Platform Epoch: AI-Powered Learning for Neurodiverse Students

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Abstract. Effective, granular and targeted education methodologies play a significant role in the neurological development of children irrespective of their neurological deficits. When observed, it is seen that a certain demographic of students will be less invested in free courses, even when they get enrolled in it, this is because these education models are least incentivized, in turn resulting in low student retention rates, this becomes even low for the students with neurological deficits like Attention Deficiency/Hyper-active Disorder (ADHD) and Autism Spectrum Disorder (ASD). This work explores the opportunities to improve the student retention rates for students irrespective of the neurological deficits by utilizing the potential of Applied Behavioral Analysis (ABA), Learning Analytics, Open-Source tools for Identity Management system, Artificial Intelligence, Machine Learning and Deep Learning methodologies. It also explores the opportunities to aid with the improvements that help children with ADHD and ASD.

Keywords: Applied Behavioral Analysis, Attention Deficiency/Hyper-active Disorder, Autism Spectrum Disorder, ASD, ADHD, Learning Analytics, Identity Management System, Virtual Reality, Artificial Intelligence, Machine Learning, Deep Learning.

1 Introduction

Educational theorists such as Vygotsky, Dewey, and Piaget have asserted that learning is an active process where knowledge is constructed through interaction and engagement with the environment (Vygotsky, 1986; Dewey, 1938; Piaget, 1964). New understanding emerges when existing beliefs are challenged by new observations, particularly in social settings where various participants bring diverse perspectives and motivations (Brooks, 1990). Lev Vygotsky emphasized that collaboration with knowledgeable peers and the use of learning tools can foster the development of higher cognitive processes like metacognition, which aid in transitioning between conceptual frameworks (Kozulin & Presseisen, 1995; Kozulin, 1998). Over time, education has become increasingly complex, with a growing need for innovative methods to deliver knowledge effectively. Traditional teaching models often fail to meet the needs of diverse learners (Zilka, Cohen, & Rahimi, 2018). In online and hybrid learning environments, reduced face-to-face interaction may limit opportunities for observing peer learning strategies. However, such environments make student activities more transparent to institutions, which can analyse this data to understand and improve learning approaches (Winne, 2017). This process is commonly referred to as 'Learning

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Analytics' (LA). Learning Analytics involves the collection and analysis of raw behavioural or aggregated data generated during teaching-learning interactions. Such data may originate from LMS activities, such as accessing materials, participating in discussions, completing assessments, or viewing grades. Beyond LMS, other educational technologies, including social media and administrative systems, also contribute to this data. The objectives of Learning Analytics are twofold: (a) to provide meaningful insights for all stakeholders, including students, and (b) to drive positive behavioural and educational changes (Ferguson, 2012). Achieving these goals presents challenges: first, identifying actionable insights that link analytics outputs with decision-making and learning outcomes, and second, designing tools that meet the needs of diverse stakeholders. The technological advancements of the past decade have encouraged educators to explore new teaching approaches leveraging modern technologies. The proliferation of information technology and the internet has introduced unique challenges and opportunities in education dynamic, personalized learning pathways that leave no student behind are key to ensuring accessible, high-quality education. Emerging computational frameworks support this vision. Artificial Intelligence (AI), particularly through Machine Learning (ML), enables personalized learning in both traditional and online settings. Tools such as recommender systems, predictive analytics, Educational Data Mining (EDM), and adaptive learning leverage metrics from Learning Analytics to optimize learning strategies. This work focuses on the intersection of Education, EdTech, Learning Analytics, ethical concerns surrounding student data, LMS, VR/AR, Applied Behavioural Analysis, AI, and ML. Our objective is to develop a platform that personalizes content for individual learners while safeguarding their privacy.

2 Methodology

The development of this project has started with comprehensive research including review of existing technologies to better understand the methodologies used in the educational domain for the efficient and effective imparting of education in the current age of information chaos. This work has its focus on the following goals -

- Increasing the student retention rate on a particular online courseware.
- Aiding with the learning experience of students who developed neurological disorders like ADHD & ASD.

The design phase focuses on the making of schematics for the working of the platform and the algorithm for the model and ABA model. The initial setup involves calibrating the dashboard according to the student responses to certain inputs from the platform, the adaptive phase involves balancing the model according to the behavior of the user. Then the next phase is about the platform adapting according to the requirements of the ser of the platform.

3 Proposed System

The proposed system for Platform Epoch introduces a unique online learning platform with the integration of Digital identity and Learning analytics to enhance information security and personalized learning experiences. Key features include:

- Digital Identity and Student Monitoring: The need to use digital identity means unique ID for the student user and parent to evaluate each of the activities in details. Then the parent is able to track the learning process for the child in a statistical way.
- AI-driven precision education: The system leverages artificial intelligence and machine learning capabilities that leverage the data created by using learning analytics to provide effective and personalized content for each learner based on their capacity and learning speed.
- Special training for kids: Take advantage of using Adaptive Learning Analyses (ALA) and applied behavior analysis (ABA) the system provides and new experience for children benefitting those with ASD and ADHD.

3.1 Tools Used

The system design for Platform Epoch includes various tools and technologies to ensure data security, simplicity and a personalized learning experience. Here is an overview of the tools used:

3.1.1 Programming Languages and Platforms

- Frontend: HTML, CSS, JavaScript for building a responsive and interactive user interface.
- Backend: Python or Node.js for handling server-side logic, user authentication, and data processing.
- Database: MySQL or MongoDB to store user information, learning data, and analytics securely.

3.1.2 AI and Machine Learning Tools

- AI/ML Libraries: TensorFlow or PyTorch to implement learning analytics and adaptive learning algorithms to personalize content based on children's learning progress and behavior.
- Data Analysis: Pandas, NumPy, and Scikit-learn for processing and analyzing large datasets of user behavior and learning outcomes.

3.1.3 Digital Identity Management

- Authentication: Custom implementation of linking student and parent accounts securely using MySQL with Python. Unique identifiers are stored in the database which are utilized to sync both accounts. Hence parents can

get more updates of every update related to his/her child by querying linked records in the db.

- Synchronization: Accounts are synchronized using Python by connecting a parent with a student. Updates made on the student account (e.g. learning progress) are shared with the parent account via database trigger or perhaps even a simple Python function that repopulates the two accounts.

3.1.4 Real-Time Learning Monitoring

- Dashboard: Using Seaborn or Matplotlib in Python, a real-time dashboard can be implemented to visualize student performance. This dashboard allows parents to monitor their student's progress through various charts and graphs.
- Monitoring Tools: Custom dashboards providing insights into adaptive learning models, progress updates, and personalized recommendations for students

3.1.5 Specialized Tools for ADHD and ASD Learners

- Behavioral Analysis Tools: Applied Behavioral Analysis (ABA) and Adaptive Learning Analysis (ALA) models integrated through AI to provide tailored learning paths for students with ADHD and ASD.
- Documentation: Google Docs for writing and sharing technical documentation, research papers, and project updates.

3.1.6 Collaboration and Documentation Tools

- GitHub tracks code changes and enables team collaboration, while Google Docs is used for documentation and project updates.

3.2 Technical Details

An innovative ecosystem, it leverages both adaptive learning and behavioural analysis to provide custom experiences for children with ASD and ADHD. The user-friendly dashboards make it easy for parents to track progress. Your training data goes up to October 2023.

Adaptive design allows students to learn at a comfortable pace with dynamically adjusting content based on their progress. The system promotes academic and personal growth for special needs children by focusing on each challenge separately and making use of AI.

This platform creates a unique environment where AI and machine learning work together to improve learning outcomes for children with ASD. It sets a suitable learning path that can help children learn the difficult parts without complexities. Using Seaborn and Matplotlib, the app provided parent-friendly dashboards that track exactly how their child is doing. These tools help transform the complex data into visually impactful graphs and charts Fig 1, so you can easily monitor progress and identify students who may need more personalized support. This makes it easier for whoever is supporting them to coordinate and collaborate with everyone else involved in their education to help them succeed, whether that's by focusing on academic skills, developmental goals, or both.

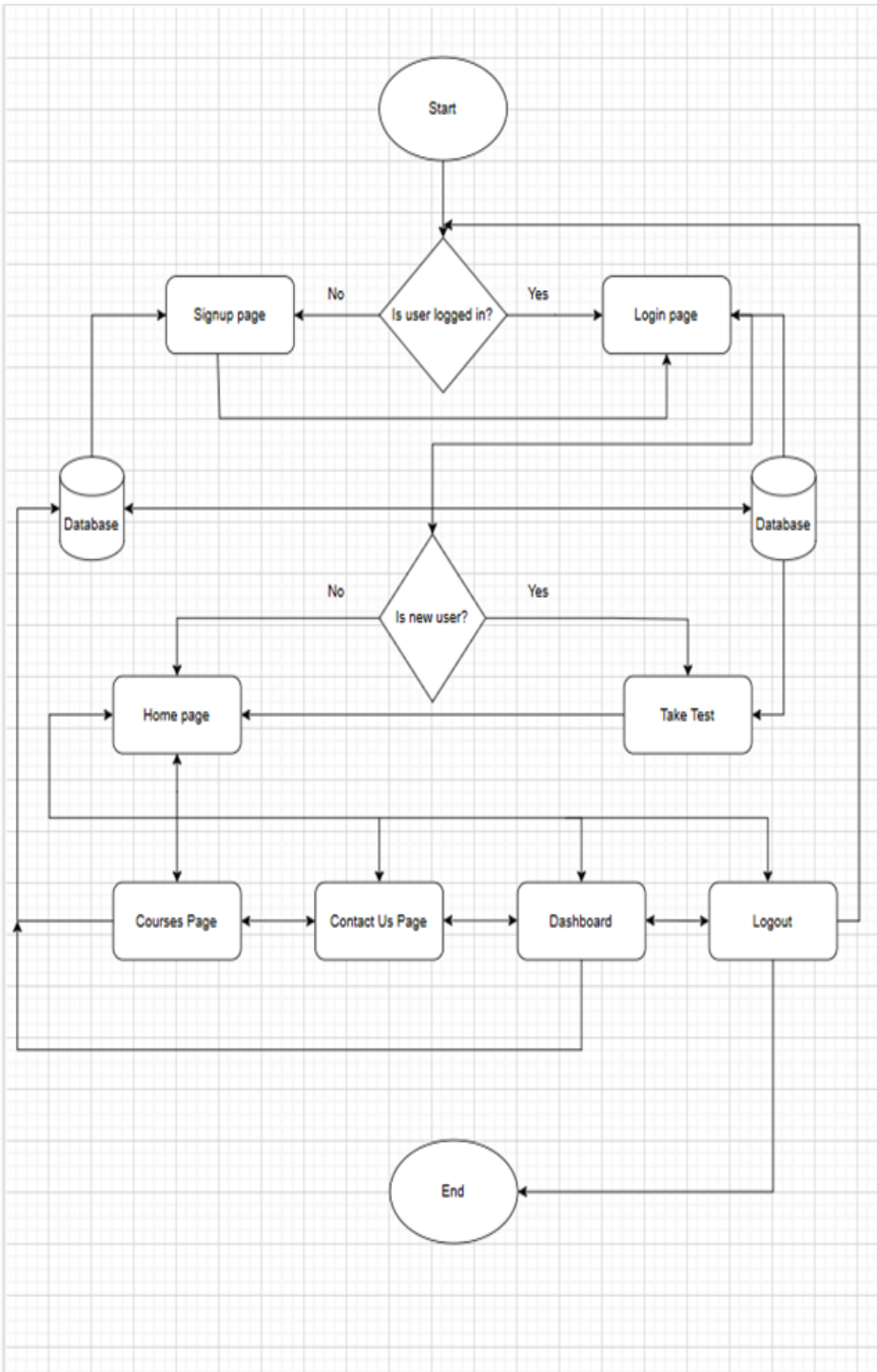

Fig.1. The working of Platform Epoch.

3.3 The working of Platform Epoch

In the platform epoch system, they establish their own learning profile set that integrates with a digital identity linking system, which acts as a secure shell between parents and children. This link is used to build tailored educational features that evolve with the student and their needs. Once the parents and children come on the platform they have to come and create their account this has been done with a very very user-friendly interface, which is very accessible and very secure.

After creating their initial accounts, parents are taken through a thorough verification process that involves providing documentation to prove that their child has a disability. This allows the platform to offer suitable accommodations and support catered to specific conditions like ADHD or ASD, which is an extremely important step. The entire verification process is done in strict confidentiality, and all sensitive documents being reviewed are transmitted over secure lines in accordance with the educational document protection model.

By utilizing a trusted digital identity system, the kids can connect with their parents in a personalized and secure learning environment. This link is the foundation of the system's adaptability, providing personalized student learning experiences. The journey starts with parents and kids inquiring about the platform and signing up via an intuitive website, hosted with inclusivity and safety in mind.

After registering, the parent goes through a verification process to verify the disability status of their respective child. This is a critical step to enable the platform to give tailored assistance to individuals with conditions such as ADHD and ASD. We respect your privacy All sensitive documentation is securely processed and compliant with educational data protection.

After verification, the platform performs an interesting academic evaluation to assess the child’s present skills and talents. Designed with a large number of adaptative questions, this diagnostic test adapts in real-time, limiting stress and optimizing the information obtained about the investigated student capabilities. Parents can see it all on an easy-to-read dashboard that uses clean graphics to draw attention to strengths and weaknesses.

The platform’s recommendation engine then creates tailored learning paths. These suggestions consider various elements like learning styles, attention span and individual challenges. Before you even get to a new piece of content, if a child is struggling with something, the system detects that in real-time and suggests easier material. Alternatively, when the child is performing well, material is given beyond their immediate reach to keep their learning in its ideal zone.

The real-time dashboard enables parents to visualize their child's progress through detailed metrics around engagement, achievements, and areas for improvement. This functionality supports parents to remain engaged and better help their child's education with actionable insights.

Platform Epoch integrates assessment, personalization, and monitoring to create a thriving environment for every child. Through this method, learners experience an increase in confidence and skills, representing a major catalyst toward offering all learners an inclusive and accessible pathway to education.

4 Related Work

Platform Epoch is a project, and this pregnancy is the result of leveraging the sophistication of existing technologies, educational pedagogy, Applied Behavioral Analysis (ABA), Learning Analytics, Identity Management Systems, Artificial Intelligence and Machine Learning with data generated by the user. It is entirely adaptive on this platform and can adapt to user behavior.

The immersivity of content with the help of Virtual **Reality (**VR), Augmented Reality (AR), Virtual Reality Learning Environment (VRLE) can add and enhance the educative methodologies. So far, research on these kinds of class learning methodologies has shown encouraging signs of the viability of these kinds of platforms. Local-first data processing methodologies will help in this regard as well.

For implementation, established projects effectively employed open-source frameworks for building, contributing community-driven improvements and adaptations. Seizing these insights and technologies, this paper aims at presenting a system that provides quality content to the users while keeping the data of the children private by making use of the 'local first' methodology, that is, Open-source JavaScript libraries are employed to process the data and as a result, data is never exposed to the cloud.

5 Conclusion

It is designed specifically for children with autism, ADHD, and other neurodevelopmental disorders, and has proven to be a valuable tool in improving learning and adaptive behavior; a flexible, individualized approach from a structured learning platform. Content customization enables educators and parents to adjust lessons based on the unique learning styles of individuals as well as their preferences, allowing a child to engage with the material in a manner that is most meaningful. The fact he personalizes their education creates a greater understanding of the subject while acquiring the most important skills at their own pace. Andoleen has even received positive feedback from parents and caregivers who note how much the platform has

helped their children. Parents have seen significant differences in their children's focus and success a testament to the potential benefits of these types of platforms and the educational advancements possible through them.

These achievements are notable, but there are still issues to be addressed by Platform Epoch. Keeping students engaged is still a major challenge (children with neurodevelopmental conditions often have widely varying levels of interest and concentration), but we are able to do that much better than before. This would require regular updates from the platform provider with new material and course features for keeping interest and motivation.

In addition, extensive training for both parents and educators is critical to maximize the potential of the platform. Trained caregivers can understand how best to support children's learning journeys and utilize the platform's features to its fullest. The platform fosters a collaborative approach by providing users with skills they need to help reach educational goals.

The Bigger Picture Platform Epoch highlights the immense transformative power of integrating advanced educational technologies.

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