Chapter 6
AI Technology for Enhanced Learning Ability of Learners Using EEG Signals

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ABSTRACT

This review paper explores recent educational research efforts to enhance pedagogical methodologies, particularly within Flipped Learning (FL). The focus is on innovative strategies aimed at optimizing the FL model, with an emphasis on sustaining student attention during pre-loaded lecture videos, a critical component of FL. Researchers have used EEG signals to analyze cognitive states and detect non-attentive behavior. A notable study introduces the Lecture Video Recommendation in Flipped Learning (LRFL) system, which uses unsupervised learning to categorize student behaviors and recommend revisiting lessons. Additionally, advancements in feature extraction methods like 1D Multi-Point Local Ternary Pattern (1D MP-LTP) are explored to improve classification accuracy. Another study proposes a specialized deep reinforcement learning algorithm, Double Deep Q-Network (DDQN), to quantify attention levels from EEG signals. These findings highlight the potential of emerging technologies and data-driven approaches to enhance student engagement and learning outcomes in digital education.

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1 INTRODUCTION

In the digital age, education has evolved through the incorporation of advanced tech- nologies and the adoption of innovative pedagogical means. The advent of Distance Learning Pedagogy (DLP) and Massive Open Online Courses (MOOCs) has revolu- tionized the delivery of education, allowing students to access a wealth of learning materials anytime, anywhere . These online platforms offer a diverse range of resources, including video lectures, hand-written notes, presentations, and e-books, enabling learners to advance at their own speed and interact with the material in a flexible way. However, the lack of real-time communication between teachers and students in these online mode has its own pros & cons in maintaining students' attention and engagement.

Advancements in educational technology have led to the exploration of novel methodologies to enhance student learning outcomes. Research has delved into the application of Electroencephalography (EEG) signals to examine cognitive engage- ment and attention levels of students, providing insights into personalized learning experiences . By leveraging EEG signals and classification techniques, instructors can identify students who may require additional support to improve their learning abilities, thereby enhancing the overall educational experience .

Moreover, the effectiveness of online videos as a teaching tool has been a subject of interest for researchers and educators. While online videos are popular for delivering educational content, students' attention spans tend to decrease rapidly, particularly in online settings . Embedded questions within online videos have been identified as a strategy to improve learners' attention levels, attitudes, and academic performance . Interactive videos with embedded questions can help boost students' engagement and prevent passive acceptance of knowledge, ultimately enhancing the learning experience

The integration of rich teaching methods, such as Problem-Based Learning (PBL) and experiential teaching, with new generation information technology has reshaped the teaching ecology in colleges and universities, enhancing the educational environ- ment and boosting student performance. These advancements aim to revolutionize traditional teaching practices, offering new opportunities for personalized and adap- tive learning systems that address the varied needs of students in the digital era. The convergence of technology and pedagogy holds promise for transforming education into a more engaging and effective learning environment for students.

2 RELATED RESEARCH

In the e-business industry, recommender systems have proven to be very beneficial to the individuals. They do so by making recommendations in a variety of fields, including recommendations for products (Ashraf et al., 2020), (Ho and Lim, 2021), news articles (Maksai et al., 2015), and friends (Wang et al., 2014).

In the field of education, there is an advanced education domain recommen- dation system to cater to individual students' unique needs by considering the individual's course history, profile, educational qualifications, etc., and suggests exer- cises (Li et al., 2021, Wu et al., 2020), learning materials (Yan et al., 2017), new courses (Gong et al., 2020, Lang et al., 2021), etc. to students aiming to optimize the learning experience for each student, fostering their academic growth and success.. There are also many prominent and contemporary works on recom- mender systems in educational technology, with a focus on cutting edge learning paradigms like flipped learning (Bergmann and Sams, 2014, Lei et al., 2020)