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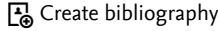
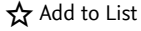
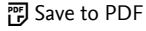
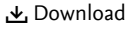
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An optimization algorithm for the multi-objective flexible fuzzy job shop environment with partial flexibility based on adaptive teaching–learning considering fuzzy processing times

[Jiménez Tovar, Mary^a](#) ; [Acevedo-Chedid, Jaime^a](#) ; [Ospina-Mateus, Holman^a](#) ;[Salas-Navarro, Katherine^b](#) ; [Sana, Shib Sankar^c](#)

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^a Department of Industrial Engineering, Universidad Tecnológica de Bolívar, Cartagena, Colombia^b Department of Productivity and Innovation, Universidad de la Costa, Barranquilla, Colombia^c Department of Mathematics, Kishore Bharati Bhagini Nivedita College, Behala, Kolkata, 700060, India

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Production scheduling is a critical factor to enhancing productivity in manufacturing engineering and combinatorial optimization research. The complexity and dynamic nature of production systems necessitates innovative solutions. The Job Shop Flexible Programming Problem (FJSP) provides a realistic environment for production, where processing times are variable and uncertain, and multiple objectives need optimization. To solve the Multi-Objective Flexible Fuzzy Job Shop problem with partial flexibility (P-MOFFJSP), this paper proposes a hybrid metaheuristic approach that combines the Teaching-Learning-based Optimization (TLBO) algorithm with a Genetic Algorithm. The proposed algorithm of Adaptive TLBO (TLBO-A) uses two genetic operators (mutation and crossover) with an adaptive population reconfiguration strategy, ensuring solution space exploration and preventing premature convergence. We have evaluated the TLBO-A algorithm's performance on benchmark instances commonly used in programming problems with fuzzy variables. The experimental analysis indicates significant results, demonstrating that the adaptive strategy improves the search for suitable solutions. The proposed algorithm (TLBO-A) exhibits low variations (around 11%) compared to the best mono-objective heuristic for the fuzzy makespan problem, indicating its robustness. Moreover, compared with other heuristics like traditional TLBO, the variations decrease to around 1%. However, TLBO-A stands out as it aims to solve a multi-objective problem, improving the fuzzy makespan, and identifying good results on the Pareto frontier for the fuzzy average flow time, all within this low variation margin. Our contribution addresses the challenges of production scheduling in fuzzy time environments and proposes a practical hybrid metaheuristic approach. The TLBO-A algorithm shows promising results in solving the P-MOFFJSP, highlighting the potential of our proposed methodology for solving real-world production scheduling problems. © 2023, The Author(s), under exclusive licence to Springer-Verlag GmbH Germany, part of Springer Nature.

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Flexible job-shop; Fuzzy processing times; Hybrid algorithm; Teaching-learning-based optimization

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