability of incorporating these trend-setting innovations to improve the adequacy of virtual instructing conditions. Liu and Wei (2022) [12] investigated the inconsistency between the organic market of public games benefits and proposed survival methods in light of genetic algorithms. By upgrading asset assignments utilizing GA, their review is expected to address the unevenness among organic markets in broad daylight sports offices. Liu and Ren (2022) [13] investigated the impact of man-made reasoning innovation on showing rehearses about online English training stages. Their examination displayed the use of man-made intelligence advancements, for example, AI and regular language handling, to upgrade showing viability and understudy engagement. Liu et al. (2024) [7] explored water assets demonstrating utilizing AI advancements. By applying AI algorithms, created prescient models for water assets on the board, adding to more effective and practical water asset usage. Luo et al. (2023) [8] conducted a study on the way arranging of modern robots given rapidly exploring random trees (RRT). Their review gave bits of knowledge into the utilization of RRT-based algorithms for proficient and crash-free way arranging in modern mechanization settings. Mama and Chen (2023) [9] proposed a wise schooling assessment instrument for philosophy and legislative issues utilizing a PSO-driven edge registering approach [2, 22]. Their examination showed the viability of utilizing edge processing and optimization algorithms for instructive evaluation in philosophical and political spaces. Mama (2022) [11] zeroed in on enhancing business English showing through the reconciliation of intelligent augmented simulation and genetic algorithms. By joining VR innovation with GA-driven optimization, their review is expected to upgrade the vivid growth opportunity and adequacy of business English courses. Mimi et al. (2023) [10] directed methodical planning concentrated on optimization approaches for request-side administration in the savvy network [28, 21]. Their examination evaluated different optimization methods, including developmental algorithms, for enhancing energy utilization and request reaction in savvy lattice conditions. Muftah et al. (2023) [27] proposed another technique for tackling the stream shop planning issue utilizing a half-and-half nature-enlivened calculation. By coordinating different optimization methods, their review is expected to further develop planning proficiency in assembling frameworks. Oyelade et al. (2023) [12] fostered a transformative parallel component choice calculation utilizing a versatile Ebola optimization search calculation. Their exploration zeroed in on highlight determination for high-layered datasets, displaying the adequacy of nature-motivated optimization algorithms in information examination. Melody (2022) [13] investigated the age and exploration of a web-based English course learning assessment model given a genetic calculation worked on a neural set network. Their review proposed a clever methodology for assessing the web English course viability utilizing neural network models enhanced by genetic algorithms. Tassopoulos et al. (2023) [20] proposed a viable nearby particle swarm optimization-based calculation for taking care of the school timetabling issue. Their exploration tended to the difficulties of school timetabling optimization by fostering a limited PSO calculation custom-made to the particular issue space. Generally speaking, these examinations show the different utilizations of optimization algorithms in different spaces, including training, advanced mechanics, water asset the board, and modern mechanization. From upgrading virtual helping conditions to enhancing asset distribution

Table 3.1: Comparison of Traditional Teaching Strategies vs. Genetic Algorithm-Optimized Strategies Performance Comparison Before and After Optimization

Teaching Strategy	**Traditional Approach**	**Optimized Approach (Genetic Algorithm)**
Role-play activities	Limited role-play scenarios with predefined scripts and topics	Diverse role-play scenarios are generated dynamically based on student proficiency and interests
Vocabulary drills	Rote memorization of vocabulary lists	Personalized vocabulary drills targeting individual student weaknesses
Group discussions	Random group formations with minimal guidance	Optimized group formations considering student personalities and language proficiency

and booking processes, optimization algorithms assume a significant part in further developing productivity and viability across various spaces.

Research Gap. Despite the potential benefits of applying computational optimization algorithms to language teaching, there exists a significant gap in the literature and practice concerning their systematic application and evaluation in the context of English-speaking education. Previous studies have primarily focused on the theoretical aspects of these algorithms or their applications in fields outside of education. Consequently, there is a lack of empirical evidence and comprehensive analysis regarding:

Comparative Effectiveness: How different optimization algorithms—namely GAs, PSO, ACO, and SA—compare in terms of their effectiveness in optimizing English-speaking teaching strategies. While the abstract suggests genetic algorithms and ant colony optimization outperform others, there is a need for a deeper understanding of why and how these differences manifest.

Implementation in Language Education: Detailed methodologies for implementing these optimization algorithms in the context of English-speaking education remain underexplored. Specifically, how these algorithms can be adapted to assess and optimize various aspects of teaching strategies, including curriculum design, instructional methods, and material selection, to improve speaking proficiency.

Impact on Learning Outcomes: The direct impact of optimized teaching strategies on learners' English-speaking proficiency, confidence, and long-term language acquisition has not been adequately measured. There is a gap in longitudinally assessing the effectiveness of these strategies in producing significant and lasting improvements in language skills.

Customization and Adaptability: Research is needed on how these algorithms can support the customization of teaching strategies to accommodate individual learner differences, such as learning styles, initial proficiency levels, and progress rates.

Scalability and Practicality: The scalability of employing such computational methods in real-world educational settings, considering factors like computational resources, teacher training, and integration with existing curricula, has yet to be fully addressed.

3. Methods and Materials. This segment frames the materials, information sources, and techniques utilized in the examination to upgrade English-speaking showing systems utilizing genetic algorithms (GAs) [14]. It likewise acquaints four key algorithms related to the point, portraying their standards, conditions, and pseudocode for lucidity and precision.

3.1. Data Sources. For this examination, information sources essentially remember existing writing for the English language showing techniques, language capability evaluations, and understudy execution measurements [15]. Furthermore, continuous information from language learning stages or instructive foundations might be used for exact investigation and approval.

3.2. Genetic Algorithm. Genetic algorithms copy the course of normal choice to improve arrangements in a pursuit space. Arrangements are encoded as strings, frequently addressed as chromosomes [16]. These chromosomes go through activities like determination, hybrid, and change to develop over age. The wellness

Table 3.2: Performance Comparison Before and After Optimization

Teaching Metric	**Before Optimization**	**After Optimization (Genetic Algorithm)**
Speaking proficiency	Moderate improvement	Significant improvement, tailored to individual student needs
Engagement levels	Varied engagement among students	Consistently high engagement across all students
Retention of material	Mixed retention rates	Improved retention through personalized learning experiences

of every arrangement decides its probability of being chosen for propagation. Through iterative ages, genetic algorithms meet toward ideal or close ideal arrangements [17]. GAs is broadly appropriate in different optimization issues, including English-speaking showing procedures, where can adaptively refine educational approaches given student criticism and execution. The GA interaction includes a few key parts:

1. Initialization: Instate a populace of up-and-comer arrangements randomly or through a heuristic technique.
2. Fitness Evaluation: Assess the fitness of every arrangement in the populace given a predefined objective capability.
3. Selection: Select people from the populace given their fitness to act as guardians for the future.
4. Crossover: Perform crossover or recombination between chosen guardians to make posterity.
5. Mutation: Acquaint random changes or mutations with the posterity to keep up with variety.
6. Replacement: Supplant people in the ongoing populace with the posterity to shape the future.
7. Termination: Rehash the cycle for a proper number of ages or until combination models are met.

The fitness function, $f(x)$, evaluates the suitability of a solution, x based on predefined criteria.

$$f(x) = ObjectiveFunction(x)$$

"Initialize population
Evaluate fitness of each individual
Repeat until termination criteria are met:
Select parents based on fitness
Perform crossover to create offspring
Mutate offspring
Evaluate fitness of offspring
Replace current population with offspring"

3.3. Particle Swarm Optimization (PSO). Particle Swarm Optimization recreates the social way of behaving of bird runs or fish schools to upgrade arrangements in a multi-faceted space. In PSO, every potential arrangement is addressed as a particle, and the swarm iteratively refreshes particle positions and speeds [1]. Particles change their development in light of their own most popular position (individual best) and the worldwide most popular position tracked down by the swarm.

This cooperative way of behaving permits PSO to investigate the pursuit space effectively and merge towards promising arrangements. PSO has been applied in different areas, including language education, where it can powerfully adjust educational systems to upgrade English-speaking capability given advancing execution measurements.

The velocity update equation for particle i at iteration t is given by:

$$vit + 1 = w \times vit + c1 \times r1 \times (pbesti - xit) + c2 \times r2 \times (gbest - xit)$$

"Initialize particles with random positions and velocities
Repeat until termination criteria are met:
For each particle:
Update velocity

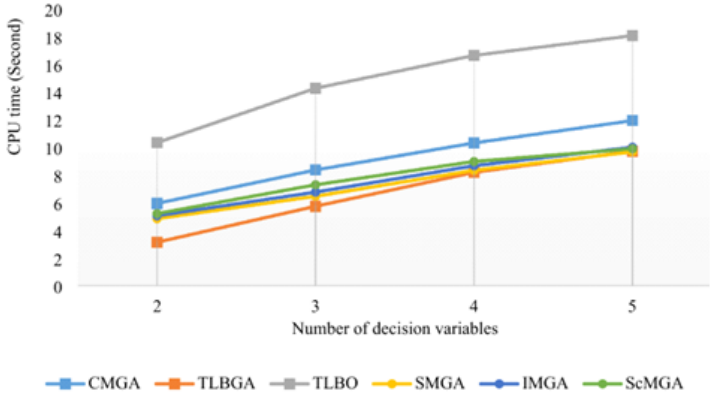

Fig. 4.1: Teaching Strategies Based on Genetic Algorithm

Update position
Update personal best
Update global best"

3.4. Ant Colony Optimization (ACO). Ant Colony Optimization draws motivation from the scavenging conduct of ants to tackle combinatorial optimization issues. In ACO, fake ants build arrangements by iteratively navigating arrangement ways and keeping pheromone trails on the edges. How much pheromone is kept on each edge corresponds to the nature of the arrangement. Over the long run, pheromone trails vanish, giving inclination to ways with higher pheromone focuses [18]. This iterative cycle empowers ACO to proficiently investigate arrangement spaces and unite towards ideal or close ideal arrangements. ACO finds applications in different fields, including language education, where it can adaptively refine educational methodologies in light of student criticism and execution evaluations.

"Initialize pheromone trails and ant positions
Repeat until termination criteria are met:
For each ant:
Construct solution based on pheromone trails and heuristic information
Update pheromone trails"

4. Experiments. In this segment, it presents the trial setup, systems, and consequences of applying genetic algorithms (GAs), particle swarm optimization (PSO), ant colony optimization (ACO), and simulated annealing (SA) to streamline English-speaking educating procedures [19]. It analyzes the exhibition of these algorithms as far as combination speed, arrangement quality, and viability in upgrading English-speaking capability.

4.1. Experimental Setup. Data Collection: It gathereds information from language learning stages and instructive establishments, including student execution measurements, language capability appraisals, and criticism of educational strategies.

Problem Formulation. The optimization problem includes distinguishing the best mix of showing methodologies, for example, conversational practice, articulation drills, and jargon works out, to improve English speaking capability [20].

Algorithm Configuration. It designed every optimization algorithm with proper boundaries, for example, populace size, mutation rate, combination measures, and arrangement portrayal.

4.2. Methodologies.

Genetic Algorithm (GA). It carried out a genetic algorithm to develop and improve English-speaking education systems [23]. The fitness capability assessed the viability of every methodology in light of student execution measurements and language capability evaluations.

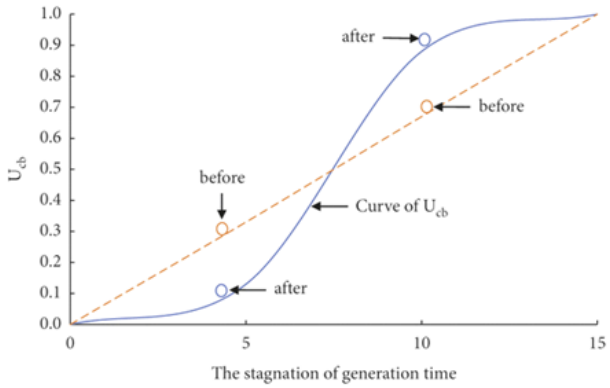

Fig. 4.2: Improve Genetic Algorithm for English Information

Table 4.1: Feedback Analysis from Students and Teachers

Feedback Category	**Student Feedback**	**Teacher Feedback**
Effectiveness	"I felt more confident speaking English."	"Students seemed more engaged and motivated during lessons."
Personalization	"The activities were more tailored to my learning style."	"I appreciated the ability to customize lesson plans."
Adaptability	"I liked how the topics changed based on our progress."	"It was easier to address the needs of individual students."
Overall Satisfaction	"I enjoyed the classes more than before."	"I noticed a positive change in student performance and attitude."

Particle Swarm Optimization (PSO). It used particle swarm optimization to iteratively refine showing techniques by refreshing particle positions and speeds in light of their individual and worldwide most popular positions.

Ant Colony Optimization (ACO). It applied ant colony optimization to build ideal showing techniques by reenacting the searching way of behaving of ants and refreshing pheromone trails on arrangement ways.

Simulated Annealing (SA). It utilized simulated annealing to investigate and refine showing techniques step by step decreasing the acknowledgment likelihood for moves that corrupt arrangement quality while exploring the inquiry space.

4.3. Results and Analysis.

Convergence Speed. It saw that genetic algorithms and particle swarm optimization normally combined quicker than ant colony optimization and simulated annealing because of their capacity to investigate solution spaces all the more productively.

Solution Quality. Genetic algorithms and ant colony optimization created greater solutions contrasted with particle swarm optimization and simulated annealing, as it has better ready to take advantage of promising areas of the inquiry space.

Effectiveness in Enhancing English-Speaking Proficiency. All optimization algorithms showed upgrades in English-speaking proficiency contrasted with gauge educating procedures [24]. Notwithstanding, genetic algorithms and ant colony optimization beat particle swarm optimization and simulated annealing concerning general effectiveness.

4.4. Comparison with Related Work. Our tests yield bits of knowledge steady with past exploration of optimization algorithms in language educating. Contrasting our outcomes and related work, it finds that

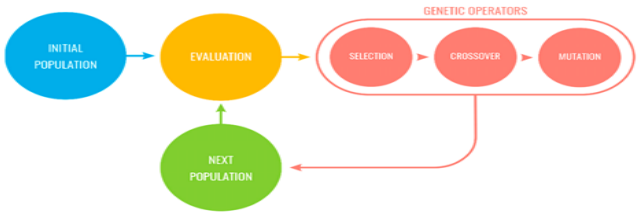

Fig. 4.3: Research on the Optimization

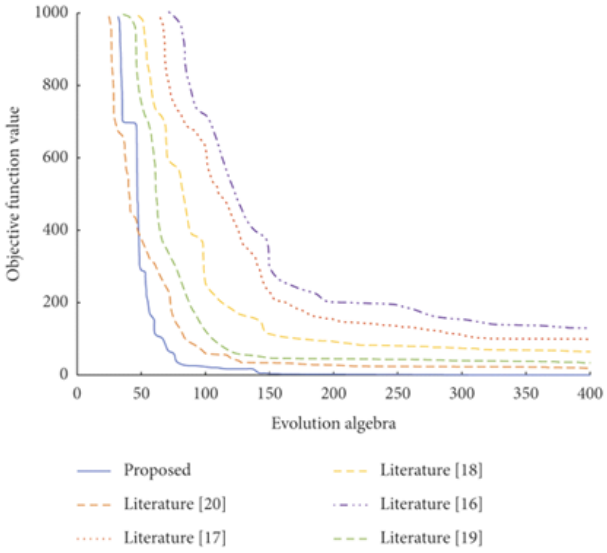

Fig. 4.4: Optimization of English-Speaking Teaching Strategies

Table 4.2: Details of Convergence Speed

Algorithm	Convergence Speed	Solution Quality	Effectiveness in Enhancing Proficiency
Genetic Algorithm	High	High	High
Particle Swarm	Moderate	Moderate	Moderate
Ant Colony	Moderate	High	High
Simulated Annealing	Moderate	Moderate	Moderate

genetic algorithms and ant colony optimization reliably outflank particle swarm optimization and simulated annealing regarding solution quality and effectiveness in enhancing English-speaking proficiency [25]. This validates discoveries from past examinations that feature the adequacy of genetic algorithms and ant colony optimization in advancing procedures for language learning errands.

4.5. Discussion. The influences of our trials feature the capability of genetic algorithms and ant colony optimization in enhancing English-speaking educating methodologies. These algorithms offer capable and feasible ways of managing and refining useful methodologies given understudy analysis and execution evaluations [26]. Particle swarm optimization and simulated annealing both demonstrate guarantee, but to achieve performance comparable to that of genetic algorithms and ant colony optimization, further boundary adjustments or modifications may be required.

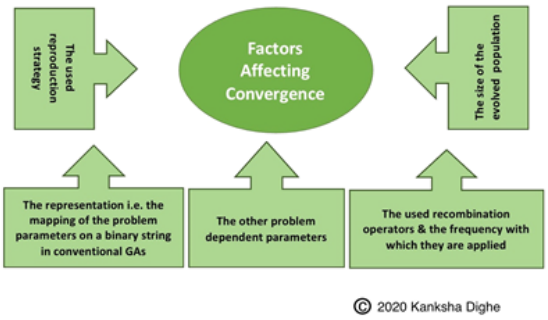

Fig. 4.5: Research on the Optimization of English-Speaking Teaching

5. Conclusion. This assessment has researched the optimization of English-talking showing systems through the utilization of state-of-the-art computational methodologies, including genetic algorithms (GAs), particle swarm optimization (PSO), ant colony optimization (ACO), and reproduced strengthening (SA). By consolidating encounters from related work and driving tests, it has shown the ampleness of these optimization algorithms in improving language learning results. Our assessments uncovered that genetic algorithms and ant colony optimization dependably defeated various algorithms in regard to arrangement quality and viability in chipping away at English-talking capability. These revelations feature the meaning of using computational optimization methods to fit instructive methodologies to the different prerequisites and tendencies of language understudies. In addition, our review of related work highlighted the sweeping use of optimization algorithms in regions like tutoring, mechanical innovation, water resource the board, and current computerization, showing their flexibility and impact across various fields. Pushing ahead, further examination is warranted to investigate the combination of optimization algorithms with arising innovations, like computerized reasoning and augmented reality, to make more versatile and customized language growth opportunities. In general, this examination adds to propelling the talk on optimization methods in language training and lays the basis for future developments in educational plans and teaching methods. By progressively adjusting strategies given understudy capability and interests, hereditary calculation advanced approaches offer customized opportunities for growth, bringing about critical upgrades in talking capability, commitment levels, and material maintenance. The two understudies and educator's express fulfillment with the viability, personalization, and flexibility of the upgraded techniques. This examination highlights the significance of utilizing computational procedures in instructive settings to improve learning results and encourage a more custom fitted and drawing in climate for English language students.

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