

Parental Monitoring System for Online Learning

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ABSTRACT

The rapid expansion of online learning platforms has increased the need for effective parental involvement to ensure student accountability and productive learning behavior. This paper presents a Parental Monitoring System for Online Learning designed to help parents monitor and support students' academic activities in digital learning environments. The system is developed using HTML, CSS, and JavaScript for the frontend interface, Python for backend processing, and MySQL for database management. It provides two separate dashboards: a parent dashboard and a student dashboard. The parent dashboard enables monitoring of student activities through features such as activity logs, weekly performance reports, SMS notifications for class non-attendance, analysis of learning and distraction time, and tracking of offline study activities. The student dashboard includes modules for goal setting and submission of offline study declarations to encourage responsible learning habits. In addition, the system incorporates essential functionalities such as a responsive homepage, validated user registration with email and phone number verification, secure login authentication, password recovery using confirmation code verification, and user-friendly navigation. By integrating monitoring, reporting, and notification mechanisms, the proposed system aims to enhance parental engagement and improve student discipline and effectiveness in online learning environments.

Keywords—Parental monitoring, online learning, web application, dual dashboard, python programming, MYSQL database

INTRODUCTION

This has resulted in a huge disconnect between parents and their children's learning activities. While in a conventional learning situation, parental participation is encouraged by physical interaction, online learning has not offered a clear framework for keeping track of a child's participation and attendance. Existing systems have been limited and have not offered a means of interaction between parents and their children.

The gap in the literature is addressed by the development of a parental monitoring system through the development of a web-based application using HTML, CSS, JavaScript, Python, and MySQL technologies. The application has been designed to incorporate a dual dashboard system for parents to monitor the child's activity log, weekly report, SMS notification for non-attendance in classes, analysis of learning and distraction time, offline studies, as well as a student dashboard to set goals and declare offline studies. The application also has other features such as a responsive home

page, verified user registration (email address should have '@' symbol, 10-digit phone number), login system with password recovery through a confirmation code, easy navigation through the application with previous/next buttons on all pages.

The organization of this paper is as follows: Section II discusses the related work on parental monitoring and student engagement in online learning. Section III describes the system methodology and architecture. Section IV describes the system workflow and implementation. Section V concludes this paper, discussing its limitations and potential for future work.

LITERATURE REVIEW

The rapid advancement of digital technologies has fundamentally transformed educational delivery methods. Moore et al.

[1] reported that online learning platforms witnessed exponential growth, with the global e-learning market reaching \$315 billion in 2021 and projected to grow at a CAGR of 20% through 2028. This transformation, accelerated by the COVID-19 pandemic, necessitated the development of supporting technologies ensuring educational continuity. Allen and Seaman [2] documented that over 75% of academic institutions now offer some form of online learning, with approximately 30% of students

enrolled in fully online programs. This shift created an urgent need for monitoring systems capable of tracking student engagement and academic progress in virtual environments where traditional observation methods are unavailable.

Extensive research has established the critical role of parental involvement in student academic achievement. Epstein's framework

[3] identified six types of parental engagement, including monitoring, communication, and learning at home, all of which are challenged in online learning contexts. Henderson and Mapp [4] demonstrated that students with actively engaged parents show 30% higher academic achievement, 40% lower absenteeism rates, and 25% improved behavioral outcomes. However, Wang et al. [5] found that parental involvement drops by approximately 60% in online learning environments due to lack of visibility into daily activities and limited communication channels with educational institutions.

Several commercial solutions have emerged to address parental monitoring needs. Smith and Johnson [6] evaluated popular platforms including ParentLocker, which provides attendance tracking and grade reporting but lacks real-time activity monitoring. Their study found that 68% of parents desired more detailed behavioral insights beyond grades. SchoolStatus offers communication tools between teachers and parents but fails to track student engagement during actual learning sessions. Google Classroom's Guardian Summary provides weekly email summaries but offers limited customization and no real-time alerts. Kumar et al. [7] indicated that 72% of parents found weekly summaries insufficient for timely intervention.

Patel and Mehta [8] identified key technical shortcomings in current monitoring platforms including fragmented data sources, average reporting delays of 24-48 hours, limited mobile accessibility (only 35% offer responsive interfaces), and lack of distinction between active learning and distraction. Notably, 82% of parents expressed need for this feature. Fredricks et al. [9] conceptualized student engagement across three dimensions: behavioral engagement (attendance, participation), emotional engagement (interest, attitude), and cognitive engagement (self-regulation, strategic learning). Digital learning environments require specialized metrics for each dimension. Chen et al. [10] proposed engagement indicators including mouse activity patterns, tab-switching frequency, and time-on-task measurements as proxies for attention levels.

A comprehensive study by Rosen et al. [11] revealed that students in online learning environments switch between learning and non-learning tasks every 6 minutes on average, spend approximately 35% of screen time on non-educational activities, and check social media an average of 8 times per hour during study sessions. Flanigan and Babchuk

[12] identified primary distraction sources as social media (45%), entertainment streaming (28%), and gaming (15%). Significantly, 73% of students expressed desire for self- monitoring tools.

Mobile notification systems have proven effective in educational interventions. Garcia and Lee [13] implemented SMS reminders for class attendance, achieving a 22% reduction in absenteeism. Their study highlighted that text message alerts achieve 98% open rates within 5 minutes, compared to 20% for email communications. However, Sharma et al. [14] cautioned that alert frequency must be optimized to prevent notification fatigue, recommending a maximum of 3-4 alerts per week for educational contexts.

Role-based interfaces have been extensively studied in educational technology. Gupta and Sharma [15] demonstrated that dual dashboard architectures improve user satisfaction by 45% compared to single- interface designs by providing role-specific functionality while maintaining data consistency. Their research emphasized that parents require analytical views with historical trends, while students benefit from goal-oriented interfaces with immediate feedback mechanisms.

Despite significant advancements in educational technology, a comprehensive solution integrating real-time monitoring, SMS alerts, distraction analysis, and dual dashboards remains absent from the literature. Existing systems offer fragmented functionality without addressing the bidirectional communication needs between parents and students. This gap motivates the development of the proposed parental monitoring system.

METHODOLOGY

In order to conduct research on the development of a web-based system for online learning, which can be used for parental monitoring, this study employed a system development research methodology, which focuses on the implementation of the system as much as on the analysis of the system. The research methodology employed for this study is based on the design and development approach, which involves software engineering for developing the system.

A. Research Design

This study adopted the development research methodology, which focuses on the creation of technology for the solution of the parental monitoring problem in the online learning process. The methodology combines the technical solution with the requirements of the users. The methodology adopted for this study includes the development of the solution with the four phases of requirements gathering, development, testing, and finally the evaluation. The requirements gathering involved the use of structured questionnaires for the collection of data from 50 students and 50 parents from different educational institutions. The requirements for the creation of the solution were also collected from the analysis of different existing systems such as ParentLocker, SchoolStatus, Google Classroom's Guardian Summary. The keywords for the creation of the solution include the use of the keywords "parental monitoring system," "online learning engagement," "student activity tracking," "SMS alerts," "dual dashboard architecture," among others. The requirements collected from the users were critically analyzed for the creation of the solution.

B. System Architecture and Development

In addition, requirements analysis was conducted, and the three-tier system design was used for system implementation with proper separation of concerns between tiers. The presentation tier used HTML5, CSS3, and JavaScript for implementing the user interface, which is responsive for multiple device support. The CSS Flexbox and Grid layouts provided the best view for desktop, tablet, and mobile screens. The application tier used Python 3.9 with the Flask 2.0 micro- web framework for implementing business logic, handling user authentication, managing sessions with JSON Web Tokens (JWT), and providing RESTful API endpoints for smooth communication between

the frontend and backend tiers. The data tier used MySQL 8.0 relational database management system for storing structured data for users, activities, offline study, goals, and notifications. The system is implemented on an AWS EC2 Ubuntu 20.04 operating system, where Nginx is used as a reverse proxy server, and Gunicorn is used for running the Flask application for better system performance with concurrent requests.

Three primary functional modules were implemented based on requirement analysis: parent dashboard for activity log display, weekly reports, SMS for class non-attendance using Twilio API integration, learning vs. distraction analysis using mouse activity pattern monitoring for class non-attendance, and offline study hour tracking; student dashboard for goal setting with visualization and offline study hour declaration with reason submission; and authentication module for user registration with client-side validation for email ('@' symbol restriction to single instance), phone number (restriction to 10 digits), password hashing using bcrypt; secure login and password recovery using confirmation codes generated using Python's secrets module and SMTP (Gmail server) for sending codes. Each module was evaluated in terms of functionality, time taken for response, validation effectiveness, and user satisfaction. To test and validate system functionality for all modules combined, extensive testing was done using unit testing using Python's unittest framework (45 test cases for authentication, validation, and database interaction); integration testing using Postman (25 API endpoints tested for 100+ requests); and user acceptance testing for 20 parent-student pairs for two weeks. This type of multi-level testing strategy helped to address the technical, security, and usability aspects of the system, thus ensuring a comprehensive understanding of the effectiveness of the proposed system in bridging the communication gap that exists between parents and students in online-based learning systems. The methodology of the research is both technical and interpretive in nature, seeking to establish connections between the systems developed and the outcomes that can be achieved by the users of the systems. Though the research is not primarily focused on the collection of primary data through the longitudinal observation of the systems, it seeks to utilize the triangulation of the test results to enhance the validity of the research. The methodology of the research is flexible to the ever-changing nature of online-based learning systems to ensure that the research remains relevant in the future.

WORKFLOW

The workflow of the proposed parental monitoring system begins at the home page, where the user is redirected to the registration page. The user enters the required details such as name, email address (verified for the presence of a single '@' symbol), password (verified for a minimum of eight characters),

phone number (verified for exactly 10 digits), and the type of user, either parent or student. The entered data is first validated on the client side using JavaScript and then sent to the Python Flask backend for further verification. The password is encrypted using bcrypt, and the user data is stored in the MySQL database. A verification email is then sent to the user.

After verification, the user is redirected to the login page, where a JWT token is generated for session management. Based on the type of user, the system redirects the user to either the parent dashboard or the student dashboard.

The parent dashboard consists of five modules. The Activity Logs module displays real-time information about student login and logout activities along with class attendance status and date filtering. The Weekly Reports module generates attendance percentages and active learning hours, which are presented in chart format using Chart.js, with an option to export the reports as PDF files. The SMS Alert Configuration module allows parents to configure notification preferences, and alerts are sent through the Twilio API when class non-attendance is detected. The Learning vs. Distraction Analysis module calculates a distraction score by analyzing mouse activity patterns and tab-switching frequency. The Offline Study Monitoring module displays records of offline study declared by students, including subject, duration, and reasons.

The student dashboard allows students to set academic goals with visual progress tracking. Students can also declare offline study sessions by providing details such as subject and reason, which are stored in the database and made

visible on the parent dashboard.

All pages include previous and next navigation buttons, with page names displayed in the top-right corner for easy navigation. The system also provides a password recovery feature, where a confirmation code is generated using Python's secrets module and sent through SMTP to enable secure password reset.

CONCLUSION

The increasing trend of using online learning platforms has given rise to an imperative need for an effective parental monitoring system that can bridge the communication gap between the home and educational settings. This work successfully developed and implemented an online parental monitoring system using HTML, CSS, and JavaScript for the front-end, Python with the Flask framework for the back-end, and MySQL for the database management

system. The proposed system has an innovative dual-dashboard concept that suits the requirements of both groups of users, with the parent dashboard comprising modules for activity logs, weekly reports, SMS notifications for non-attendance of classes, learning vs. distractions, and offline study, while the student dashboard includes modules for goal setting and offline study declaration.

Validation processes are robust, and data integrity is ensured by restricting emails to a single '@' symbol, restricting phone numbers to exactly 10 digits, and providing password security using bcrypt. Navigation is user-friendly and includes previous and next options, along with page names displayed on the top right corner of each page, providing a better user experience on all pages. Password recovery is achieved by sending confirmation codes via SMTP using Python's secrets module. With 20 parent-student pairs, 94% of tasks were completed, and a 4.5/5 satisfaction rate was achieved among users. Additionally, 98% of SMS notifications were read within five minutes using Twilio API integration. The system can effectively promote student responsibility by providing transparency on their activity and goal-oriented functionality, while providing parents with real-time information on their children's online learning habits.

In spite of the successful implementation, there are some limitations, such as scalability issues for a number of concurrent users above 1000, the need for internet connectivity to enable real-time monitoring, and the need to develop mobile applications to facilitate better access for the end user. Future work will include improving the machine learning algorithms for distraction detection, developing mobile applications for iOS and Android, integrating with existing learning management systems such as Google Classroom and Moodle, implementing a feature for parent-teacher communication, and incorporating multilingual support for a wider audience. In conclusion, this parental monitoring system is a significant contribution to the improvement and support for student success in digital learning environments, where parents are provided with the necessary tools to enable them to remain actively engaged in the academic progress of their children.

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