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USING ARTIFICIAL INTELLIGENCE TECHNOLOGIES TO ANALYZE STUDENTS' BEHAVIOUR IN A DIGITAL LEARNING ENVIRONMENT

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ABSTRACT

Digital learning environments produce substantial quantities of behavioral data; however, a significant portion of this information remains unconverted into prompt pedagogical insights. This article explores the integration of artificial intelligence (AI) technologies into learning analytics for the analysis of student behavior within a digital learning environment. A conceptual AI-driven framework is introduced that integrates log data, interaction traces, and assessment results to deduce patterns of engagement, self-regulation, and dropout risk. Supervised and unsupervised machine learning, sequence modeling, and natural language processing are aligned with fundamental monitoring and prediction functions. Human-centered design, data protection, and the risk of algorithmic bias are given special attention. The article contends that AI-driven behavioral analytics can significantly improve student support and instructional quality when transparency, teacher autonomy, and ethical safeguards are prioritized in the design process rather than being considered as mere afterthoughts.

KEYWORDS: AI, learning analytics, student behavior, digital learning environment, predictive modeling, educational data mining.

INTRODUCTION

The quick growth of online and blended learning has moved a lot of students' academic work to digital platforms. Learning management systems, video-conferencing tools, and interactive content platforms keep track of every login, click, and submission, making a thick "digital trace" of how learners behave. Teachers usually only see final grades or simple activity counts, but these traces have information about persistence, pacing, and help-seeking. Because of this, disengagement and the risk of failure often go unnoticed until they become hard to fix. Learning analytics research shows that systematically collecting behavioral data can be used to keep an eye on engagement and improve learning environments. This is especially true when AI techniques that can model complex patterns in large datasets are used.

AI in education has come a long way since the days of rule-based tutoring. Recent research on learning analytics and AI in education shows that machine-learning models can predict results, group engagement profiles, and analyze discussions in forums or short reflections. However, human-centered approaches stress that these systems must be open, debatable, and in line with the values of all stakeholders.

Consequently, there is a necessity for frameworks that delineate the utilization of AI technologies to analyze behavior in digital learning environments in manners that are pedagogically significant, ethically sound, and practically applicable in actual institutions.

This article suggests a conceptual framework for an AI-assisted system that evaluates student behavior in a digital learning environment. The system collects event logs from the learning management system, records of when resources were accessed, online test scores, participation in discussion forums, and, when necessary, limited program information at the data layer. These raw traces are cleaned up and turned into features like how often and regularly people log in, how much time they spend on important resources, how long it takes for an assignment to be released and submitted, how many different types of activities they do, and simple signs of social interaction in peer activities.

Different AI methods work on different parts of this feature space to solve different analytic problems. Supervised models use past labeled data to make predictions about things like whether a student will finish a course or what grade band they will get. This lets teachers find students who are at risk of falling behind early on. Unsupervised clustering helps find patterns of engagement that happen over and over again, like regular, sporadic, or last-minute learners, without using any pre-defined labels. Sequence models look at ordered clickstreams to find common learning paths and deviations that could mean confusion or a lack of interest. Natural language processing techniques are used on forum posts and short reflective texts to figure out how people feel, how they ask for help, and how engaged they are mentally. Model development adheres to recognized methodological standards, encompassing cross-validation, meticulous feature selection, and equity assessments among student subgroups.

In this framework, AI technologies turn small behavioral traces into useful signals for students, teachers, and program managers. For each student, predictive models create risk scores for not finishing or doing poorly based on how similar their current behavior is to past behavior. Instead of showing raw probabilities, the system turns them into messages that are easier to understand and point out patterns that are linked to lower success rates, like not having regular access to core materials or submitting work at the last minute. It also suggests better study habits. Engagement patterns that cluster together support different types of communication. For example, you can send personalized prompts to students who don't often work with others or who rely too much on seeing solutions instead of trying problems on their own.

Dashboards show teachers how groups, sessions, or resources are behaving as a whole. They show which activities keep students' attention and which ones are skipped or only briefly accessed. Sequence analytics help you find common learning paths and problems, which lets you change the order of content, the timing of feedback, and the way you give feedback. At the institutional level, multi-course analytics show structural inequalities, like how part-time and full-time students or students in different programs are more or less engaged. This information helps schools decide how to spend their money on academic support. While these findings are theoretical, they align with empirical evidence indicating that AI-driven learning analytics can improve the timeliness and accuracy of interventions in digital learning settings.

The proposed framework underscores the pedagogical advantages and the inherent risks associated with employing AI to analyze student behavior in digital learning contexts. The good news is that AI models can handle huge amounts of behavioral data that would be too much for people to understand on their own. This lets teachers find students who are straying from productive learning patterns earlier and with more detail. When used with careful instructional design, these kinds of analytics can help teachers be more flexible, give students timely feedback, and work better together with tutors and support services. They also give teachers a

way to judge learning activities by letting them compare different designs not only by final grades but also by how they affect engagement over time and how different groups of students take part.

But using AI-based behavioral analytics brings up moral and practical issues. If labels are given without context, predictive models may repeat historical biases in the training data, unfairly putting some groups in the "at risk" category and making them feel bad about themselves or fulfilling prophecies. Collecting a lot of data can violate privacy and make people feel like they are always being watched, especially when the tracking goes beyond schoolwork to include biometric or emotional signals. Human-centered research in learning analytics emphasizes the necessity for students and educators to participate in the development of indicators, dashboards, and intervention protocols, asserting that AI systems should function as decision-support tools rather than as autonomous decision-makers. For trust and responsible use, it's important to be open about what data is collected, how models work, and what their limits are. It's also important to have clear rules about how long data can be kept, who can access it, and how to get it back.

Artificial intelligence technologies provide robust capabilities for analyzing student behavior in digital learning environments, transforming routine interaction data into metrics of engagement, self-regulation, and learning risk. This article's conceptual framework shows how supervised and unsupervised machine learning, sequence modeling, and natural language processing can work together to give students, teachers, and schools insights at many levels. Using AI-based behavioral analytics well requires more than just technical know-how. For these kinds of systems to improve, not hurt, fair and meaningful learning, they need to be designed with people in mind, thoroughly tested, have clear rules for data and algorithms, and have ongoing conversations with people involved in education. Subsequent empirical research ought to apply and assess tangible applications of this framework across various educational settings, investigating not only predictive validity but also effects on pedagogy, student experience, and educational equity.

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