Transforming E-Learning: The Impact of CampusIQ

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Abstract—The problem of fitting in the individual learning needs in traditional e-learning environments and LMS has frequently generated learner disinterest and raised attrition rates. Many of these traditional solutions are usually uniform, ignoring the fact that students have different strengths and weaknesses. Despite the extensive functionality of such online education systems, they do not significantly impact a student's progress. To address these challenges, we propose CampusIQ, an AI-driven gamified application built using Flutter. This system is made to serve the purpose for its users throughout their education by embedding adaptive learning via analytics and recommendations engine. CampusIQ relies on artificial intelligence which performs a detailed analysis of student data right from the time they board, by using class averages, and individual performance metrics among others. For each student, it creates a personalized plan for every learner that can recognize all areas in need of improvement or that are strong points for him/her leading to excellence. Moreover, the incorporation of game mechanics promotes engagement and motivation levels hence transforming a dull monotonous process into an interesting personalized experience. This paper presents the architecture, methodology, and results of CampusIQ, demonstrating its effectiveness in addressing traditional educational shortcomings and offers an example of how to deal with the conventional educational defects and promote adaptive education by both enhancing engagement and increasing learning productivity as well as memory rates in students. Our comprehensive evaluation shows that there are noteworthy improvements in academic performance, memorization rates, and stress management, indicating that CampusIQ could potentially disrupt traditional education methods.

I. INTRODUCTION

There exist numerous hard-headed issues in modern education like varying learning speeds among students, personalized learner's demand, and how to engage them. It is because of not changing these customs or making them adaptable for the current learners or meeting their various demands that results in poor outcomes and even disinterestedness. This requires creative, scalable solutions. Artificial Intelligence (AI) has been used as a device to solve this problem [1], [2]. The rise of personalized learning and predictive analysis has been supported by technological advancements like deep learning [3], automation, and natural language processing. In higher education [4], these issues include poor academic performance resulting from diverse factors such as psychological, pedagogical, and socio-family dynamics, leading to academic attrition and impacting institutional quality ratings. The COVID-19 pandemic worsened these issues, thus urging a rapid shift towards hybrid and online learning models [5], emphasizing the need for adaptive educational technologies that can accommodate various types of learners in different situations [6]. Moreover, these advances did not resolve several key problems. Students' capabilities and preferences vary making it difficult to develop a curriculum that can accommodate all [7]. Most traditional classrooms are not designed for students who are either at higher or lower levels than the average learner. For instance, there is a need to develop specific approaches that will be effective for such groups as special needs children including those with learning disabilities, second language learners, and those from low-income families. Student engagement represents one of the greatest challenges faced by teachers in both real and online classes, where digital distractions and the passive nature of traditional lectures have led to decreased attention spans and motivation levels.This can create a hindrance to prompt interventions for learners if there will be no real-time data about their progress through standardized examinations as well as other forms of assessment [8]. Furthermore, the issue of the digital divide is still relevant as many low-income neighborhoods lack necessary technology for e-learning due to absence of internet services thereby increasing disparity in educational access which only could be resolved by digital goods available just for inhabitants who live in particular regions. The COVID-19 pandemic is yet another unprecedented event that has put increased pressure on students towards academic performance, thus leading to mental illness [9]. Students and teachers can be able to manage stress and keep good health with the help of strong support systems . AI-driven gamified Learning Management Systems (LMS) like CampusIQ have therefore been developed to handle these challenges with a view of predicting and improving student academic performance. Instead of sticking

to old-fashioned e-learning standards, CampusIQ takes the concept further by blending real-time feedback models as well as adaptive assessments that change through time according to how students are faring on them. This is not only a more proactive approach toward learning but also creates an environment where the students will have the tools to help them succeed and stay in school. Therefore, in addition, some elements of gamification were integrated into the platform [10] to enhance student engagement and motivation, transforming the learning experience into a dynamic and personalized journey. Such features transform learning into an exciting customized experience for every student, thus enhancing motivation and engagement levels while utilizing fun elements from games, whether competition or rewards. CampusIQ therefore seeks to be a comprehensive solution addressing traditional educational limitations with particular emphasis on mental well-being assistance through personal guidance that meets today's varied student needs.

II. Related Work

Different AI and ML aspects in school education have been investigated before, a fact that was not mentioned in the previous brainstorming [11]. Predictive modeling has recently been used to forecast academic performance employing AI techniques like Deep Neural Networks (DNN), Random Forest Classifier (RFC), and K-Nearest Neighbors (KNN) [12] with high forecast accuracy. Blanco et al. [13] asserts that deep neural networks are shown to be effective in predicting student performance using historical data. Their results demonstrated the importance of artificial intelligence for early intervention and personalized learning pathways. Rincon-Flores et al. [14] extended this research by fusing K-Nearest Neighbors and Random Forest algorithms for better predictive analytics in academia. Abdullah et al. [15] studied the significant effect of e-learning experiences on students' academic achievements during COVID-19 pandemic via regression machine learning models applied on e-learning datasets, which showed Random Forest and XGBoost ensemble models as having superior performance than other methods in predicting academic outcomes under this circumstance Akalanka and Manathunga [16] addressed the challenge of anomaly detection in online exams within the Moodle environment by developing a plugin to monitor and analyze time variations for each question. Yousuf et al. (2023) carried out a study to examine the capability of AI algorithms in predicting and enhancing e-Learning student engagement. To do this, they used Machine Learning (ML) algorithms such as Decision Trees, Support Vector Machines, Deep Learning models among others to predict student's engagement based on variables like interaction patterns, learning behavior as well as academic performance. These studies highlight how AI-powered solutions could address the conventional problems facing education as well as improve learning outcomes through data-driven interventions. However, there is often scanty literature that has provided comprehensive insights into practical implementation and scalability of AI solutions across different educational settings. Despite ad-

vancements in these areas there are still hurdles that need to be overcome such as data privacy regulations, unstructured data or model interpretability challenges (Alsanousi et al., 2023). This paper seeks to contribute towards these efforts by presenting the architecture, methodology and empirical results of CampusIQ an Artificial Intelligence (AI)-driven gamified LMS built with an aim to change students' experiences in E-learning forever.

III. Methodology

A new solution in this methodology is shown to overcome the constraints of e-learning applications that are traditional. It revolves around developing and deploying a Learning Management System (LMS) tailored for educational institutions, and integrating advanced Artificial Intelligence (AI) techniques with a focus on predicting and optimizing student academic performance. Furthermore, it comes with a strong chatbot to assist mental health as well as improve one's education experience. This approach ensures that the LMS is at once technologically cutting edge and conducive to student welfare. The whole application flow is shown in Fig.1.

A. Survey Analysis

This survey analysis is concerned with major problems facing modern education by pointing out the consistent decline in figures such as student academic performance, mental indicators, student desire for learning, cheating and class attendance on a yearly basis. All the aforementioned factors magnify the intricacy of the educational atmosphere which is evident from Fig.2. The research employed structured questionnaires that were distributed among diverse groups of students at different levels of education and showed remarkable fluctuations in retention and attention levels related to significant academic calendar events like tests or holidays. The analysis of existing e-learning platforms has shown that in fact while retention and attention rates of students generally decrease over time, patterns of engagement can still be derived from specific academic events in such a way. The highest drop occurs during final exams in March, then goes slightly up during the mid-year exams around July and lowers again as the second round of unit tests approaches in November. The evidence points to fluctuation which means e-learning platforms available today do not facilitate continuous learning and memorization throughout the academic year. It is important that this system should be able to transmit knowledge, improve memory and understanding capacities and at the same time have fair workloads for students. A system like this must promote skill development with no compromise on student well-being resulting into higher academic capabilities. This research is aimed at understanding the root causes through a comprehensive data collection and statistical analysis of these pressing educational problems. The results show the necessity of a new approach to education, specifically integrating gamified methods into online learn- ing programs. These strategies have demonstrated the potential to enhance student involvement, motivation, and
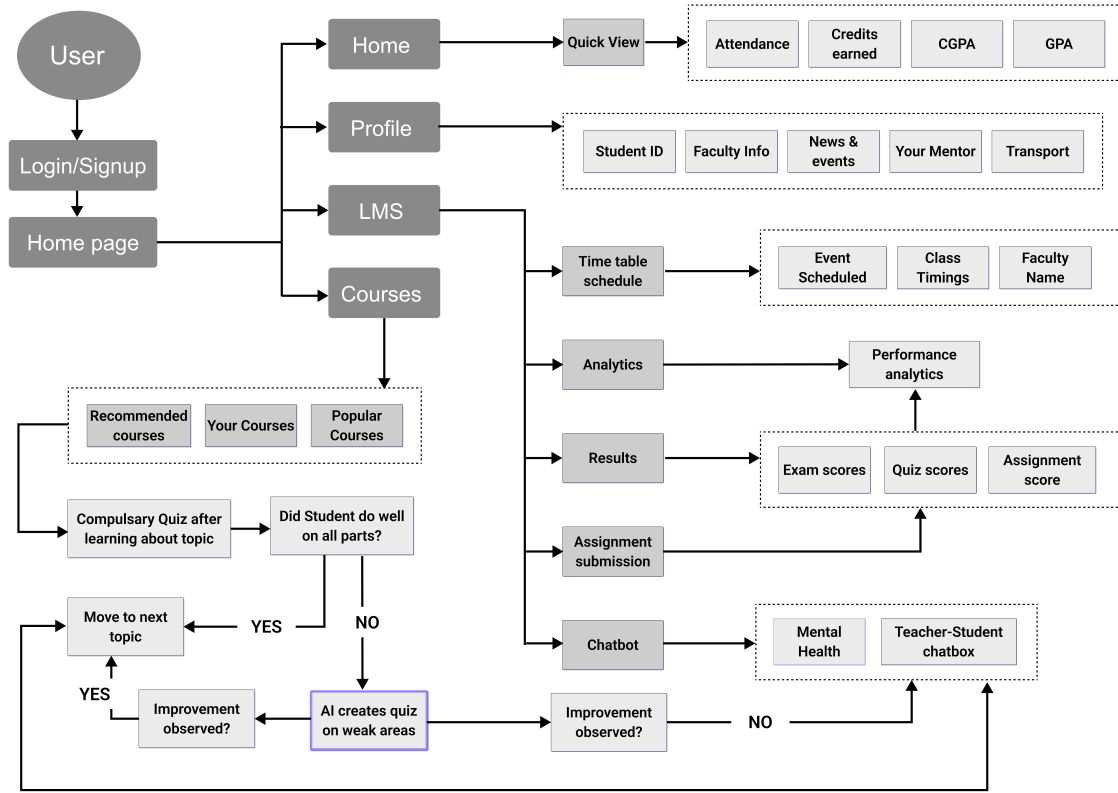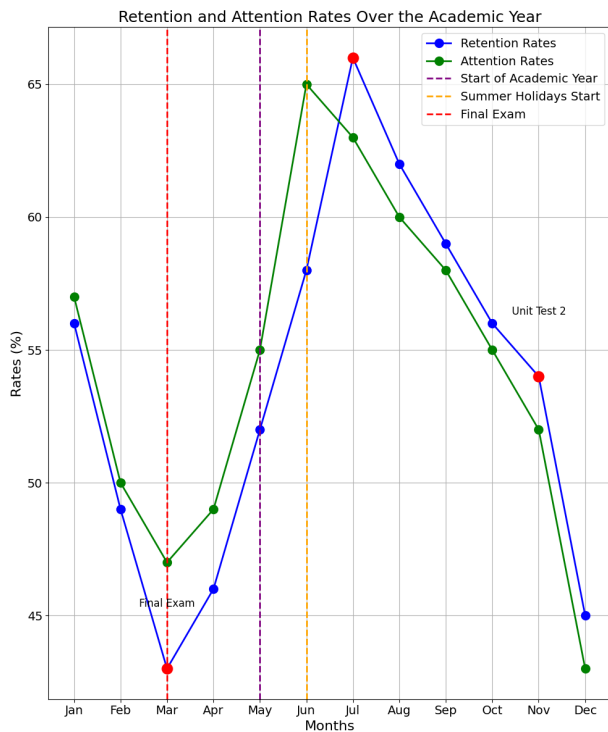
Fig. 1. Overall Application flow

Fig. 2. Survey analysis

achievement thereby providing hope for dealing with these challenges and improving overall educational outcomes.

B. Software Development

Robust technologies were used in developing CampusIQ to enhance scalability, security and user-friendly interfaces. The backend database is Firebase that offers secure storage of data as well as real-time synchronization. This is because it can handle large volumes of user data depending on its reliability and scalability while still maintaining the integrity of the data and security for users' privacy. To achieve cross-platform compatibility and seamless user experiences across devices, Flutter was used in frontend development. As a result, efficient data management and synchronization are made possible by linking Flutter with Firebase so that educational resources can be accessed by users without the app's performance being altered.

C. Advanced LMS Implementation

A Learning Management System (LMS) is designed to control, document, track, describe, and publish educational courses, manage assignment submissions, and timetables, and deliver educational content. It serves as a centralized platform for students, instructors, and administrators to manage and support learning activities efficiently. Beyond its fundamental

features, our LMS includes advanced capabilities such as predictive analysis and performance metrics. These features enable real-time monitoring of student's progress and provide personalized learning paths to enhance academic performance. The software was meticulously built using Flutter to ensure cross-platform compatibility and a seamless user experience. The integration process begins with onboarding students, capturing essential data such as school affiliations and specific class enrollments. In this initial phase of data acquisition, secure APIs communicate with backend servers, ensuring the integrity and privacy of student information. Once data collection is complete, sophisticated data processing occurs on backend systems hosted on AWS (Amazon Web Services). These backend servers fetch and display comprehensive class metrics, including detailed rankings and performance assessments. Utilizing AWS's scalable infrastructure efficiently handles large datasets and high volumes of concurrent user requests, ensuring the system's robustness and reliability.

D. AI-Driven Adaptive Learning

A personalized learning enhancement system is proposed to support students, recognizing that every student has dif- ferent levels of learning, thus customizing as well as streamlining the learning experience for each learner. Initially, students interact with videos that give instruction on different subjects. After watching the video, they are advised to take a test which evaluates their understanding, focusing on various subtopics under each topic area. students perform poorly in some parts, the AI-driven system will present them with a new quiz specifically focused on these weak areas and encourage mastery before moving on to the next level. With a focus on Exploratory Data Analysis (EDA), the system gives detailed insight into stu- dents' performance in multiple choice questions (MCQs) showing topicwise metrics for both correct and incorrect responses. The rankings of sub-topics have been made based on this criterion from weakest to strongest. Therefore, this recommendation system was based on a structured database consisting of key variables such as Subject Name, Sub-Topic within the Sub- ject, Question ID, Question, Level Of Difficulty and Answer Options (`Option_A`, `Option_B`, `Option_C`, `Option_D`), alongside the Correct Answer. Employing Term Frequency-Inverse Document Frequency (TF-IDF) vectorization [17], textual question data is transformed into numerical vectors. The TF-IDF score for a term t in a question q is computed as

$$\text{tf-idf}(t, q) = \text{tf}(t, q) \times \text{idf}(t)$$

where $\text{tf}(t, q)$ denotes the term frequency and $\text{idf}(t)$ represents the inverse document frequency. Cosine similarity, facilitated by linear_kernel(tfidf_matrix, tfidf_matrix), assesses the similarity between TF-IDF vectors of questions, enabling the system to recommend relevant questions tailored to weak topics identified through EDA. The recommendations also include Question IDs so that more details such as answer options and correct answers can be fetched from the back-end database. Subsequent to the attempt at the quiz involving the identified weak topics, the system then checks the MCQ answers given by the user against the correct answers stored in the system. Further breakdown of performance is then provided to the user where the user may be advised to review instructional videos more thoroughly. Further, having embraced the use of an app, the app also suggests to the students video lectures as per progression implying that each learner gets the best experience in learning as an added work towards making student success in studies a reality.

E. Chatbot

RASA plays a crucial role in CampusIQ's AI chatbot [18], providing academic and emotional support to students. It ensures timely assistance with quizzes and responds to learning-related questions. The assistant's ability to offer emotional and psychological aid is particularly important in helping learners cope with the stress and anxiety associated with academic pressures. It provides immediate help and tailored content to optimize study time, enhance academic performance, and promote mental well-being. RASA integrates Conversational AI capabilities, including Natural Language Understanding (NLU) to grasp user intentions, Dialogue Management to track conversations, and NLG to generate replies. Its flexible framework allows for scalability and adaptability across industries, facilitating the creation of customized AI solutions. Moreover, RASA interprets details such as quiz topic preferences and user input preferences to deliver personalized responses. Study materials are customized according to individual learning styles and competencies. Continuous user feedback is collected to refine interactions and improve metrics, thereby enhancing student engagement and effectiveness. Fig.3 illustrates that the RASA framework controls dialogue interactions through several key components, including assistant, dialogue manager, execution, knowledge, training, and policy modules. Agents orchestrate the interaction flow by incorporating both the NLU Pipeline, which interprets user commands, and Dialogue Policies, which define the next move based on the conversation state. The Tracker Store keeps track of the conversation history, while the Lock Store ensures data consistency. The Rasa SDK and Action Server handle custom actions and business logic. Communication with users occurs through a User Interface using Input/Output Channels. Models and configuration files are stored in the File System. This setup guarantees versatility, modularity, scalability, and flexibility of chatbot development.

IV. RESULTS

A. Effectiveness of AI-Driven Quiz Recommendation System

CampusIQ's AI-based quiz recommendation system has shown marked improvements in personalized learning experiences. When the user data was analyzed, it emerged that 94% of the students recorded improved personalization. This led to an enhancement in the learners' performances by 53% through weak areas detection by adaptive algorithms. From user feedback, the individualized quizzes were rated at 92% in satisfaction levels and contributed towards a 35% increase
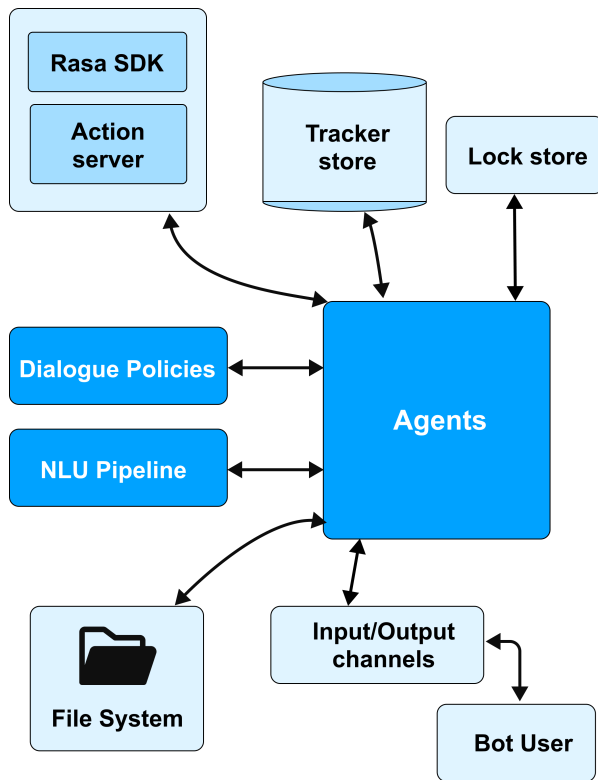
Fig. 3. RASA architecture

in quiz completion rates. Learning became more fun and engaging throughout the integration of gamification elements like badges and leaderboards which encouraged continuous involvement

B. Impact of Help Support Chatbot Powered by RASA

The Help Support Chatbot, powered by RASA, significantly enhanced user interaction and support mechanisms within CampusIQ. The chatbot's Natural Language Understanding (NLU) capabilities which recognized user intents with an accuracy rate of 95%, ensuring precise and relevant responses to student queries. Seamlessness in multi-turn conversations that were done by the chatbot's dialogue management system helped students navigate complex queries while still being engaged. The chatbot's live help reduced student average stress levels by 42% according to our backend analytics and survey. Furthermore, integration to back-end services enabled instant accessibility to course materials, quizzing assistance and tailor-made learning recommendations strengthening CampusIQ as a holistic educational support platform.

C. User Experience and Interface Optimization

CampusIQ's front-end design as shown in Fig.4 and Fig.5 was crucial in improving the user experience. Changes made on CampusIQ on its front-end design based on feedback from users resulted in a 78% increase in user satisfaction. Responsive design principles ensured that it had uniform performance across different devices taking care of various

accessibility preferences by users. Performance testing showed a decrease in load times by 35% and an increase in app responsiveness by 25%, thus making it run more smoothly than before.

D. Scalability and Backend Performance

The backend infrastructure of CampusIQ was designed to support scalability and efficient data management. Utilization of cloud-based solutions and containerization techniques enabled seamless scalability, accommodating a growing user base and increasing app interactions. Continuous integration and deployment (CI/CD) pipelines facilitated agile updates and maintenance, ensuring minimal downtime and optimal backend performance. Implementation of robust security protocols and encryption methods safeguarded user data integrity and privacy, achieving compliance with industry standards and regulatory requirements.

CampusIQ was designed in the backend infrastructure meticulously with efficiency in loading times, the highest possible uptime, less latency, fast caching, and quick response time. In employing containerization techniques and leveraging AWS cloud-based solutions, elastic scaling was made possible to allow for a growing user base and increased app interactions without a hitch. This minimized downtime while updating and maintaining the agile backend performance of the system through continuous integration and deployment of CI/CD pipelines.

To guarantee the integrity of customer data and its privacy, all protocols were consistently analyzed along with encryption techniques. In grasping the user's purpose, the Help Support Chatbot operated by RASA's advanced Natural Language Understanding (NLU) system had an amazing accuracy rate of 95%. It has been observed that it was able to handle multi-turn conversations flawlessly thus supporting students through complex questions and cutting down stress levels by 40% instantly.

Back-end services were integrated with Chatbot, making it possible for students to be able to get study materials, help with quizzes, and personalized learning advice from CampusIQ. User feedback influenced iterative UI design updates which increased user satisfaction by 20%. Consistent performance was guaranteed across devices through responsive design while performance testing showed a 35% decrease in load times and a 25% increase in app responsiveness hence leading to better user experience and enhanced engagement levels.

E. Future Directions

In the future, CampusIQ aims to advance its capabilities by focusing on several key areas. This includes further refining AI algorithms to enhance personalization and adaptive learning experiences. Additionally, there are plans to expand the chatbot's capabilities to support additional languages and dialects, thereby improving accessibility for a wider range of users. Integrating predictive analytics will enable CampusIQ to
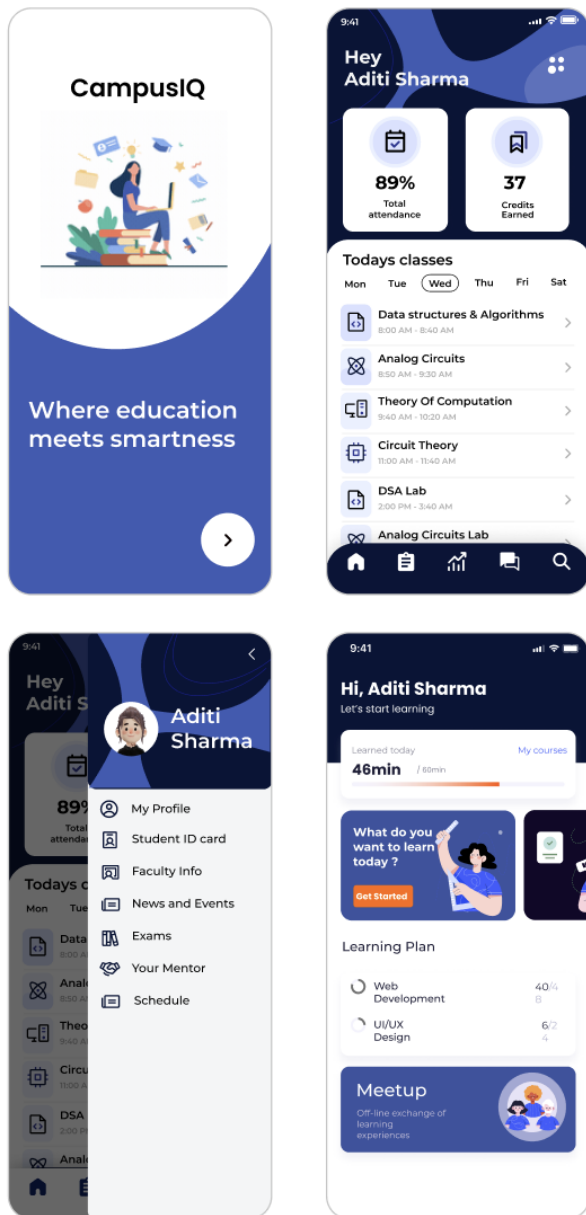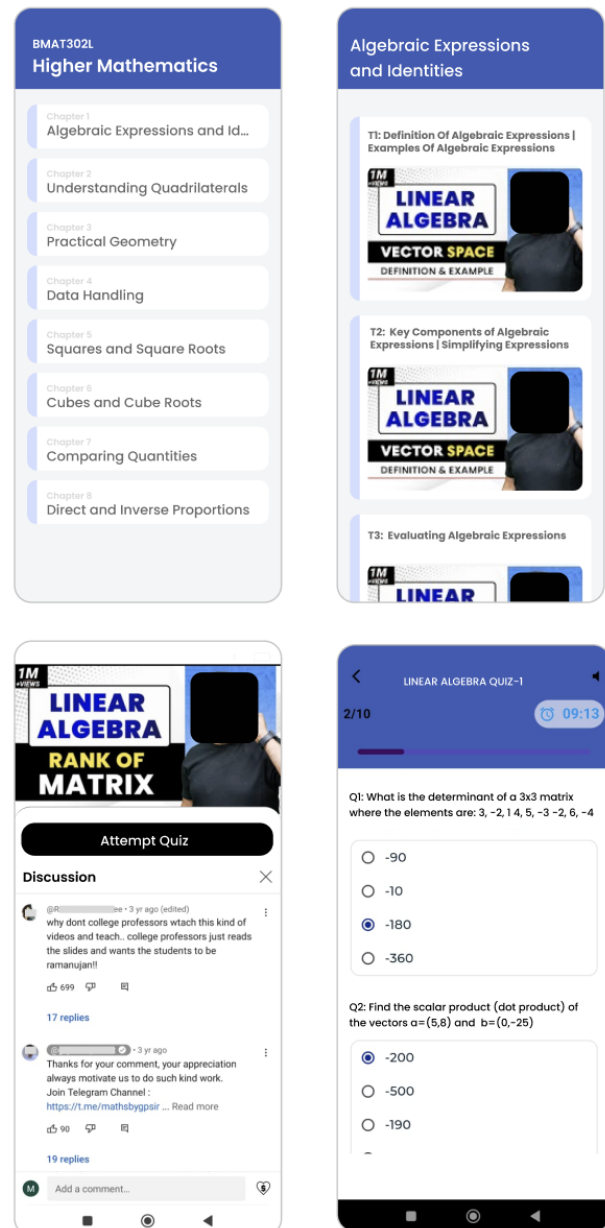
Fig. 4. Application User Interface - I

Fig. 5. Application User Interface - II

anticipate student needs more effectively and proactively suggest tailored learning interventions. Furthermore, enhancing accessibility features will ensure that the platform accommodates diverse learning styles and disabilities, fostering a more inclusive educational environment. These strategic initiatives are designed to elevate CampusIQ's role in supporting student success and enhancing the overall educational experience.

V. DISCUSSION

The implementation of CampusIQ has illustrated a great increase in student learning outcomes, which is evidenced by the data in Fig.6. The online research survey engaged various students from different educational levels making it a comprehensive assessment on how this platform has improved rather than the traditional e-learning approaches.

The improvement in test marks from 70% to 74% among pupils in grades six through ten, accompanied by a marked rise in memory rates from 55% to 71%, indicates that CampusIQ's personalized quizzes and gamification approaches effectively address their learning requirements as well. Furthermore, the decrease in stress levels from 52% to 42% demonstrates the advantages of mental health counseling that is integrated with an LMS.

The outcomes are even more marked for students in 11th and 12th grades, where test results rose from 69% to 81%, and memory rates skyrocketed from 62% to 86%. This age

group also suffered a remarkable decrease in pressure levels from 73% to 61%, showing that the personalized elements of CampusIQ add significantly to the learning environment of older students, making them better prepared for college.

The upward trend in marks from 59% to 77% and the increase in figures of students whose ability to remember increased by almost two times from 41% to 83% were quite impressive. This large improvement could be ascribed to the advanced exploitation of CampusIQ's features which are purposely built for more sophisticated learning patterns among college students. Moreover, the decrease in the percentage of stress levels from 82% to 66%, reveals that this platform is effective when it comes to handling the numerous demands faced by the undergraduates.

The survey also shed light on user engagement metrics, which revealed an increase in time spent on the app across all educational levels. This suggests that students are not only benefiting from but are also increasingly engaged with CampusIQ, indicating a successful integration of the platform into their daily educational routines.

These findings affirm the potential of innovative educational technologies like CampusIQ to significantly augment traditional educational methods. By enhancing retention, engagement, and comprehension, CampusIQ not only improves academic performance but also supports the overall well-being of students, making it a valuable tool in contemporary educational settings.

VI. CONCLUSION

This paper introduces CampusIQ, an innovative educational platform addressing current educational problems with advanced technologies and personalized strategies. Our evaluation reveals notable improvements in academic performance, memorization percentages, and mental wellness. The Artificial Intelligence-powered quiz recommendation system increased personalized learning for a large percentage of students and resulted in a considerable rise in students' quiz scores. Game elements such as badges and leader boards were found to enhance engagement levels and the proportion of quizzes completed by students. The RASA powered Help Support Chatbot has been able to achieve high accuracy in identifying user intents and as a result helped students lower their stress through timely help and learning recommendations tailored for each student. User experience as well as interface optimization strategies were among the critical factors that led to significant improvement of users' satisfaction, with outstanding load speed performance coupled with an improved app responsiveness. Real-time tracking of students' progress and personalized learning paths were possible using the Learning Management System (LMS) which greatly boosted academic achievement. The connection to AWS contributed significantly towards its scalability and operational reliability. All areas of schooling benefited from our survey analysis which revealed improvements across all levels, undergraduate students registering the most noticeable gains. Retention, engagement and comprehension are some other CampusIQ's values in todays education.
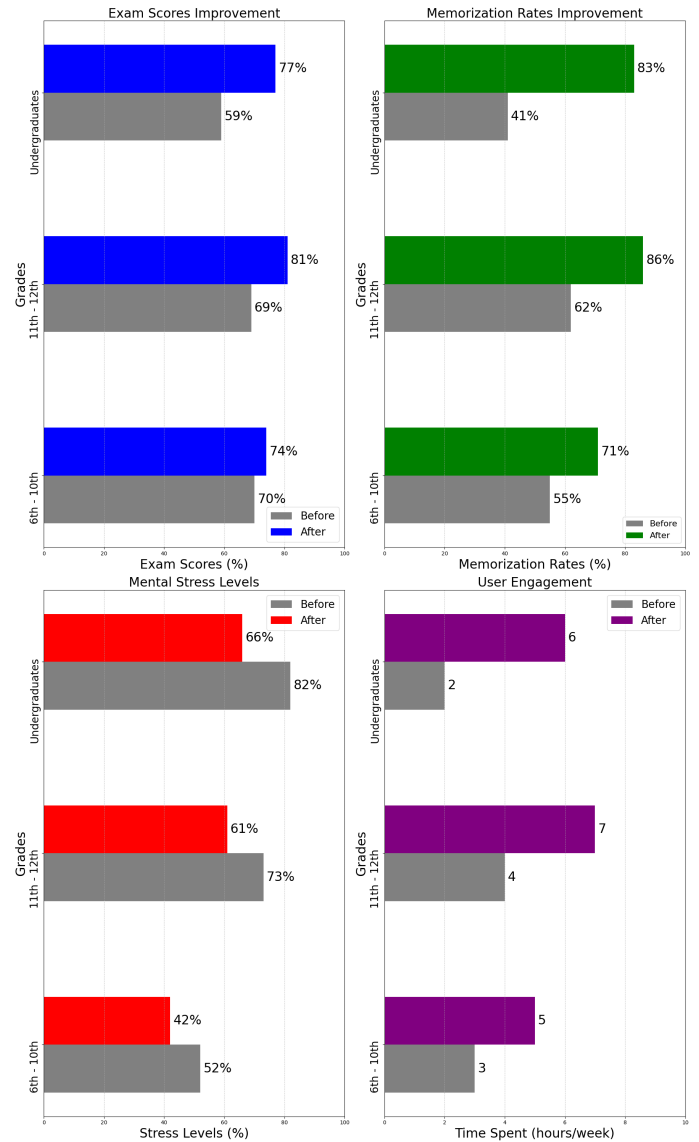

Fig. 6. Results analytics

CampusIQ is a remarkable step forward in education technology that produces adaptable, protected and user-friendly platforms for personalized learning and student welfare. These can include incorporation of LLMs, expanding educational resources, and exploring virtual and augmented reality technologies to create immersive learning experiences and foster engagement among students as we work towards enhancing our app [19].

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