STAX Business Intelligence System
(https://starapp32.herokuapp.com/)

GROUP- 32

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Design and Implementation of STAX Analytical Platform

Introduction

STAX Business Intelligence System (SBIS) is a key tool for the STAX, a leading Online Education Provider to support and enhance their educational businesses while improving the efficiency of learning and teaching processes combined. The Data Warehouse (DW) system helps to monitor the data from different Database (DB) and combines all together under one schema by using OLAP which in turn helps the Analytics board to make the right decision depending on the circumstances faced. Educational Administration Analytics Platform combines the critical information regarding the Students, Instructors, Courses with time into one Data Warehouse. The output of SBIS mainly consists of the analytical reports which are used to get insights and make business decisions efficiently to meet the Key Performance Indices (KPI's). The proposed Data Warehouse system is implemented based on the simulated databases with data created using Mockaroo for the last 6 years.

Purpose

The e-learning industry is on a stable rise in the past decade, data showing an annual growth of nearly 10-12% and generating more than $60 billion in revenue every year. It is no surprise that students and instructors are preferring to use online platforms as it equips the relevant parties to gain knowledge, earn money and save time in travelling physically to the institute's while being comfortable at home. However, the recent study has shown that a significant population are dissatisfied with the services being provided by the e-learning education institutes in various aspects such as courses provided, instructors & students changing interests and demands.

This application is analysing the STAX's data using STAX Business Intelligence System as an analytical tool by summarizing and visualizing information from the StarApp database created on Heroku PostgreSQL and enabling the output view in the form of tabular and graphical representation in various ways. The tool also serves as a Actionable Intelligence Dashboard as it allows the business and decision makers to modify the courses using the user interface.

This meaningful outcome is the unified, consolidated perspective extracted from the data which is being put into utilization in respective business processes enabling faster and informed decision making. This is the best approach for the analytics to perform the data analysis and suggest the actionable decision to STAX Stakeholders.

SBIS Technical Specifications

The application takes the information of students, instructors and courses as an input from STAX and dumps it into STAX data lake.

In the above application, following the **Star Schema** Design, Course registration is a fact table having attributes which references to the dimension tables Student, Instructor, Date and Course. The model resembles to the star shape having a fact table at its center and the dimension tables at its peripheral representing the star's points as shown in Fig.1.

Windows Functions and **SQL** queries to were used to dynamically generated the data displayed in the charts.

Technology Stack :

- *PostgreSQL*
- *Flask*
- *Python*
- *SQLAlchemy*
- *HTML*
- *JavaScript*
- *Bootstrap 5*
- *ChartJS*
- *Heroku*

Database Table details are as below.

Student Dimension Table

Student ID	Student Unique ID
First Name	First name of the student
Last Name	Last name of the student
Email	Email of the student (unique)
Gender	Student's gender
Type	Student/Professional
Address/Country/Postal Code	Address of the Student

Instructor Dimension Table

Instructor ID	Instructor's Unique ID
First Name	First name of the instructor
Last Name	Last name of the instructor
Email	Email of the Instructor (unique)
Gender	Instructor's gender
Experience	Instructor's Experience
Address/Country/Postal Code	Address of the Instructor

Course Dimension Table

Course ID	Course Unique ID
Course Name	First name of the student
Learning hours	Total Learning Hours of Course
Subject	Course Subject
Category	Course Category
Course Type	Course Type (Free/Paid)
Price	Price to sign up for Course
Rating	Course Rating

Date Dimension Table

datekey	Unique Id	
date timestamp	Date Time Stamp	
fulldate	Full Data	
dayofmonth	Day of the Month	
dayname	Name of the Day	
more ….		

Course Registration Fact Table

Course ID (FK)	Course Unique ID
Instructor ID (FK)	Instructor Unique ID
Date Key (FK)	Date Unique Key
Student ID (FK)	Student Unique ID
Registration ID(PK)	Unique Registration ID
Price	Price for each course if it is paid else 0
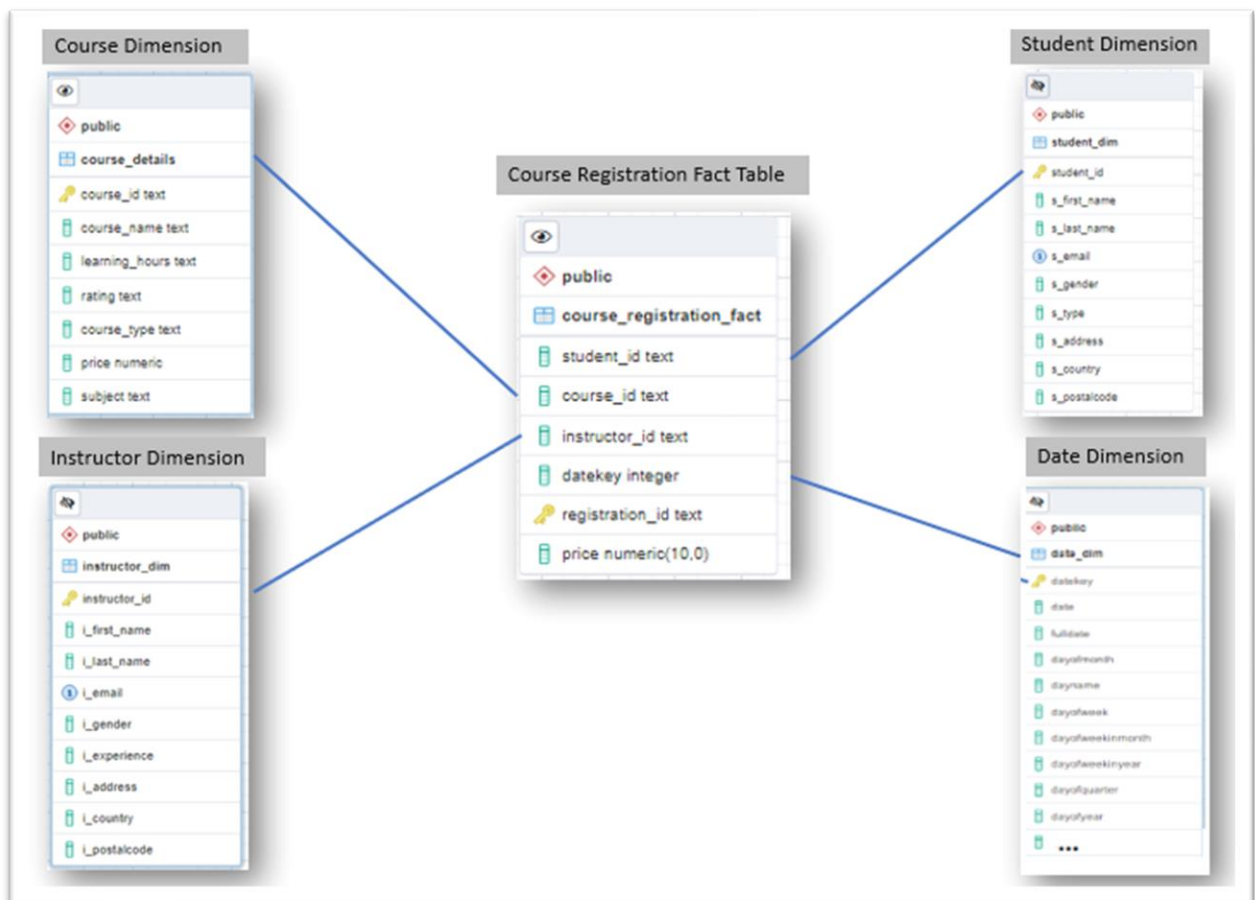
Fig.1 Star Schema

Business Capabilities

The current STAX Analytical platform enables the analytical board professional to perform their responsibilities with ease access through our application once they login with their credentials.

- **Data Visualization**

The Application displays the Student, Instructor and Course details and provides the visuals in the form data represented as Trends and Pie Charts. The application also supports the end user to gain data insights based the instructor's performance and number of registrations for their courses.

- **Actionable Intelligence**

Analysing the data and making appropriate decisions by updating the courses based on the demand and market trends, helps to improve business performance.

Design and Implementation

1. **Design and implement database schema**
   Data tables for Students, Instructors, and Courses were generated from the Mockaroo website where Student ID, Instructor ID and Course ID are used as primary key for their respective tables. These respective primary keys are used as foreign keys in Fact Table.

2. **Design and implement Data Warehouse**
   The data extracted from Mockaroo was executed in the PostgreSQL using pgAdmin4 where separate tables were created and interlinked with the fact table using the primary and foreign keys following the **Star Schema** Data Warehouse Design.

3. **Design and implement Report Dashboard**
   From the Reporting Console we organized visual representation of data by combining different fields and generating charts within a single interface.

Results

There are multiple pages for the user to interact with to analyse the data which help them in taking appropriate decision for business purposes.

Navigation Interface

    a. Courses
    b. Add Courses
    c. Enrolled Courses
    d. Dashboard
        i. Course
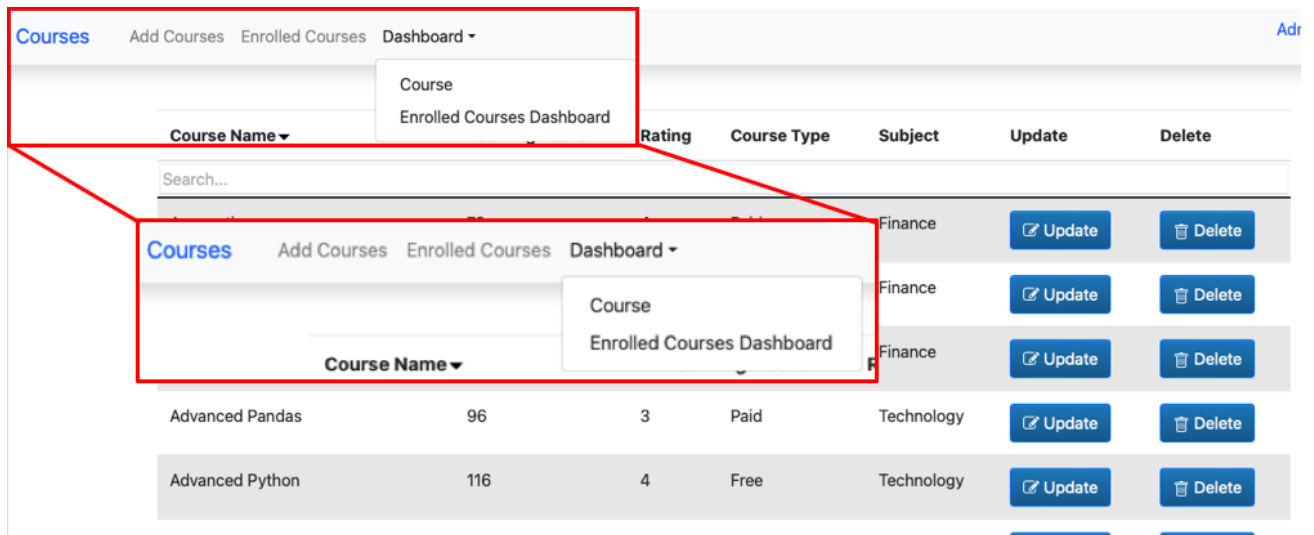   ii. Enrolled Courses Dashboard

Fig.2 Application Home Page

Courses

Under the Courses tab the application allows the decision maker to view the courses that are currently offered by their e-learning institute, and it includes the details such as Course Name, Learning Hours, Rating, Course Type, Subject sections. Results are displayed in a data table format. The search filter flexibility is also been implemented to the application making it user friendly.

In addition to the details, this field also allows the decision maker to update/delete the details of the existing course by clicking on the Update/Delete buttons displayed across that course.

Fig.3 Courses View Page

Add Courses

As the institute also needs to consider offering the courses that are in demand in the current market, a decision might also be taken to introduce new courses in their institutes. This Add Courses field in the application allows the decision maker to add new courses into the list of courses offered by the institute.
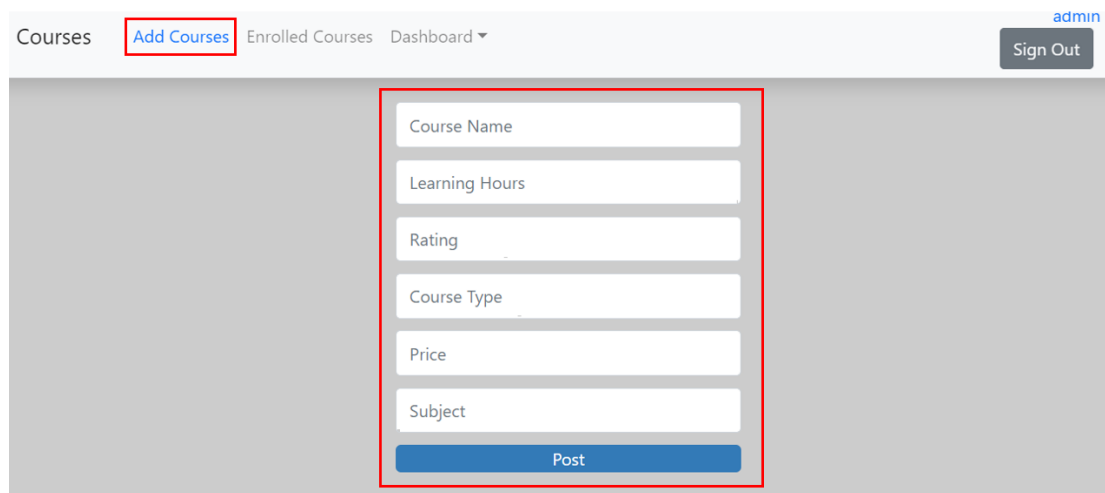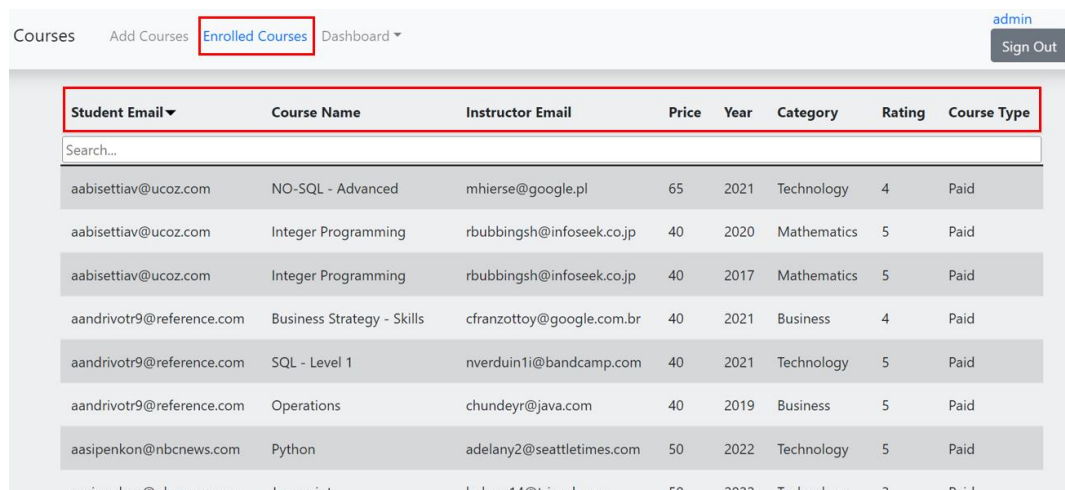

Fig.4 Add Courses Page

Enrolled Courses

This tab in the application showcases the Course, Student & Instructor details of the courses that are enrolled by students across 6 years. It includes the details such as Student Email, Course Name, Instructor Email, Price of the course, Year Enrolled by student, Course Category, Course Rating and Course Type. Results are displayed in a data table format with search capability.

Fig.5 Enrolled Courses View Page

Course Dashboard

Course Dashboard showcases the summary of the courses being offered by the institute and displays the results in form of charts.

The following 5 components displayed as result in this field

Charts:

    a. Bar Chart of number of courses in the system partition by Course Categories
    b. Bar Chart of number of courses in the system partition by Course Type

Badges:
    a. Display the number of active courses being offered
    b. Display the number of active students who are currently enrolled
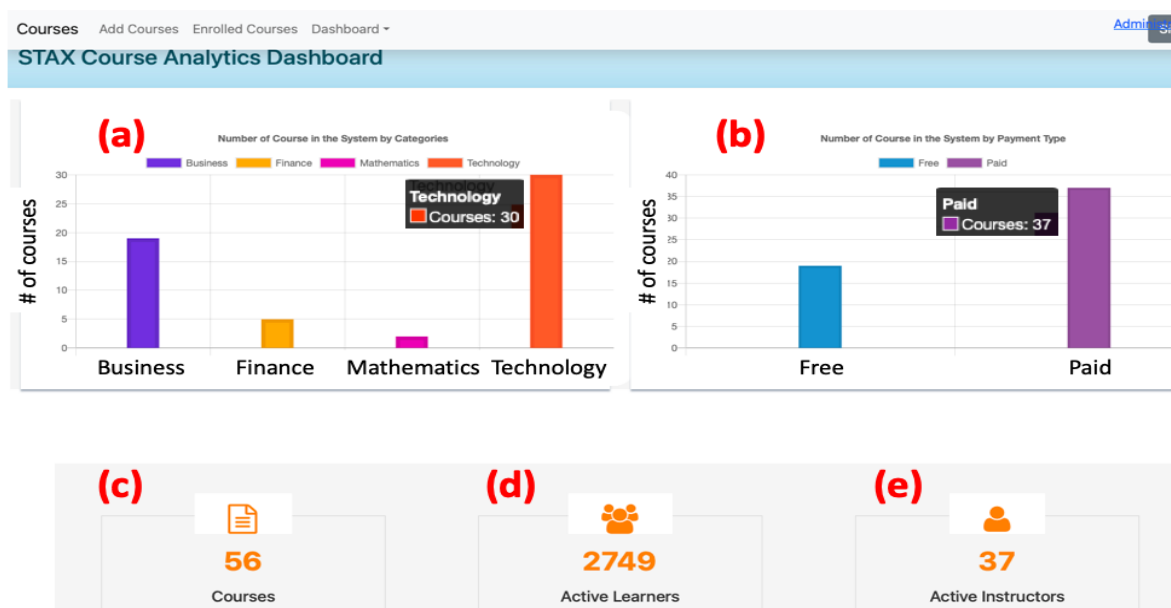   c. Display the number of active instructors in the institute

Fig.6 Course Dashboard

Enrolled Courses Dashboard

Enrolled Course Dashboard showcases the summary of the courses that are enrolled by students across multiple years.

The following 5 components displayed as result in this field

    a. Number of courses enrolled in the system by Course Categories – Business, Finance, Mathematics and Technology.
    b. Number of students by their profession "Student" of "Working Professional"
    c. Revenue generated across different course categories partitioned by year.
    d. Increase in number of enrolments every day since the beginning of the institute
    e. Top 10 courses based on the student's enrolments in the past 6 years.
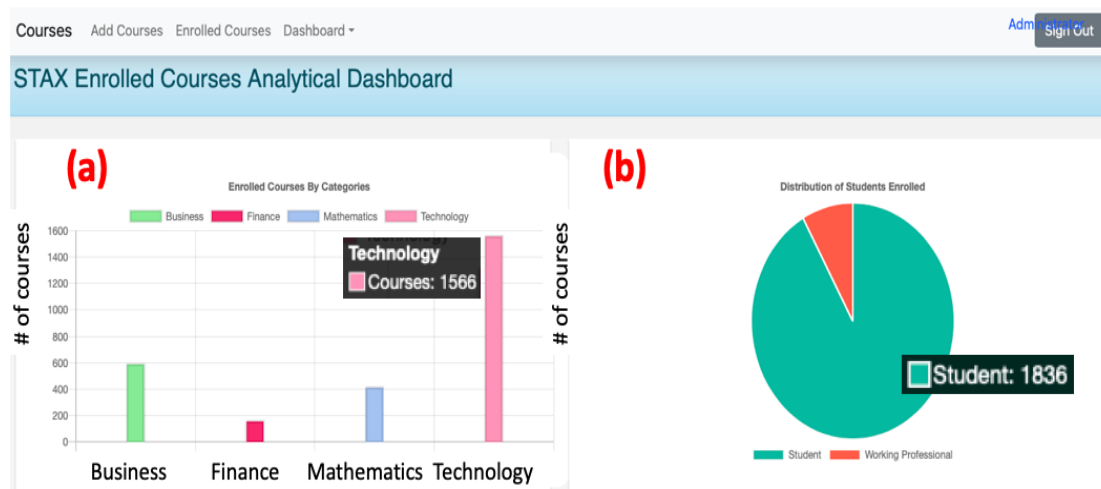   f. Leader board to showcase Top 10 Instructors based on the students enrolled in their class.
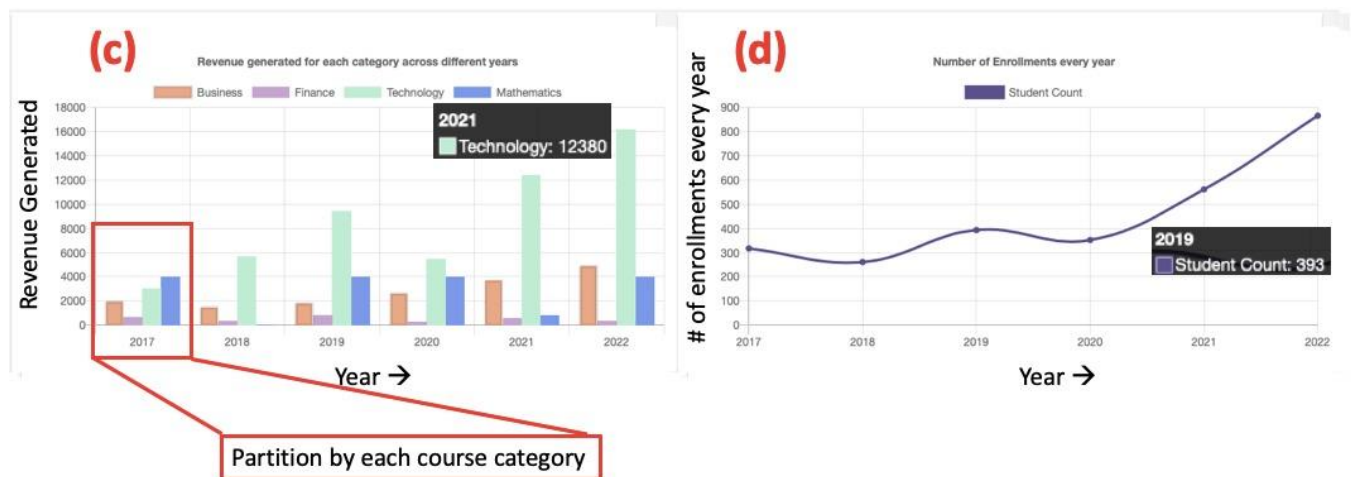
Fig.7 Enrolled Courses Dashboard (a,b)
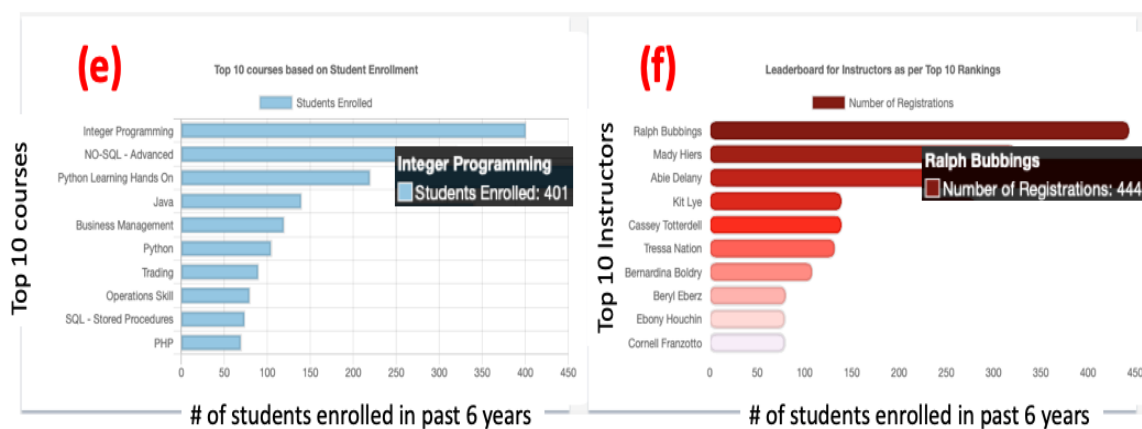

Fig.8 Enrolled Courses Dashboard (c,d)

Fig.9 Enrolled Courses Dashboard (e, f)

Insights

All the analysed results that are displayed in the respective sections in the application are crucial for the analytical board in following ways.

a. Develop revenue generation innovative ideas by targeting a particular category of course which in on demand.
b. Cost reduction possibilities by stop offering selected courses (profit maximization).
c. Strategy on course offering by analysing the patterns of student's enrolment based on past years.

Conclusion

This report describes the design and implementation of the successful Business Intelligence Platform for STAX. Star Schema design is used to build the Online Analytical Processing (OLAP) technology for analytics. With the usage of ChartJS, dynamic SQL Query and Window functions, data is displayed and reported in the form of graphs which would be used by the analytics team to view and make appropriate and informed business decision. The proposed designed approach might be implemented by any e-learning institutes or analytics team or any decision makers.

Future Works

E-learning has developed to make learning more accessible and effective for learners. These changes have also impacted teachers, students, and technology. This application could further be improved by taking other factors into consideration such as location of students & instructors, demand of a courses. Other features could include,

- Export Functionality of the tabular data details and charts.
- Data drill downs on the aggregated value on the charts.

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