

# Sci-learn: An Interactive Science Learning Web Application Using React and MongoDB

T.Prasath

Student, Department of Computer Application, Vels Institute of Science, Technology and Advanced Studies(VISTAS)

Dr. S.Prasanna

Professor, Department of Computer Application, Vels Institute of Science, Technology and Advanced Studies(VISTAS)

## ABSTRACT

The current environment of education is being impacted by technology at an accelerated rate. Many aspects of how students receive information and learn, therefore, are being modified. With the emergence of online-based learning platforms, students can access content much easier and take courses in a more flexible way; therefore, these platforms have become a huge resource for students. Textbooks do not provide the same level of engagement or level of retention (i.e., true understanding) as other types of media do; therefore, there is a need for a quality digital solution that can enhance the overall experience of learning. The primary goal of this project is to develop a web-based application that enables students to learn science (i.e., Physics, Chemistry, and Biology) more effectively with online references and tools; thus, creating a more efficient way for students to gather the necessary information when they need it, and to learn through superior educational materials that have a more logical organization of content than most print-based materials do. The goal is to provide students with curriculum content that is both readily available at all times and also conducive to self-paced learning while being educational in nature.

**Keywords** — React.js, Node.js, MongoDB, Science Learning, MERN Stack, Web Application, Online Education, Quiz System.

## I. INTRODUCTION

Technology has become more prevalent in education, significantly altering the learning and knowledge-sharing processes of students in today's digital age. Textbooks and classroom teaching are still relevant, but they often lack the flexibility and interactivity required for traditional learning. Many students struggle to grasp the complexities of science, often only by using theoretical explanations. This results in a requirement for modern learning solutions that are more engaging, accessible, and user-friendly. The Science Learning Web Application is designed to solve these problems by providing a simple and effective means for students to learn science concepts. Its main focus is to develop an easy-to-use web application that helps students understand subjects such as Physics, Chemistry, and Biology in a clear and engaging way. The system's objective is to provide a structured learning experience, making it easier for students to understand and recall different topics. The app facilitates flexibility by providing study materials at any location, facilitating self-directed learning. It is possible for students to select a subject that interests them and explore various topics related to that subject. The use of a clear and concise explanation for each topic promotes better learning. This method makes learning easier than traditional methods. The system includes a user authentication feature as one of its primary characteristics. It has a password protected system for users to register, sign in and access the site securely. Users can be managed and their data protected with the help of this feature. The app's access is restricted to authorized users only.

## II. EXISTING SYSTEM

The current system mainly uses textbooks, classroom instruction, and handwritten notes as the primary means of learning. While these methods are effective, they may not always result in an interactive learning experience. Students in Physics, Chemistry, and Biology frequently require extra assistance to comprehend science concepts in a clear manner. Several science subjects are too intricate for students to grasp simply by looking at theoretical examples. The teacher cannot repeatedly teach the same subject to all students in a classroom setting. Furthermore, it is not always possible to have all the learning materials in one place, making it hard for students to revise at any given time. Students are limited to specific times and locations for accessing learning through the current system.

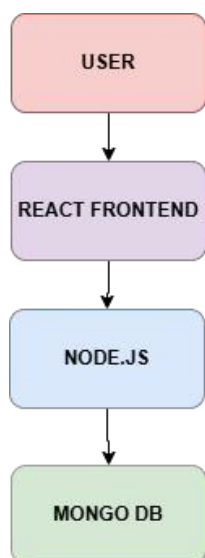
## III. PROPOSED SYSTEM

The proposed system aims to create a Science Learning Web Application that makes it easy for students to learn science concepts through an interactive approach. The app offers learning material in Physics, Chemistry, and Biology. The platform enables students to learn topics through a web browser at any time.

## IV. FEASIBILITY STUDY

The effectiveness of the proposed system is evaluated through feasibility studies. The project's feasibility, cost, and operational efficiency are all crucial factors to consider.

## V. SYSTEM ARCHITECTURE



This application utilizes the client-server architecture. The frontend of the application utilizes React.js, which provides both the user interface as well page rendering functionality. The backend of the application is built with both Node.js and Express.js, providing management of the API requests and business logic. User information as well quiz data is stored in MongoDB. Data flows between frontend and backend by means of REST APIs utilizing Axios.

## VI. TECHNOLOGIES USED

Technology	Purpose
React.js	Frontend Development
Node.js	Backend Runtime
Express.js	Server Framework
MongoDB	Database
Axios	API Communication
HTML/CSS	UI Design

## VII. IMPLEMENTATION

The science Web application is designed with up-to-date standards for the World Wide Web. The application is utilising a client-server architecture, where the client side of the application is the user interface and the server side of the application is the area of data handling/storage. The User Interface is implemented in React.js, allowing users to have an interactive way of searching for various subjects within science & viewing their respective topics as well as taking quizzes. The design of the User Interface was intended to be simple for any user. Node.js is used to write the server to provide user authentication and perform back-end processing (all server-side operations). The server will process requests from the user interface, and return results to the user. In order to manage user information (user account creation/ log-on information), the application utilises MongoDB as the database. The server connects to the database using Mongoose. The application provides users with registration, log-on, selecting a subject, viewing topics, and taking quizzes by implementing several different component modules.

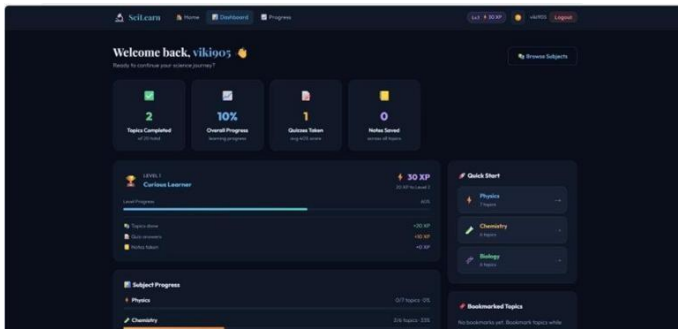
## VIII. RESULTS AND DISCUSSION

The successfully created application provides users with the ability to interactively learn about science by allowing them to choose from available science areas to view video lessons, conduct quizzes, and keep track of their progress. Users have found it easy to navigate through the various sections of the developed application as it functions properly and responds quickly. The addition of the quiz module increases user interaction and provides feedback about the user's performance in real time.

Feature	Traditional Learning	SciLearn
Accessibility	Limited	Anytime
Quiz Evaluation	Manual	Instant
Interaction	Low	High
Progress Tracking	Not Available	Available

## SCREENSHOTS

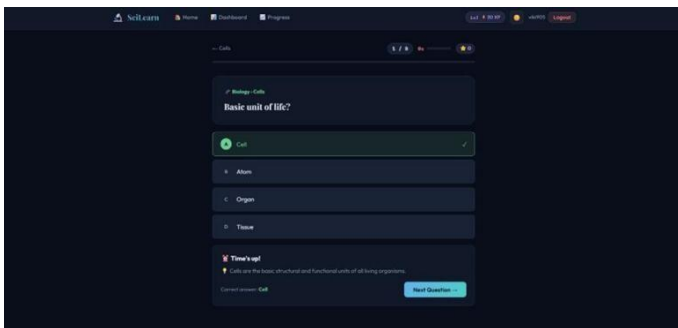
### Dashboard page:



### Explanation:

A User Dashboard Page for the Science Learning Web Application is shown below. The system's central control panel, this page, provides users with the ability to view their learning progress, access subjects, and navigate to various features of the application. This page is a vital component of the system, and users are redirected to it after successfully logging in. Users can customize their experience by presenting a welcome message with their name on the dashboard. This makes the environment more stimulating and enjoyable.

### Quiz module:



### Explanation:

This page is an important part of the learning because it provides a real time assessment system for users to test their knowledge. A variety of answer choices are available on the quiz interface, including a multiple-choice question. This example asks a question about the topic of Biology, cells. The labeling of options ensures that users can easily select their preferred option. The layout is designed to be easy to read and distract users, allowing them no more time spent on the question. This page is particularly notable for its instant feedback mechanism.

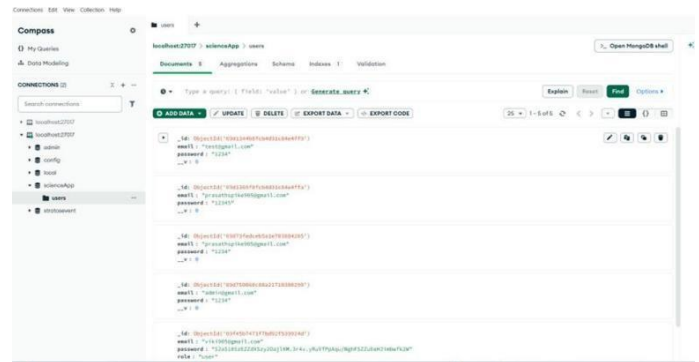
### Result Analysis Page:



### Explanation:

On the Result Page, users can see their final score after taking the quiz. By providing performance-based feedback, it enables users to assess their knowledge level. This page encourages users to enhance their learning.

### Mongo DB Collection Page:



### Explanation:

The MongoDB database view of the Science Learning Web Application, as shown in the figure above, contains the Users collection. User-related data, such as email addresses and passwords, is stored in this collection along with unique identifier. It has a significant impact on both authenticating users and maintaining their records within the system. The implementation of the database involves MongoDB, a NoSQL database that utilizes document storage for data storage instead of traditional tables. Each document in the collection is a single user and has fields such as `_id`, `email`, and `password`. MongoDB automatically generates a unique `_id` field for all user records. During the login process, the email field is used to identify users uniquely, while the password field stores the user's authentication details. The frontend server receives user

data from the application and stores it in its collection upon logging into the app

### IX. SYSTEM TESTING

The process of ensuring that the application is functional and user-friendly involves system testing, which is an essential component of software development. Its primary role is to identify flaws, verify functionality, and enhance system reliability. Several testing methods are used in the Science Learning Web Application to test various modules, including user authentication, subject selection, topic presentation, and quiz functionality. The purpose of testing is to verify that the system operates with correct performance and produces accurate outcomes under various conditions.

#### Test Cases:

Test ID	Module	Input	Expected Output	Status
TC01	Registration	Valid User Data	Account Created	Pass
TC02	Login	Correct Credentials	Login Success	Pass
TC03	Login	Wrong Password	Error Message	Pass
TC04	Subject Module	Select Subject	Topics Displayed	Pass
TC05	Quiz Module	Correct Answer Submit	Score Updated Result	Pass
TC06	Module	Quiz	Generated	Pass

### X. PERFORMANCE ANALYSIS

The Science Learning Web Application's performance was checked by looking at how fast it responds, how users interact with it, and how well it works. The app had easy navigation and worked well with the connection between the front and back parts of the system. Using React.js made the front part faster to show pages, and Node.js along with Express.js managed the back part smoothly. MongoDB offers efficient storage and retrieval of

data for user authentication and quiz evaluation. The system performed well under normal usage and maintained consistent performance during testing. The incorporation of contemporary web technologies guaranteed dependability and expandability. The incorporation of modern web technologies ensured reliability and scalability.

### XI. CONCLUSION

A modern solution for science education that enhances students' learning has been developed through the development of The Science Learning Web Application. The rapid growth of the digital era has made it crucial for web-based platforms to offer accessible and flexible learning opportunities. The aim of this endeavor is to make use of cutting-edge technologies to create an interactive platform that facilitates the comprehension of intricate scientific concepts. With the aim of creating a user-friendly and effective learning experience, the system offers students specialized study materials for subjects like Physics, Chemistry, and Biology. Instead of being constrained by time and location, this application enables students to learn from any location they desire. Learning is made easier by this flexibility, which enables students to study at their own pace. Several key functions of the application, such as user registration and login, ensure secure system entry. Only authorized users can access the application due to the use of this authentication mechanism, which also ensures privacy protection for user data. A structured dashboard is created for users to explore topics and subjects after logging in. By being arranged, clarity and comprehension are enhanced. The system's quiz module is a vital component of the learning process.

### XII. ADVANTAGES OF THE SYSTEM

- Interactive learning environment
- User-friendly interface
- Instant quiz evaluation
- Progress tracking
- Multimedia learning support
- Accessible anytime and anywhere
- Scalable architecture

The created app offers a smooth and easy-to-use way for students to learn. The combination of quizzes, progress tracking, and interactive user interface helps improve user engagement and makes learning more effective.

### **XIII. FUTURE ENHANCEMENT**

Although the present system provides essential tools for understanding scientific topics, there are always potential improvements. The system's future advancements may enhance its functionality, make it more engaging, and offer benefits for a greater diversity of users. Detailed video tutorials covering all subjects is one of the significant improvements that can be made. Visual comprehension is crucial for comprehending complex concepts, particularly in the field of science. Quality video can be incorporated to greatly enrich learning and make the system more stimulating. Moreover, it may involve the use of an advanced chat-bot system that can aid students in quickly resolving their uncertainties. The application's interactive nature can be enhanced by implementing this feature, which can also offer real-time support to users. The chat-bot can be created to provide solutions to commonly asked questions and offer guidance on various topics. The system can be upgraded to include more subjects and advanced learning modules. Currently, the application is limited to basic science subjects, but it can be expanded to include other subjects and specialization in the future. By doing this, the application will be more useful for a wider range of students.

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