Chapter 5
Personalizing Learning Pathways Through Deep Learning Models and Educational Data Analytics

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ABSTRACT

The aim of this research is to investigate the role of deep learning and educational data analysis in personalizing learning paths. Relying on the capacity of deep learning models to identify behavioral patterns and predict learner performance, it is possible to design learning paths that meet individual needs. In this context, educational data analysis not only helps to improve the quality of education, but also paves the way for the development of adaptive and intelligent learning systems. The research also addresses the technical challenges, ethical considerations, and implementation limitations of this approach and offers solutions for the responsible use of new technologies in education.

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1- INTRODUCTION

The rapid growth of new technologies in recent decades has brought about significant changes in the field of education and learning. The emergence of digital tools and advances in data analysis and artificial intelligence have provided opportunities to improve the quality of learning and transform educational methods. In the meantime, deep learning, as one of the important achievements of artificial intelligence, has become an effective tool in analyzing complex data and identifying hidden patterns (Naseer, Khan, Tahir, Addas, & Aejaz, 2024). Along with the expansion of e-learning and the development of virtual learning environments, the need to more accurately understand the behavior of learners and provide educational paths tailored to individual needs has become more important than ever (Aliahmadi & Nozari, 2023).

Personalization of education has become one of the key approaches in modern educational systems in recent years. This approach is based on understanding individual differences among learners and adapting learning processes to their unique needs, preferences, and characteristics. The learning experience is most effective when the content, timing, structure of the learning path, and delivery style are designed to suit the unique characteristics of each learner. In contrast to traditional models of education that emphasize the integration of content and teaching style for everyone, the personalized approach focuses on providing a dynamic, interactive experience tailored to individual circumstances and needs (Nozari & Chobar, 2024).

Educational data analytics, as one of the central tools in realizing personalization, plays a fundamental role. By collecting and processing data from learners' interactions with educational systems, valuable information can be obtained about learning styles, behavioral trends, cognitive engagement, and academic progress. This data, which often remains in the form of digital footprints in online learning environments, is a rich and potential resource for use in designing personalized learning experiences (Dwivedi, Mahanty, & Dwivedi, 2024). Analyzing this data enables informed decision-making at different levels of education and can lead to optimization of the learning process.

Deep learning, with its high processing power and big data analysis capabilities, has gained a prominent position in the field of educational data analysis. Unlike traditional methods based on simple models, deep learning models have the ability to understand and analyze nonlinear and complex relationships between educational data. Deep neural networks, using multilayer structures, are able to extract hidden information and high-level features from raw data and identify meaningful behavioral patterns (Bathaee, Nozari, & Szmelter-Jarosz, 2023). This capability has enabled the development of educational recommender systems, predicted the path of learners' progress, and designed learning paths tailored to individual needs.