

ABSTRAK

Platform *e-learning* konvensional umumnya menerapkan pendekatan *one-size-fits-all* yang menyajikan materi identik bagi seluruh mahasiswa. Pendekatan ini lemah dalam mengakomodasi keragaman pemahaman dan kecepatan belajar, sehingga berpotensi menurunkan hasil belajar. Solusi sistem rekomendasi saat ini juga terbatas; *Content-Based Filtering* berbasis TF-IDF lemah memahami konteks semantik, sedangkan *Rule-Based System* (RBS) cenderung kaku. Mengatasi masalah tersebut, penelitian ini mengusulkan Sistem Pembelajaran Adaptif menggunakan metode hibrida yang mengintegrasikan RBS dan *Sentence-BERT* (SBERT). RBS berfungsi sebagai kontrol pedagogis penentu intervensi remedial berdasarkan kinerja kuis secara *real-time*. Keputusan tersebut diproses oleh SBERT menggunakan representasi vektor untuk merekomendasikan materi secara presisi dan relevan. Hasil pengujian menunjukkan fungsionalitas sistem berjalan 100% (29 skenario valid) dan memperoleh skor *System Usability Scale* sebesar 70,96 (*Acceptable/Good*). Pengujian efektivitas mencatat peningkatan pada mode konvensional dari *pretest* 80,29 menjadi *posttest* 82,89 (N-Gain 0,14/rendah). Sebaliknya, mode adaptif memacu nilai dari *pretest* 84,61 menjadi *posttest* 90,11 (N-Gain 0,35/sedang). Terdapat selisih N-Gain sebesar 0,21 yang membuktikan bahwa pendekatan hibrida yang diusulkan lebih efektif secara empiris dalam meningkatkan pemahaman kognitif siswa dibandingkan *e-learning* konvensional.

Kata kunci: Sistem Pembelajaran Adaptif, E-learning, Rule-Based System, Sentence-BERT, Sistem Rekomendasi.

ABSTRACT

Conventional e-learning platforms generally apply a one-size-fits-all approach, presenting identical content to all students. This approach struggles to accommodate diverse understanding levels and learning paces, potentially reducing learning outcomes. Existing recommendation solutions also have limitations; TF-IDF-based Content-Based Filtering lacks semantic understanding, while pure Rule-Based Systems (RBS) tend to be rigid. To address these issues, this study proposes an Adaptive Learning System using a hybrid method integrating RBS and Sentence-BERT (SBERT). RBS acts as a pedagogical control to determine remedial interventions based on real-time quiz performance. These decisions are processed by SBERT using vector representations to recommend precise and relevant materials. Test results showed 100% system functionality (29 valid scenarios) and a System Usability Scale score of 70.96 (Acceptable/Good). Effectiveness testing recorded an increase in the conventional mode from a pretest of 80.29 to a posttest of 82.89 (N-Gain 0.14/low). Conversely, the adaptive mode boosted scores from a pretest of 84.61 to a posttest of 90.11 (N-Gain 0.35/medium). The 0.21 difference in N-Gain proves that the proposed hybrid approach is more empirically effective in improving students' cognitive understanding than conventional e-learning.

Keywords: Adaptive Learning System, E-learning, Rule-Based System, Sentence-BERT, Recommender System.