

HYBRID FUZZY ANALYTICAL HIERARCHY  
PROCESS WITH FUZZY INFERENCE SYSTEM  
ON RANKING STEM APPROACH TOWARDS  
BLENDED LEARNING IN MATHEMATICS

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## **SUPERVISOR'S DECLARATION**

I hereby declare that I have checked this thesis and, in my opinion, this thesis is adequate in terms of scope and quality for the award of the degree of Master of Science.

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## STUDENT'S DECLARATION

I hereby declare that the work in this thesis is based on my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously or concurrently submitted for any other degree at Universiti Malaysia Pahang or any other institutions.

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## ABSTRAK

Dalam era Pendidikan 4.0, pembelajaran teradun dipilih sebagai salah satu transformasi pedagogi dalam pengajaran dan pembelajaran bersepadu dengan Sains, Teknologi, Kejuruteraan dan Matematik (STEM), merupakan satu norma baharu yang perlu diadaptasikan oleh Malaysia. Sejak pandemik COVID-19, isu ini diketengahkan di kebanyakan tahap pengajian dalam pendidikan. Walau bagaimanapun, disebabkan pengetahuan yang terhad mengenai perlaksanaan pembelajaran abad ke-21 dan Web 2.0 menyebabkan pelajar hilang semangat untuk pembelajaran matematik. Tambahan pula, perubahan dinamik dalam standard kurikulum membuatkan situasi semakin mencabar bagi pendidik dalam membuat pemilihan pendekatan yang bersesuaian untuk memastikan pelajar terlibat secara aktif sepenuhnya. Diilhamkan daripada masalah ini, kajian ini dilihat dengan mengaplikasikan konsep membuat keputusan dalam pelbagai kriteria (MCDM) secara kabur. Model hibrid kabur MCDM dicadangkan dalam empat peringkat untuk menentukan kedudukan dan mencari penyelesaian bagi pelaksanaan pendekatan STEM yang terbaik. Model ini dibina dengan mengintegrasikan Proses Hierarki Analitikal Kabur (FAHP) untuk menentukan wajaran STEM kriteria dan sub kriteria, dan Sistem Inferens Kabur (FIS) untuk mengira pendekatan STEM terbaik dalam pembelajaran matematik. Proses ini dijalankan dengan meneroka isu yang mungkin dikaitkan dengan masalah pemilihan membuat keputusan berbilang kriteria, menerbitkan pemberat keputusan wajaran penting, menyusun pelbagai alternatif dengan menggunakan Centroid Berbilang Intuitif sebagai kaedah defuzzifikasi. Oleh itu, keputusan menunjukkan pendekatan STEM yang telah dipersetujui untuk dijadikan alternatif adalah pendekatan secara putaran berstesen, aktiviti secara hands on, pembelajaran atas talian, pendekatan berasaskan masalah, kelas berflip dan pembelajaran kearah sendiri. Manakala, kriteria STEM yang dipersetujui ialah pengetahuan yang diperlukan, kemahiran pembelajaran, mengasah sikap, nilai, teknologi, fleksibiliti dan sumber rujukan. Antara yang tersebut, keputusan menunjukkan aktiviti hands on adalah pendekatan STEM terbaik yang dipilih manakala pengetahuan yang diperlukan adalah kriteria penting dengan wajaran yang paling besar nilainya. Oleh itu, model yang dicadangkan bukan sahaja membantu memberi gambaran yang jelas kepada guru tentang perlaksanaan pendekatan STEM terbaik dalam Matematik berdasarkan pandangan yang komprehensif tetapi juga meletakkan pengetahuan asas baharu dalam pandangan MCDM kabur, khususnya dalam pendidikan STEM. Selain itu, dapatan ini dapat membantu Kementerian Pendidikan Malaysia (KPM) untuk mencapai salah satu inisiatif dalam Gelombang 3 (2021-2025) Pelan Pembangunan Pendidikan Malaysia, iaitu berkongsi amalan terbaik dalam bilik darjah untuk memupuk budaya kecemerlangan profesional yang diterajui rakan sebaya dalam kalangan guru sebagai asas penambahbaikan pelaksanaan dan pencapaian STEM di peringkat kebangsaan.

## ABSTRACT

In the era of Education 4.0, blended learning has been selected as one of the transformational pedagogies for the teaching and learning process that integrate Science, Technology, Engineering, and Mathematics (STEM), a new norm that needs to be adopted by Malaysia. Since the COVID-19 pandemic, the issue has been highlighted at most levels of study in the education field. However, limited knowledge of the implementation of 21st Century learning skills with Web 2.0 among teachers has made the students demotivated for their mathematics classroom. Moreover, dynamic changes in the standard curriculum have made the situation more challenging for teachers in selecting the appropriate STEM approach to ensure students are fully engaged. Inspired by the problem, this research used fuzzy multi-criteria decision-making (MCDM) concepts. A hybrid fuzzy MCDM model proposes a four stages process to rank and find the best implementation STEM approach in the mathematics classroom. The model is constructed by integrating the Fuzzy Analytical Hierarchy Process (FAHP) to determine the weights of STEM criteria and sub-criteria and the Fuzzy Inference System (FIS) to compute the best STEM approach in the mathematics classroom. The procedure involves exploring the issue associated with the selection problems, deriving decision criteria important weights, and ranking various alternatives with applied intuitive multiple centroids as a defuzzification method. The results showed hands-on activities as the best STEM approach while requisite knowledge is the important criterion with the greatest value of weights. Thus, the proposed model helps provide a clear picture for teachers in the implementation of STEM approach in Mathematics based on a comprehensive view and also lay a new foundation knowledge in fuzzy MCDM view, particularly in STEM education. Also, it helps the Ministry of Education (MoE) to achieve one of the initiatives in Wave 3 of the Malaysia Education Blueprint (2021-2025), which is to share the best practice in the classroom to cultivate a peer-led culture of professional excellence among teachers as the basis for improving the implementation and achievement of STEM at the national level.

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