RESEARCH ON APPLICATION OF APPROPRIATE DATA MANAGEMENT AND ANALYTICAL APPROACH IN LEARNING MANAGEMENT SYSTEM FOR ANALYZING AND IMPROVING STUDENTS ACADEMIC PERFORMANCE

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Abstract

This research demonstrates how data analytics can help improve learning and teaching methods in schools and colleges, hence boosting students' overall academic performance. Oracle Linux was used as a server, and Oracle was used as a database management system. Oracle database 11g is used, as the database. Tableau is used for analysis and visualization, whereas Tableau Prep Builder is used for data cleansing. The application of CRISP-DM in the development of data strategy is discussed. The benefits and problems of system configuration are highlighted by using proper tools, technology, and methodologies. The system's quality attributes, such as availability, security, backup, recovery, and automation, are discussed. Furthermore, the data analysis process is explained, from data extraction to transformation and visualization. The application of several dashboard levels is discussed in the report.

Keywords


Data-Driven
LEARNING MANAGEMENT SYSTEM
DATA ANALYTICS
ORACLE
LEARNING
Oracle 11g
Security
ANALYTICS
Recovery
Tableau
Backup
Visualization
Education
Automation
Decision-making
Visualization

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Introduction

“The equation is simple: education is the most basic insurance against poverty. Education represents an opportunity. At all ages, it empowers people with the knowledge, skills, and confidence they need to shape a better future.” - Irina Bokova (*Overview of Education Sector*, n.d.)

The education sector is rapidly expanding, and its numerous firms are hungry for fresh talent, both seasoned experts and motivated newcomers. Schools, colleges, universities, and various private institutions are part of the education industry. (*Overview of Education Sector*, n.d.). In the case of Nepal, it has made significant progress in education. The net enrollment rate in primary schools has increased to 97% (*Education*, n.d.). Education plays a major role in the economic development of both developing and developed countries. The education industry also generates a large volume of revenue and employment. The US alone generated revenue of $400 billion from higher education (*All About Education Industry: Key Segments, Trends, and Competitive Advantages in 2022 - Reviews, Features, Pricing, Comparison - PAT RESEARCH: B2B Reviews, Buying Guides & Best Practices*, n.d.). Many educational institutions have failed because of poor management and surveillance of students' behavior and performance. For that reason, many institutions have installed learning management systems so they can track their students. But there is not any statistical analysis. Learning Management System does not replace traditional classrooms but supplements classrooms with content that can be assessed from the internet. It is also not enough to enhance their learning power. Since, Learning Management System keeps track of students, performing data analysis and visualization helps us to find what students are lacking, and why their performances are low. etc, and helps in making a decision like what needs to be done next? and what happens if not done. etc.

Figure: learning analytics

"**Data are just summaries of thousands of stories–tell a few of those stories to help make the data meaningful.**" - Dan Heath, bestselling author (STEVENS, 2021).

Data has been around for a long time, and people have generally acknowledged its importance in the actual world. In contrast, data has become a success factor for many sectors including health, industry, and many more. Data has become so prevalent and publicly available that many firms and sectors are transitioning to data-driven industries in order to enhance corporate choices, customer experience, and a variety of other factors. Many large corporations like Facebook, Amazon, etc have made use of data management, analytics, and visualization to understand their customer, and their needs and grow their business. With the help of data analytics and visualization, they introduced features like personalized ads and a marketplace to help users and businesses. Hence, they made a revenue of over $10 billion in 2017 (Marr, 2016, 72). Another company Fitbit has become the undisputed market leader in linked fitness wearables. Their gadgets function as fitness trackers, letting users monitor a variety of parameters that help them live a better and more informed life. In 2014, the business sold about 11 million gadgets which is one of the biggest achievements in the industry (Marr, 2016, 189). Another popular taxi booking service app has grown to numerous major cities on all continents except Antarctica, and the company is currently valued at $41 billion. The company is deeply founded on Big Data, and exploiting this data more

effectively than traditional cab companies has played a significant role in their success (Marr, 2016, 267). Data analytics in education isn't just about collecting data that already exists and then processing it. It's also about using advanced algorithms to turn the data that already exists into more useful information. The way that LMS analyzes data helps students understand how well they are doing and where they need to improve. The data analysis shows their problems, which need to be fixed right away. Since the education industry will also benefit from data management. analysis and visualization. Different data analytics techniques such as descriptive, diagnostic, predictive, and prescriptive analytics can be done to gain better insights and make better decisions. Many educational industries have failed and fallen down due to poor decision making which directly and indirectly harms the students also. So, it is recommended to make use of data analytics in online learning management systems to track students and improve their performances. Better analytics helps to find the area for improvement.

Aim

Figure: aims

Objectives

Figure: objectives

Justification

Educational institutes, especially higher education have installed online learning management systems to track students' performance. Also, a lot of students have dropped out of college and many of them failed exams, which automatically impacts the education sector and also affects the development of a country. Even though the education industry is one of the largest industries that help in the development of a country it lacks behind in many ways. There are a high number of dropouts, an increase in the number of failures, and a decreased quality of education. It not only affects the education system but also the development of the whole country. It creates dissatisfaction among the parents of the students and students themselves. Higher education has become even more degraded. During the pandemic, schools and colleges went through an online learning system, which saved a lot of resources but the teaching and learning process could not go well. Schools had installed online learning management systems to keep tracks of students like how much they read, are they attending classes or not, their results. But those data was not utilized for good outcome.

If we made good utilization of those data, it is sure we can improve learning and teaching process further and uplift the academic institutes.

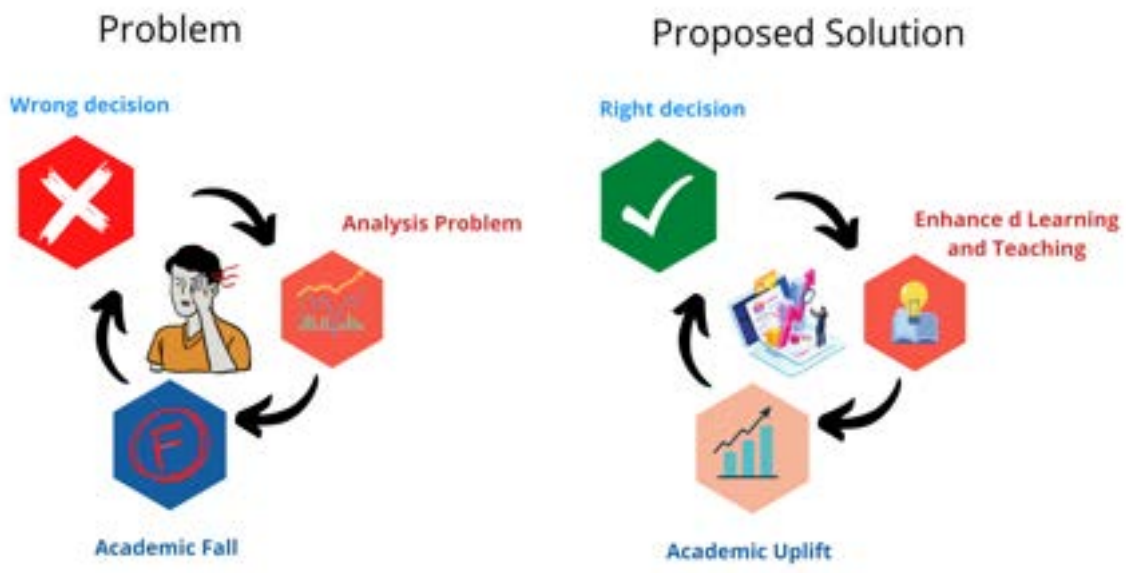

Figure: Problems

When it comes to improving online learning experiences, educators and Learning Management System solution providers must prioritize data analytics. Advanced analytics tools backed by cognitive technology help educational institutions to lower student dropout rates, and improve their academic performances by improving the learning experience overall. Furthermore, it allows them to examine their students' learning rates and evaluate their academic achievement with minimum prejudice. Above all, it helps to reduce the learning curve for students, learners, and prospective candidates for their overall development. It also helps to ascertain the future performance of students based on their past or current academic records (Bhardwaj, 2021). Analyzing and visualizing the data, helps to find out the areas where the institute is lacking. It helps to find the weak point and also help in decision-making like what should be done and what should not be done. It makes easier. Data-driven decision can be more precise than decision done recklessly. Also, providing a clear and concise analytical dashboard with gamifications features motivates the educators and learners as they can see their process like xp points in games. So they improve themselves more in order to gain more xp points and unknowningly enhance learning and teaching process. It also helps in many areas indirectly. For this a seperate dashboard for learners and educators can be made. Other than these, we have executive dashboard, decision supporting dashboard, and operational dashboard. It helps strategic department to think and improve easily. In this way, data analytics and visualization can help in improving education sector as, it has become heart of many business, health organization and much more.

Research Questions

Figure research questions

Scope

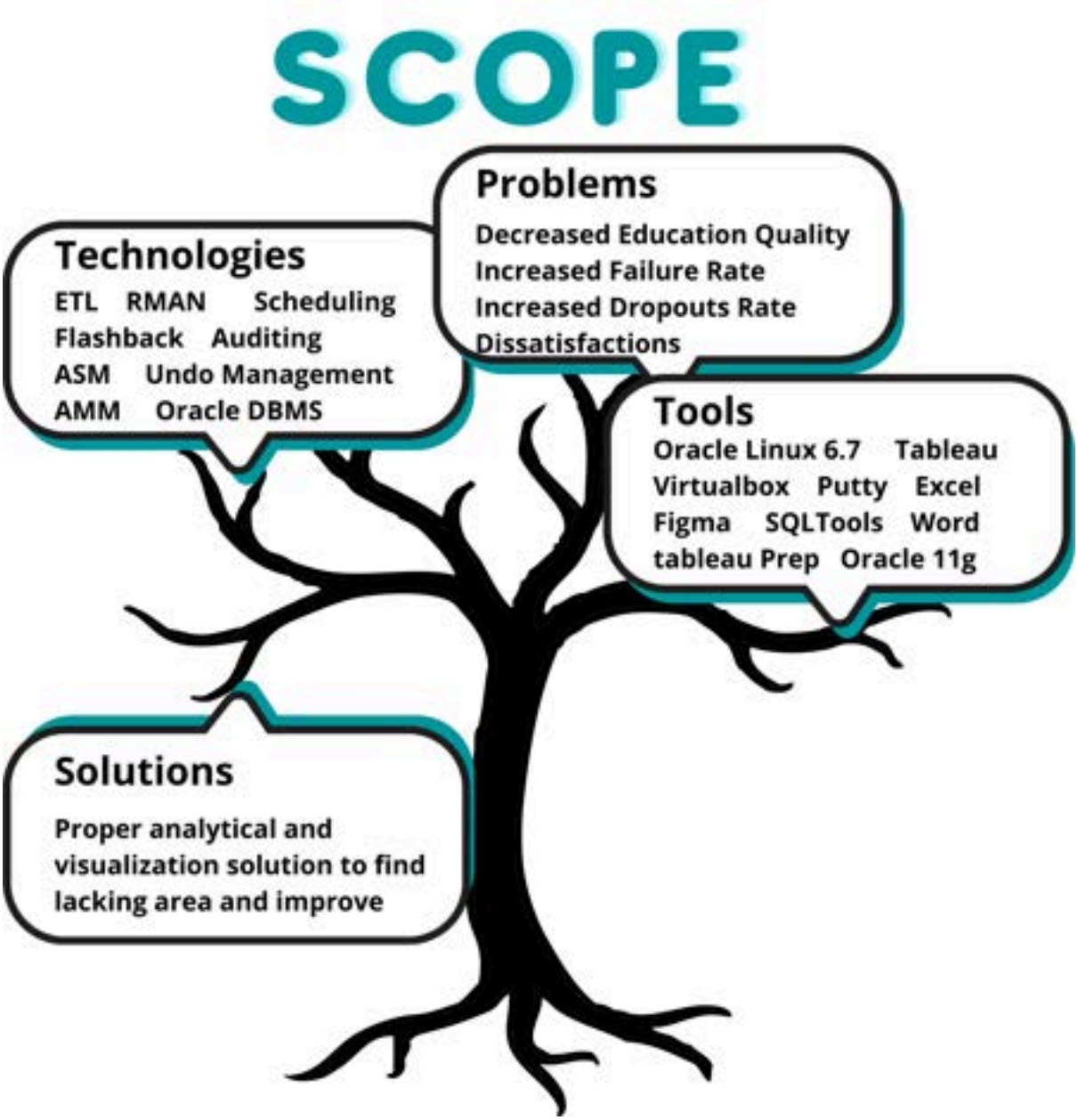

Figure: scope

Ethical Considerations

Ethical consideration is a set of ideas and beliefs that should be observed while dealing with others. The ethical principles ensure that no one acts in a destructive way to society or an individual. Ethical issues such as the validity of research, the research method used, and data confidentiality, must be considered while conducting the study (Bhasin, 2020). In order to show the good validity of the research, proper citation and references were provided in the paper. Data used in the project was kept confidential so that no one would be harmed and adequate data security was provided to safeguard the individual data. Individuals' privacy was considered according to The Privacy Act 2018. Data is protected from unauthorized persons. Only those who have privileges to access data can see otherwise they are not able to see it. As per the frontend part, the data

visualization dashboard built must be accessible, perceivable, operable, understandable, and robust. In order to achieve this, we need to create content that can be used by people with auditory, cognitive, neurological, physical, speech, or visual disabilities. When publishing the dashboard author must conform to the Web Content Accessibility Guidelines(WCAG 2.0 AA). For more accessibility, Tableau supports keyboard navigation, the programmatic context for assistive technologies using ARIA roles, and a text equivalent for charts and visualizations. It also has the ability to conform to contrast standards (Krostag, 2017). The dashboard is adaptable for the executive and operational level.

Figure: ethical Considerations

Literature review

Research Methodology

Desk-based

Desk-based research involves the use of existing data. They are collected and summarized to increase the overall effectiveness of the research. Secondary research is far less expensive than primary research as it uses existing data. It is a popular choice as not everyone can pay a large sum of money to conduct research and collect data. Since not every company or organization can afford to spend big quantities of money to do research and gather data, desk research is a common option. That's why you could hear it referred to as "documentary research" as well (*Desk Research: What It Is, Tips & Examples*, n.d.).

Figure: dissertation writing process

Before planning the system and choosing the research topic, proper desk research was done to make sure the research would be successful. Desk research was used to write the literature review for this dissertation project, which is mostly based on secondary research. This research helped review a lot of previous research on the topic and gain a better understanding of the subject matter so that theories, ideas, and concepts could be used in the research to meet the project's goal. Also, the results of the research tend to be more reliable and trustworthy because they are based on proper research from different sources about the research topic.

Facebook: How is Big Data used to understand customers?

As the most visited webpage and the world's biggest social network in the world Facebook stores and processes a huge volume of data. Businesses must offer items and services in order to thrive. To do so, they must first locate clients to sell to. Traditionally, this has been accomplished through "broadcast" advertising: newspaper, TV, radio, and display advertising work on the premise that if you place your ad in the most prominent location you can afford, a large number of people will see it, and some of them are likely to be interested in what you're offering. However, this is clearly a hit-or-miss strategy. For a huge multinational corporation, it may be obvious that a TV commercial will improve its visibility and expose its brand to new clients. A small firm that is just getting

started, on the other hand, must think far more carefully about how to spend its limited marketing budget. These businesses can't afford to cover all of their bases, so technologies that assist them to figure out who their consumers are and where to locate them may be really useful.

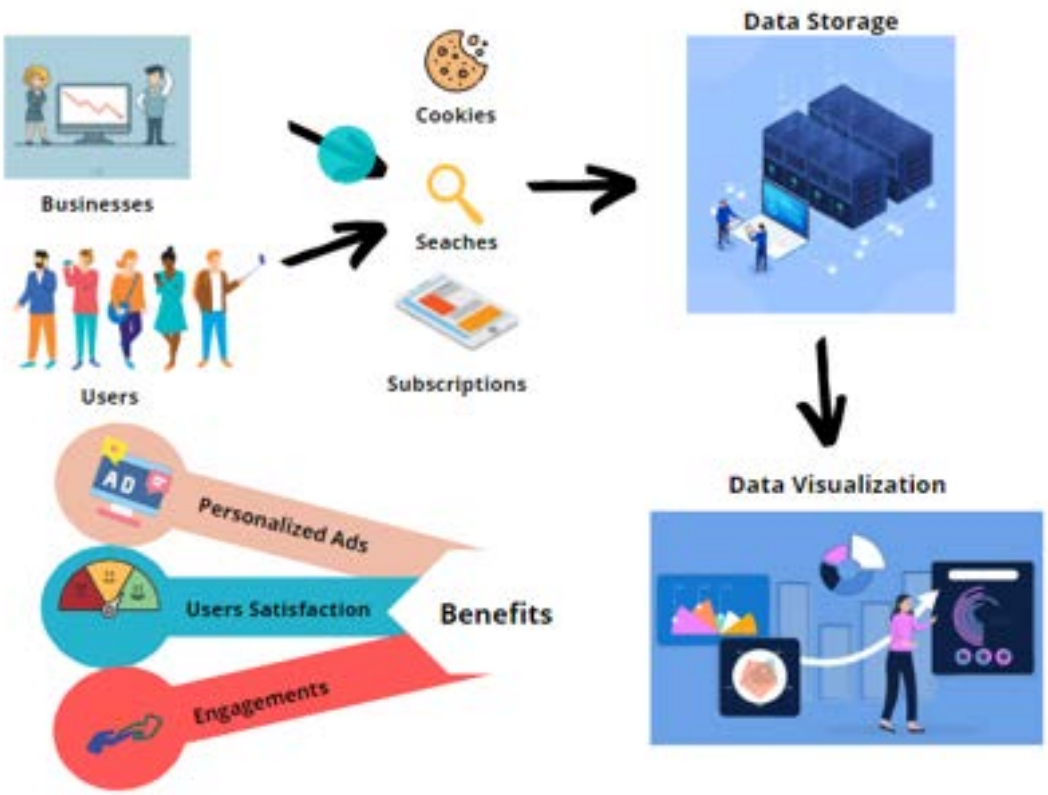

Figure: Facebook and big data

With 1.5 billion active users per month, Facebook can access more user information than anybody else combined. Unlike services like Google, which can track our Web page visits (which Facebook can now also do) and infer much about us from our browsing habits, Facebook often has full access to straight-up demographic data about us, including where we live, work, play, how many friends we have, what we do in our spare time, what movies, books, and musicians we like. For example, a book publisher may pay for Facebook to target a million individuals who have shown interest in reading novels like theirs. By compiling information on a user's Facebook activity, businesses may better target ads to those who are most likely to be interested in those items. Facebook has, without a doubt, amassed, and is continually adding to, one of the largest and most detailed databases of personal information ever compiled (Marr, 2016, 70). In addition to serving as a medium for communication, Facebook may also be used to run applications. The vast APIs (application program interfaces) that Facebook provides have encouraged the development of over 500,000 applications, the vast majority of which make use of the access they have to user data. Developers of these applications

may then utilize the information they collect about their users to display advertisements that are more relevant to them. In addition to organic growth, Facebook uses acquisitions to grow by incorporating new services and their user bases into its own. Recently, the firm has bought Instagram and WhatsApp, giving them access to even more information about our photo- and chat-sharing habits. Even more fascinating is the company's acquisition of Oculus, a developer of virtual reality headsets. Some observers have taken this as evidence that Facebook is serious about creating services that will allow us to communicate with one another in virtual reality rather than just on flat displays. In the near future, it will be highly useful to track our actions in these cutting-edge, fully immersive virtual environments (Marr, 2016, 71).

As a result, ad sales accounted for $5.3 billion in income for Facebook in 2014, and the company took 24% percent of the US online display advertisements market thanks to its strategy of utilizing its vast trove of consumer data to sell advertising space. In 2017, this is expected to amount to 27% of the market and more than $10 billion. Also, not only does Facebook earns profit but also is helping in uplifting its customers and businesses (Marr, 2016, 72).

Fitbit: Big Data in Personal Fitness Arena

Fitbit has been successful because of the belief that informed customers would choose options that will improve their health and well-being. By making it easier to keep tabs on and improve upon one's dietary and exercise routines, Fitbit's devices work as a powerful catalyst for positive lifestyle changes. Employers, healthcare professionals, and insurance companies are just some of the groups that may benefit from the wealth of data being gathered from Fitbit users' attempts to improve their health. (Marr, 2016, 189).

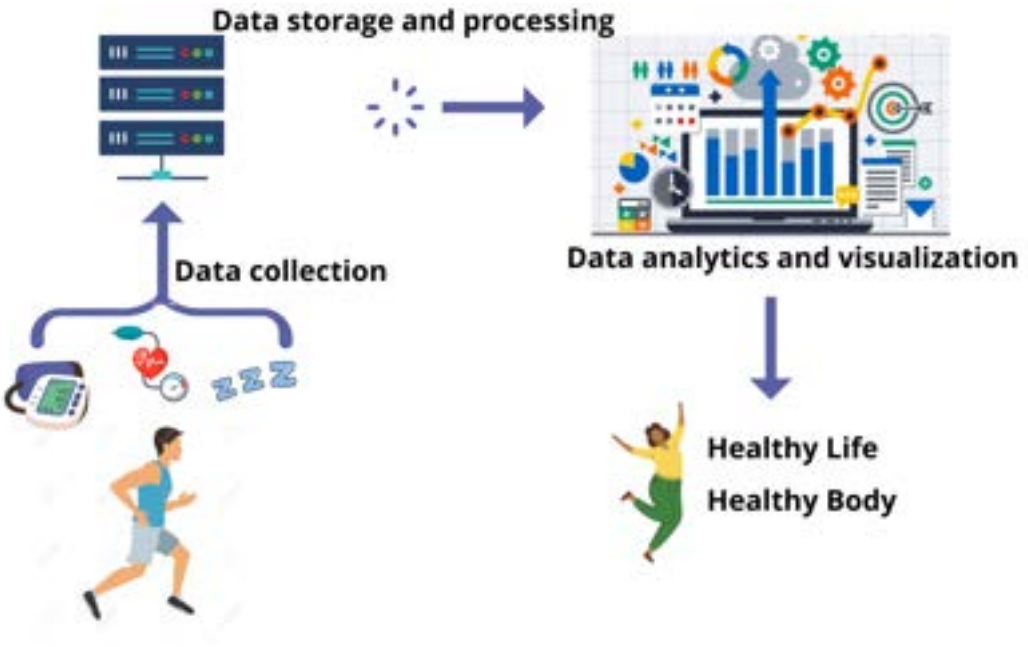

Figure: data analytics in health

The user's activity, exercise, calorie consumption, and sleep are all tracked by Fitbit. Users have access to information about their routines that is updated in real-time, and the statistics are synchronized (wirelessly and automatically) from the device to the user's computer or smartphone. Users are able to track their progress with useful charts and graphs and keep themselves motivated with the help of a dashboard. Aria, Fitbit's Wi-Fi smart scale, keeps track of a person's weight, body mass index (BMI), lean mass, and body fat percentage. The scale can remember up to eight different users, so everyone in the family can use it. Their results will be kept separate and private. The stats are synced with the user's home Wi-Fi network and can also be synced with Fitbit's wearable devices. Again, an online dashboard helps the user set goals and keep track of their progress. This kind of health information is clearly very useful and informative for many people, not just the user themselves. For business purposes, Fitbit compiles information on users' exercise and health habits and then shares that information with carefully selected business associates. With the user's consent, private information can be divulged as well. By allowing users to upload and share data from their fitness tracker with health professionals, Microsoft's HealthVault service, for example, may provide physicians with a more comprehensive understanding of a patient's health and lifestyle than is possible through traditional means such as consultations and physical examinations alone. The recent announcement by insurance company John Hancock that they will offer a discount to policyholders who wear a Fitbit device expands the implications even further. A policyholder can trade their Fitbit data for incentives based on their level of physical activity and nutritional intake. This trend suggests that more people are "trading" their personal information for a better product or service or monetary reward, which is great so long as the transaction is transparent and the individual knows what information is being shared and why. Employers like BP

America are buying Fitbit trackers and the accompanying software so that they can monitor their workers' health and activity levels with their permission (Marr, 2016, 190). Speaking to Forbes, Fitbit CEO James Park said selling Fitbit devices to employers was becoming one of the fastest-growing parts of their business, so we can expect to see more and more companies monitoring the day-to-day fitness of their staff (*Home*, n.d.).

Because of this, Fitbit has become the market leader in fitness wearables since it was founded in 2007. By March 2015, they had sold almost 21 million devices. The company's growth is impressive; in 2014 alone, they sold 11 million devices, up from 4.5 million in 2013 and it's clear that people who wear Fitbits use their analytical monitoring services a lot. Fitbit has sold 21 million devices, but 19 million people have signed up for their platform (*Home*, n.d.). This shows that Fitbit is more than just the latest fitness craze; it's a useful tool that helps millions of people learn more and stay healthy. Fitbit's move into the employer market shows that they understand the power of health data beyond the individual user, and it's likely that the employer market will continue to grow at a phenomenal rate for them (Marr, 2016, 191).

Uber: How Big Data is at the Centre of Transportation?

Since its formation, Uber has been hugely popular and has been expanded to many major cities on every continent. The business is based on "Big Data," and the fact that they can use this data more effectively than other taxi companies has been a big part of their success. Uber's whole business model is based on the Big Data concept of crowdsourcing: anyone with a car who is willing to help someone get where they want to go can offer to do so. This gives people who live in places with few public transportation options more options and helps reduce the number of cars on our busy streets by sharing trips (Marr, 2016, 267).

Figure: uber data analytics process

Uber records and analyzes data from every ride that customers take in order to forecast demand, allocate resources, and establish prices. In addition to providing coverage in underserved areas and connecting with buses and trains, the company conducts in-depth analyses of public transportation networks in the cities they serve (Marr, 2016, 268). Uber wants to collect as much data as possible, and with cheap storage options like Hadoop and Spark, it has information about every GPS point of every Uber trip. Uber keeps the information about its system from the past. With a huge database of drivers, as soon as a user asks for a car, the company's algorithms match the user with the best driver within 15 seconds. Uber stores and analyzes information about every trip its users take. This information is used to predict how many cars will be needed, set prices, and make sure there are enough resources. Uber's data science team also does in-depth analyses of how public transportation works in different cities. This helps them focus on cities with bad transportation and make the best use of the data to improve customer service (Guide, 2022). The company has created algorithms that monitor traffic conditions and journey times in real time, which means that rates may be changed when demand for rides fluctuates and traffic circumstances vary. Journeys are expected to take longer due to conditions. This promotes more drivers to get behind the wheel when needed - and stay there when demand is low, return home. Data also drives UberPool, which allows users to find others nearby who make similar journeys at similar times to share a ride. According to Uber's blog, introducing this service was a no-brainer because "the vast majority of [Uber trips in New York] have a look-a-like trip – a trip that starts near, ends near, and happens around the same time as another trip." UberChopper offers helicopter rides to the wealthy, Uber-Fresh delivers groceries, and Uber Rush delivers packages. Uber uses a detailed rating system to build trust and allow both parties to make informed decisions about who to share a car with. Drivers must keep their

standards high or risk not getting more UBER work. They must also consider their "acceptance rate." This is the ratio of jobs accepted to rejected. Drivers have been told to keep this above 80% to provide passengers with a consistent service (Marr, 2016, 269).

As a result, by use and help of data science in Uber, is able to change how we get around in our crowded cities. There are both economic and environmental reasons why this would be a good thing. It is also now valued at around $64 billion as of August 16, 2022 (*Uber Technologies Net Worth 2017-2022 | UBER | MacroTrends*, n.d.). Not only Uber but also its users and drivers are gaining profit by use of data analytics.

Development Methodology

Agile

The Agile methodology is a way to manage a project by breaking it up into several stages. It requires working with stakeholders all the time and making improvements at every step. Once the work starts, teams go through a cycle of planning, doing the work, and judging how well they did. It's important to keep working together, both with team members and with people who have a stake in the project (*What Is Agile Methodology in Project Management?,* n.d.).

Figure: agile process

How was Agile implemented in the project?

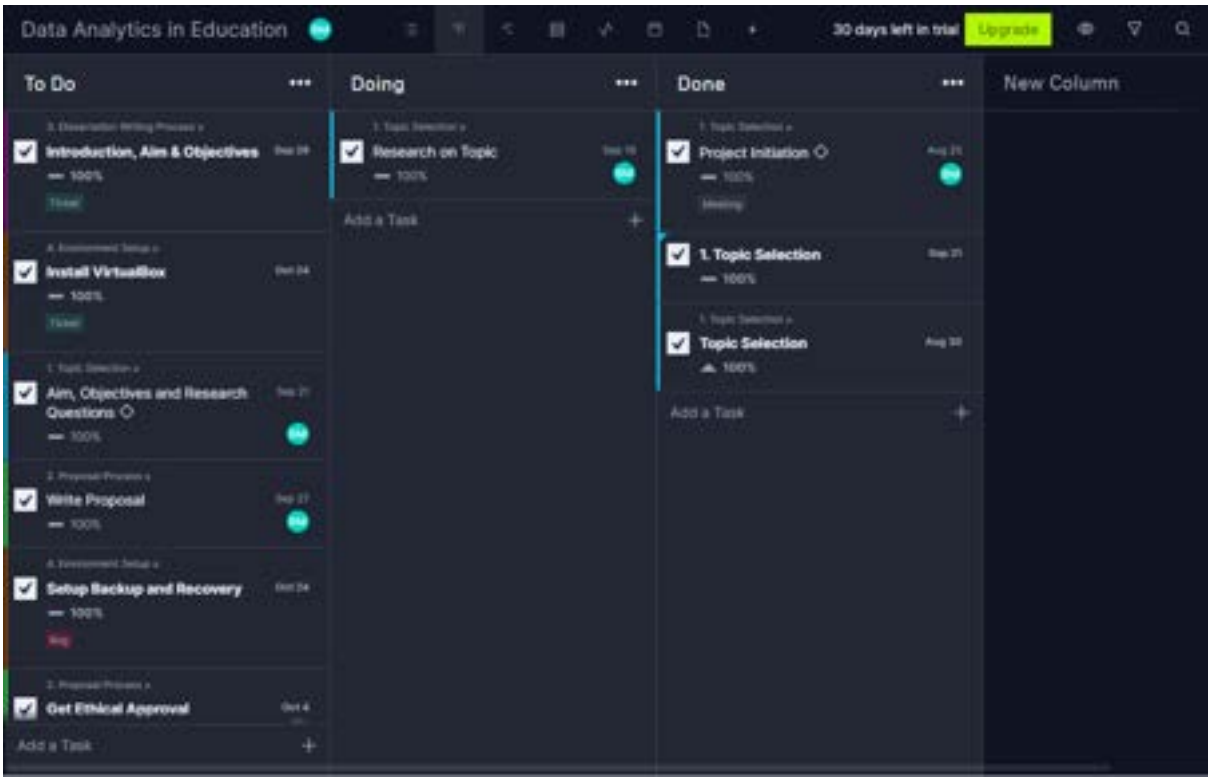

Figure: project board,

First of all, the title, aims, and objectives of the project were determined and finalized. Then, ethical approval was taken from the module leader and the system was designed how it needs to be. After that, goals were defined for every week and those goals were added in Trello for visualizing the progress of the project. After the task was completed they were reviewed to check whether they met goals or requirements. If everything went well then they were marked as complete and released otherwise, the task was done again until they met the goal. After the completion of the task, the project was published. In this way, the project was handled and managed using Agile Methodology.

Tools, Techniques, and Technologies

Using various tools, technologies, and techniques a system was developed. The diagram is shown below:

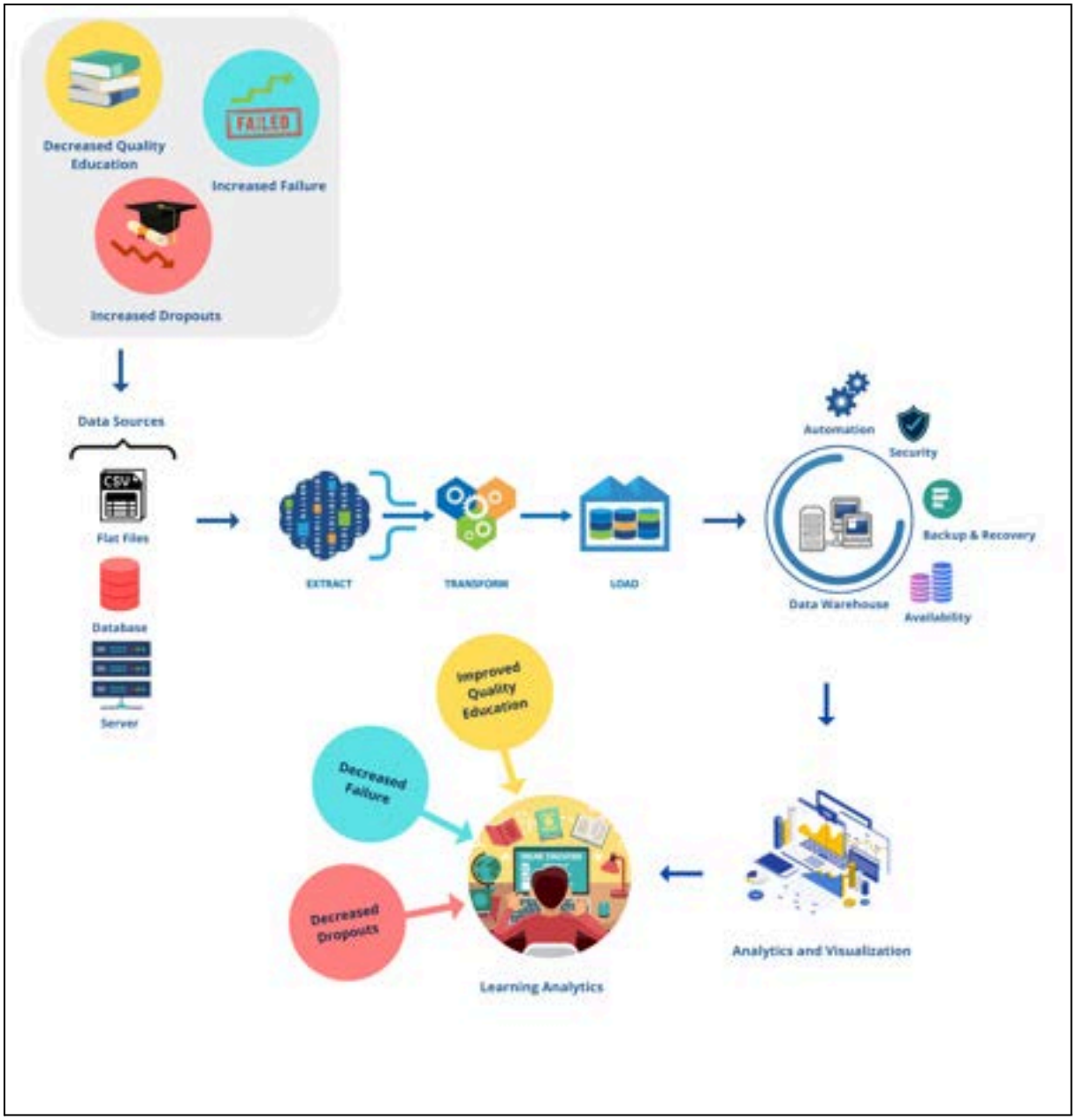

Figure: working process

Data Strategy

Cross-Industry process for Data Mining (CRISP-DM)

Crisp-DM is an industry-proven way to guide your data mining efforts. CRISP-DM is a process model that shows how the data mining life cycle works. As a method, it describes the typical stages of a project and the tasks that go along with each stage. It also explains how these tasks relate to each other. The CRISP-DM model is flexible and can be customized easily (*Home*, n.d.).

Figure: crisp-dm process

CRISP-DM was used in this project because of its benefits. First of all, a proper study was made to understand the business and its need. The project goals were identified and the project plan was designed to gain the business goal. In the second phase, data were collected from different sources and studied in order to understand data. After that, data preparation (means cleaning, joining, formatting, standardization, etc.) was done with the help of Tableau Prep Builder and was loaded into the data warehouse. Then in the Modelling/Visualization stage, various analytical dashboards were designed from lower level to higher level. In the evaluation phase, the analytical dashboards were evaluated to ensure efficiency and business need. And at the last stage, those analytical dashboards were deployed.

Types of Analytics

There are four types of analytics from simple to complex upon the value they generate from low to high as shown in the figure below:

Figure: types of data analytics

Descriptive Analytics (What Happened?)

The goal of any descriptive analysis is to characterize or summarize the data being examined. While it lacks the ability to foretell the future, it nonetheless has the potential to be very useful in professional settings. One reason for this is that descriptive analysis makes data more consumable, which in turn might make it simpler for analysts to take action. Additionally, the descriptive analysis might aid in the elimination of irrelevant information. This is due to the fact that the statistical methods used within this form of study tend to concentrate on the norms rather than the exceptions when examining data. When evaluating previous or current data, descriptive analysis is used. Raw data is difficult to ingest and analyze, but descriptive analysis offers targeted measurements. Descriptive analysis may be used as a prelude to diagnostic or predictive analysis, offering insights into the past before explaining why it occurred or projecting the future. (Bush & Momin, n.d.).

Diagnostic Analytics (Why did it happen?)

Like descriptive analytics, diagnostic analytics relies on the past to draw conclusions about the present. One of its distinguishing features is an emphasis on discovering the causes of anomalies and other types of outliers. Diagnostic analytics uses probability theory, regression analysis, grouping analysis, filtering, and more. Statistics aren't everything. It involves thinking laterally, evaluating other variables or external factors that may be affecting your data patterns, seeking new sources to form a fuller picture,

and validating these findings against the original dataset. One of the main disadvantages of it is that one correlation mistake has high-cost impacts (HILLIER, 2022).

Predictive Analytics (What happens next?)

The goal of predictive analytics is to foresee future events by analyzing past ones. Predictive modeling is the process of assigning a numerical value, or score, to the chance of an action or event occurring by using statistical analytic methods, data queries, and machine learning algorithms applied to datasets (Tucci, n.d.).

Prescriptive Analytics (How to prevent?)

Using prescriptive analytics is one way to help your firm uncover data-driven strategic choices and avoid the limits of typical data analytics approaches. Prescriptive analysis affords the organization's ability to map a path to success, inform real-time and long-term business operations, and reduce human bias and errors. (*What Is Prescriptive Analytics? Definitions and Examples*, n.d.).

Environment Setup

Oracle Linux 6.7

For this project, Oracle Linux 6.7 is used for the database servers. This operating environment has been used because it is free, easy to set up, fast, flexible, scalable, secure, and easy to use. It also gives enterprise applications the best performance, progressive scalability, and reliability. It also has great business support for a large community of users. The system is easy to use and allows database servers to be set up quickly. Also, it's different from other Linux distributions and works with Oracle because it offers deep integration and improvements over time. It is an operating system that can be used with the Oracle database. Operating an Oracle database on Oracle Linux has benefits like faster transaction rates, better resource management, scalable efficiency, built-in security, availability, and the dependability needed to meet strict service level agreements (*Oracle Linux*, n.d.).

Oracle Database 11g

Oracle Database 11g provides the best performance, scalability, security, and dependability. Because it has so many features, it can handle even the most complex applications for transaction processing, business intelligence, and content management (*Oracle 11g*, n.d.).

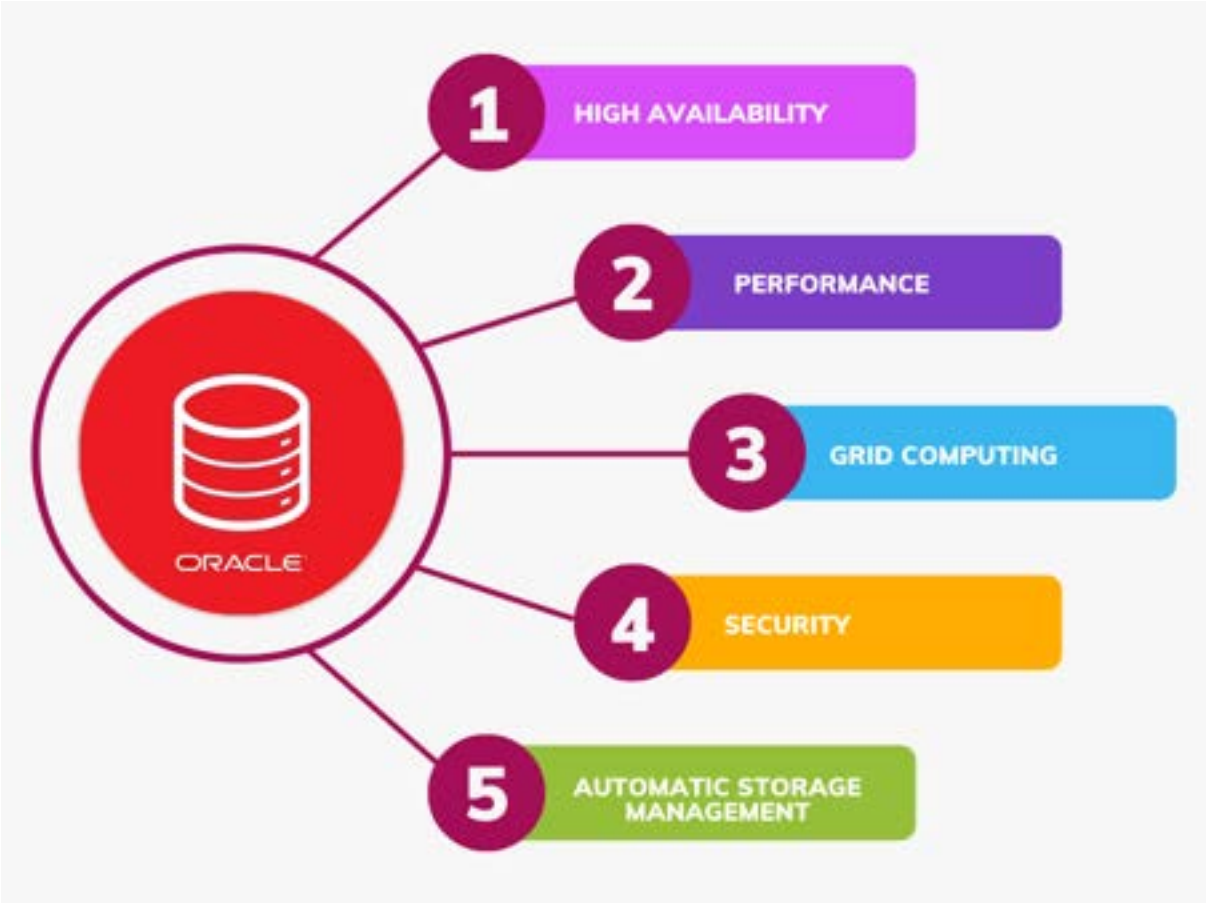

Figure: oracle database 11g benefits

It was chosen for this project because of its features. It has high performance as it enables the database for speed to retrieve and change data quickly resulting in improved query execution time and application operations. Another reason to choose this database was because of the automatic storage management (ASM) feature that helps in gaining the best possible I/O performance with the lowest management expense. It automatically distributes data to drives which in response provide high availability. Because of these and a couple more features like multiple databases and clusters, it attracts the user to use Oracle Database 11g.

Installation

A virtual machine was created with the name '**Oracle**' with 5GB RAM and a hard disk of size 145GB. Then Oracle Enterprise Linux 6.7 ISO image was mounted on the VirtualBox to start the installation. Custom layout option was chosen for disk partition and disk were partitioned into components such as '**/**', '**/boot**', '**/tmp**', '**/home**', '**/u01**', and 'swap'. A basic server was selected for installation. Also, Kdump was enabled and 256MB of memory was provided for Kdump.

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Figure: Oracle installation

Yum was configured to resolve dependencies issues and install required packages. Then, the kernel was configured in order to establish communication between software and hardware. Different OS groups such as **asmdba**, **admin,** and users such as **grid**, and **oracle** was created. Grid and Oracle were specified as host and database. Disk group DATA was created to store data whereas disk group FRA was created to store backup files.

Data Warehouse

A data warehouse is a central place where data can be stored and analyzed to help people make better decisions. Transactional systems, relational databases, and other sources send data into a data warehouse on a regular basis. Data warehouse powers the data analytics, visualization dashboard, and reports by storing data efficiently, minimizing I/O of data, and delivering query results quickly to hundreds and thousands of users concurrently. A data warehouse architecture is made up of tiers. The top tier is the front-end client that presents results through reporting, analysis, and data mining tools. The middle tier consists of the analytics engine that is used to access and analyze the data. The bottom tier of the architecture is the database server, where data is loaded and stored. (guide, n.d.)

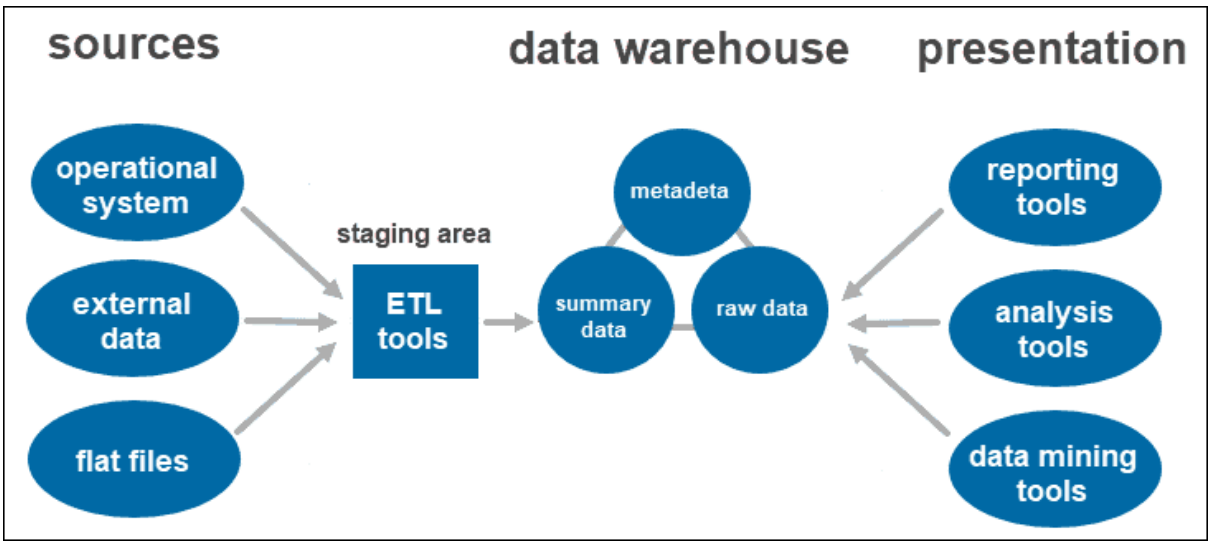

Figure: data warehouse

Extract, Transform, and Load (ETL)

ETL is a process that takes data from various source systems, changes it by doing things like calculations, concatenations, etc., and then loads it into the Data Warehouse. Extract, Transform, and Load is the full name for ETL. It helps businesses look at their business data so that they can make important business decisions. The ETL process can make complex changes and needs more space to store the data. It helps improve productivity because it codifies and reuses without requiring technical skills (Taylor, 2022). The ETL process is explained below:-

Figure: ETL process

Extract

In this step of ETL architecture, data is moved from the source system to the staging area. Changes, if any, are made in the staging area so that the source system's performance doesn't get worse. Also, it will be hard to roll back if corrupted data is copied directly from the source into the Data warehouse database. (Taylor, 2022)

Transform

Data pulled from the source server is raw and can't be used as is. So, it needs to be cleaned up, mapped out, and changed. In fact, this is the most important step in the ETL process where value is added and data is changed so that insightful BI reports can be made. It is one of the most important ETL ideas, and it includes putting a set of functions on data that has been extracted. Filtering, cleaning, validations, joining, merging, data redundancy, and standardizations are done during this stage (Taylor, 2022).

Load

The last step of the ETL process is to load data into the target data warehouse database. A typical data warehouse needs to load a huge amount of data in a short amount of time. So, the load process should be made as efficient as possible (Taylor, 2022). Then, these loaded data are used for analytics and visualizations.

Availability

Automatic Storage Management (ASM)

ASM is a technology for managing the storage of Oracle databases. It lets Oracle administrators manage the storage of all servers and storage systems more efficiently and consistently. It is a different way to manage disk groups than what is usually done. It uses a disk group to store data files. The files that are stored on a disk group are spread out evenly so that there are no "hot spots" and the disks all work the same. Performance is about the same as that of raw devices. ASM spreads the load of the content of a data file stored on a disk group evenly across all the disk groups to improve performance, use, and balance load. This even distribution of files means that I/O performance doesn't need to be constantly checked and tweaked. (*1 Introduction to Oracle Automatic Storage Management*, n.d.).

Automatic Memory Management (AMM)

Oracle suggests using the AMM method which is a feature for automating the distribution and deallocation of memory by an application. It takes care of the System Global Area (SGA) and Program Global Area (PGA) well enough. When it's set up, Oracle will dynamically manage both the SGA and the PGA, changing pool allocations as memory needs change. Database management has changed a lot, and AMM is proof of that. Rarely does a DBA have to spend time figuring out how much memory a database needs? This is good because it gives the DBA more time to do more important things, like query tuning. (Fitzjarrell, 2019).

Security

Database Security

"Privacy is not something that I'm merely entitled to, it's an absolute prerequisite." – Marlon Brando, Actor (Buttice, 2019)

Figure: Security

In IT security is a set of cybersecurity strategies that keep computers, networks, and data from being accessed by people who shouldn't be able to. It protects the integrity and privacy of sensitive information by keeping hackers from getting to it (*What Is IT Security? - Information Technology Security*, n.d.). Oracle uses schemas and security domains to limit who can access data and how different database resources can be used (*20 Database Security*, n.d.). In this project, some of the oracle database security tools, such as user security, data security, and system security, have been used to protect the system from hackers, malware, and data leaks. The database is set up so that only authorized people can access the system from outside the office.

System Security

System security refers to the steps an organization takes to make sure its networks and resources are safe from downtime, interference, or people trying to do something bad. If data security is meant to protect the information in the books in the library, then system security is meant to protect the library itself (*Data Security Vs. System Security*, n.d.).

Figure: system security

In order to safeguard users' data and to maintain confidentiality and integrity, system security was configured in Oracle. Also, the students' data are the main basis and essential factor in educational business intelligence.

User Security

User security talks about how to protect the parts of Sitecore that users can see, as well as how to protect users, accounts, security roles, domains, and user access rights (*User Security*, 2022).

Figure: user security

Oracle has a number of services that can be added to a system to give users security permissions. For user security, Oracle provided methods such as profiling, password complexity, roles, privilege, and quota were used.

Backup, Recovery, and Automation

Recovery Manager (RMAN)

It is an Oracle utility that can backup, restore, and recover database files. It stores information or metadata about its operations in the control file of the target database and, if desired, in an Oracle database's recovery catalog schema (*1 Introduction to Recovery Manager*, n.d.). It was used as it helps in simplifying the complexity of backup and restore operations. It also minimizes the possibility of human errors. In comparison to the user-managed method, the recovery manager is more efficient, and reliable. It is also used to automate the administration of backup strategies. It greatly simplifies backup, recovering, and restoring database files (*RMAN*, n.d.). RMAN can back up all database files needed for efficient recovery in the event of a failure (*Rman*, n.d.).

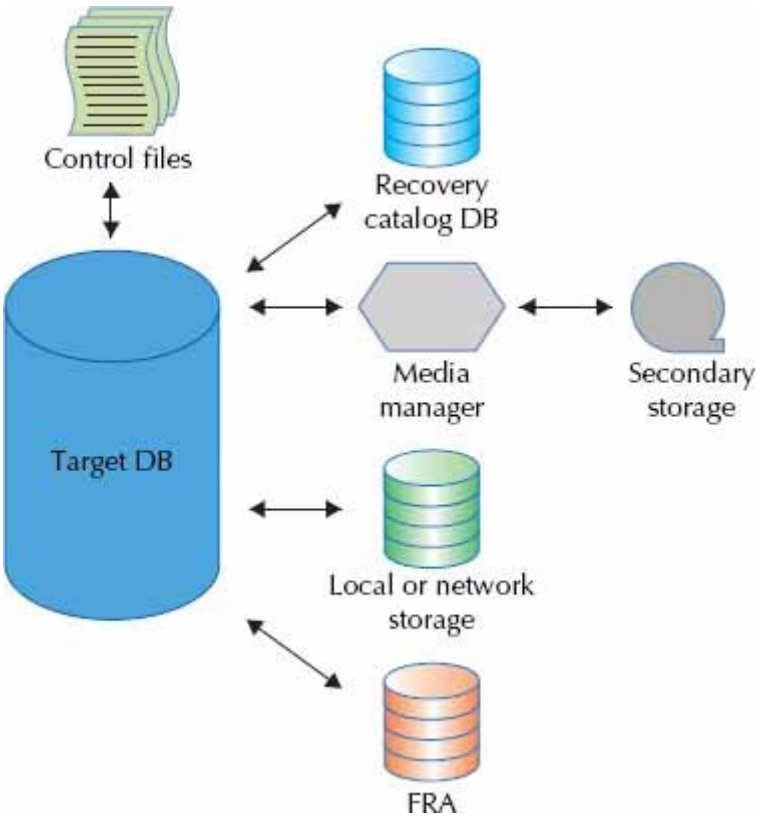

Figure: Oracle recovery manager (RMAN)

In this project, Recovery Manager (RMAN) was used along with FRA and recovery catalog. The recovery catalog keeps records and stores all RMAN activities on one or multiple databases. And created a database named **'catdb'** for the recovery catalog in this project.

Flashback and Flashback Data Archive

Oracle use flashback technology to recover lost and damaged data quickly and efficiently. It allows viewing past states of database objects or returning the database to its previous state. It automatically tracks and archive transactional data changes. It also allows performing queries that return past data and metadata that shows a detailed history of changes and recover tables or rows to the previous point in time. It uses Automatic Undo Management (AUM) System (*FDA*, n.d.). It was used in this project so, that lost or damaged data can be retrieved quickly and efficiently. It works like a rewind button for the database. Also can be used in case of logical data corruption caused by users.

Automation

Automation is the utilization of technology to accomplish jobs with minimal human intervention. Automation can be used in any industry with repetitive operations, although it is particularly prevalent in the manufacturing, robotics, and automotive

industries, as well as in the technology sector, IT systems, and business decision software (*Topics Understanding Automation*, 2022).

Figure: automation in oracle

In this project, automation was used to make backups. Backups are normally scheduled during the night shift and require humans to do it. But humans might not be available so, backup was scheduled with help of Scheduler. The backup job was scheduled for every month so, that it keeps backup of data monthly. Other than that, it can also be used for gathering stats and monitoring the system's health. So, automated scheduling makes our work more efficient and reliable by making sure that scheduled tasks are done at the right time.

Integration

In this project, Oracle's centralized database was configured. The database is configured with automation, backup, and recovery, and user and system security. The database was created as a data warehouse. Data from multiple sources were loaded to Tableau Prep Builder. The data was cleaned and transformed enough to load into the data warehouse. Then the transformed data loaded in the warehouse was used for analytics and visualization.

Figure: system integration

The data warehouse was connected to Tableau Desktop and then data analytics and visualization were done. Different level of analytics was done and a chart was designed therefore to help decision-making in the education sector to improve the learning and teaching process.

Data Visualization

Executive Dashboard

Key performance indicator (KPI) data is presented on an executive dashboard in one place so that corporate officers can make quick, data-driven decisions that improve productivity, boost sales, and lower risk. Modern executive dashboards bring together data from all departments and let users dig deeper to find insights. All critical performance metrics are presented in this dashboard (*Executive Dashboard: 5 Examples for Data-Driven Leaders*, n.d.).

Figure: executive dashboard

The dashboard above shows the KPI measures. This data consists of filters and multiple charts. It also consists of What If charts. That shows what if some percentage of improvement is increased or decreased. Also, it shows the highest contributing majors.

Decision Supportive Dashboard

Decision Supportive Dashboard allows decision-makers to present key information that affects decisions in the right way, or use key performance indicators to track how your business is doing (Tamhankar, 2019).

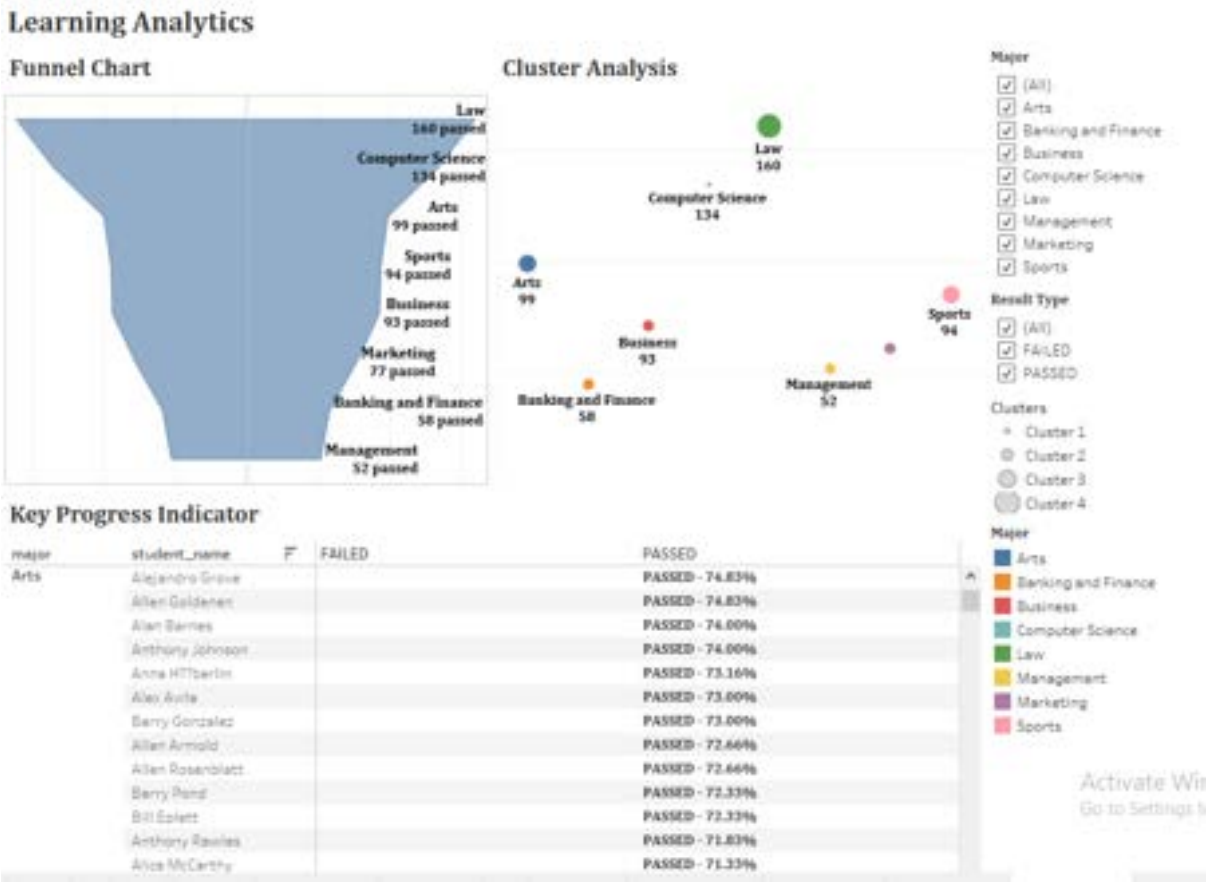

Figure: decision supporting dashboard

The dashboard shows some KPI charts, Cluster Analysis, and Funnel charts. The first chart shows the contributions by major. The second chart shows cluster analysis and the last chart shows the student's results grouped by major.

Operational Dashboard

One type of dashboard used to track and manage operations with a shorter time horizon is called an operational dashboard. They are usually run by lower levels of management because they focus on keeping track of operational processes. Most of the time, they are used to track and analyze what a company is doing in a certain business area. Most of the time, these dashboards are used to warn about business problems and are based on real-time data. (Calzon, n.d.).

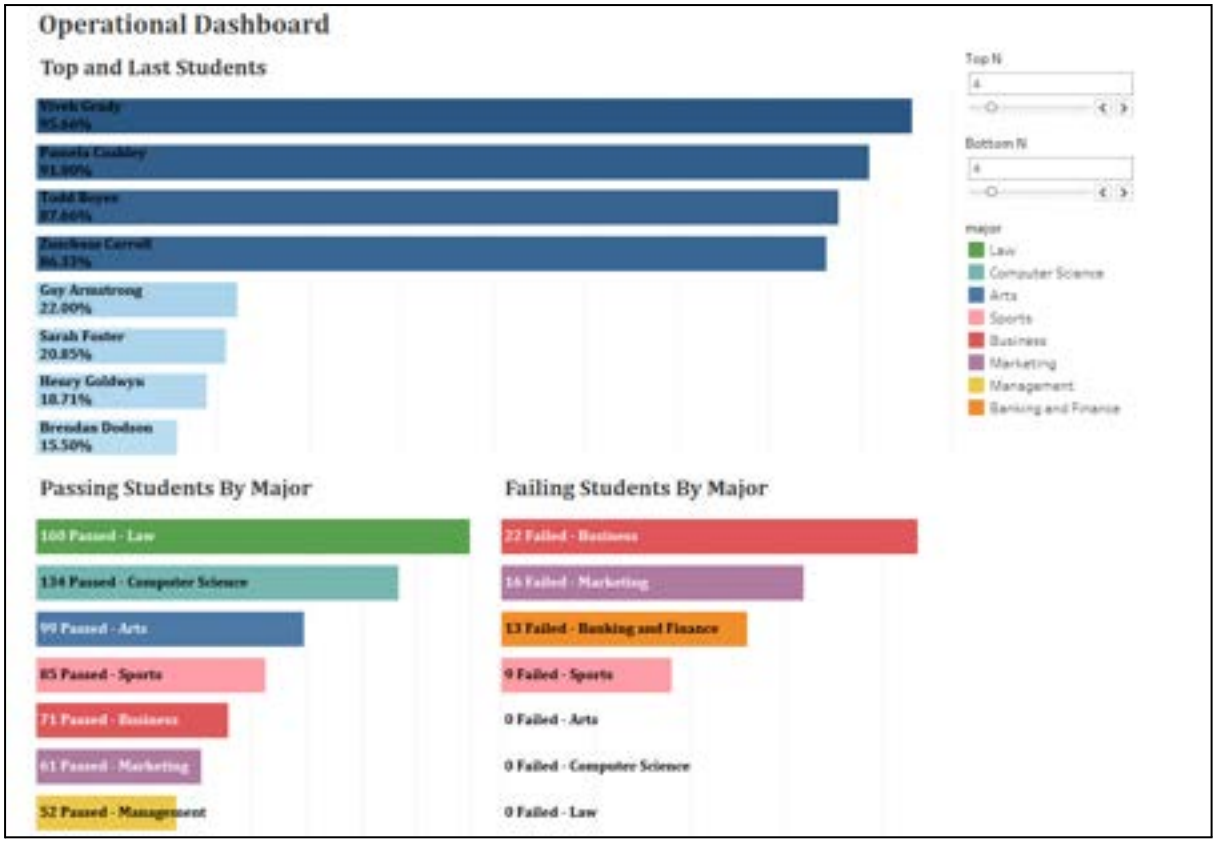

Figure: operational dashboard 1

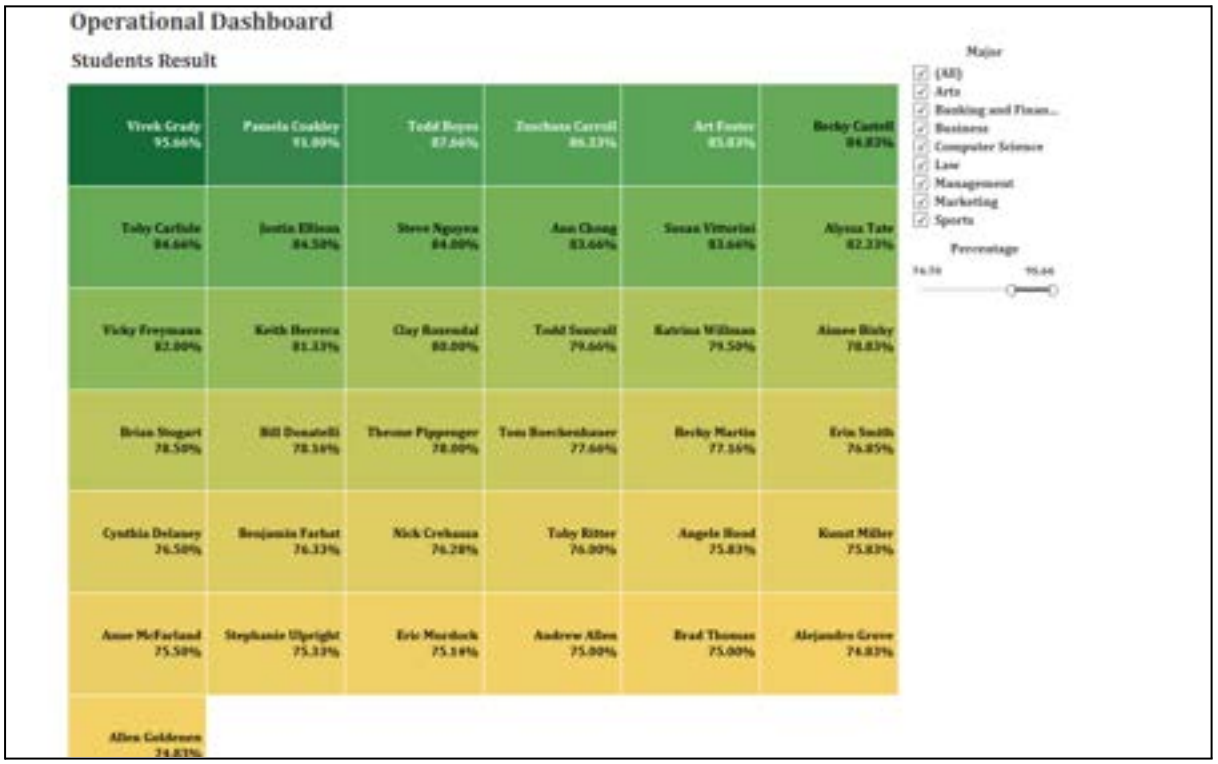

Figure: operational dashboard 2

The two dashboards above show the percentage of students in the result and the major with the most passing and failing students. The first chart is the top and bottom chart which shows n number of top students and n number of last students. Similarly, the second and third bar chart shows the number of passing and failing students in each major. Our second dashboard consists of a panel chart that shows students along with their percentages. It can also be filtered in terms of percentage in the sidebar.

Findings and Discussion

Before the initiation of the project some of the research questions were set to be answered. Those questions are answered below briefly.

What are the benefits of data analytics and how can the appropriate solution be implemented to achieve efficiency in the educational sector?

There are a lot of benefits of data analytics. Many sectors like business, sports, etc. have already gained more benefits from it. It helps in decision-making and achieving goals. It tells us 'what has happened?', 'why did it happen?', 'what might happen next?', and 'what can be done to prevent it?'. It helps to understand the customer need and optimize customer experience and develop a long-going relationship. Additionally, it aids in preventing internal and external threats from misusing material, financial, and intellectual assets. Because of this feature, it helps people very easy to make decisions. Schools and colleges keep data on their students like attendance, results, and how much they have studied. These data can be very useful to determine the overall performance of the institute and thus improve the teaching and learning process. There are four types of analytics that can be performed such as descriptive, diagnostic, predictive, and prescriptive. Analytics can be performed and analytical dashboards for the executive team and the operational team can be developed to visualize progress graphically. They can see which class or department is doing well, and which is lacking behind. And, also see why is so happening. Also, they can see what might happen next and can make decisions about what can be done to mitigate that problem. In this case, a decision supportive dashboard along with a What If chart and forecasting chart comes in handy. Also, a range of graphs, tables, and other visualizations can be provided to learners, and educators so they can relate how they are doing and even gets motivated to improve themselves, With the help of better data analytics, it helps in improving academic performance and increasing efficiency in learning and teaching mechanism in schools and colleges.

How will the data analytics technique help in optimizing decision-making in the educational industry?

Many industries are already gaining a lot of profit from data analytics and visualization techniques. The education industry is one of the largest industries that help in the development of the country. By simplifying data and reducing the need to fill in gaps with assumptions, data visualization increases decision-making accuracy. Analytical

dashboards help business people evaluate how well they are doing without having to look at a lot of data. Also, data that is correctly analyzed and displayed can give amazing insights and results. These results could mean help business leaders and people who make decisions make better, more timely, and more cost-effective choices about how to set up the business. It is claimed that colleges and universities should establish more data-driven educational decision-making processes in order to optimize current curricula and increase higher education quality.

What ethical issues should be considered while using an educational database for data analytics?

There are sets of ethics and rules that should be considered by everyone while performing research. One performing analytics should ensure the safety of the data. The data should not be misused. To identify the ethical issues relating to the decision-making process, engaging in an ethical decision-making process should follow guidelines and acknowledge the value of each individual and institution and their legal, cultural, political, and economic context. There are three main types of ethical issues that overlap. These include the location and interpretation of data, informed consent, privacy, and de-identification of data. Other ethical issues include the management, classification, and storage of data. Transparency, data ownership, and control, accessibility of data, validity, and reliability of data, institutional responsibility and obligation to act, communication, cultural values, inclusion, consent, and student agency and responsibility are all core issues that are important on a global scale for the use and development of Learning Analytics (LA). Also, one needs to make sure what will and will not be done with students' data and the roles of those involved. When you play with data, it is indeed important to keep it safe. System security should be kept up, so auditing has been turned on to keep the integrity of the system up. Data When making the database, the privacy of sensitive information like personal records, user data, and student data is taken into account. As for privacy, roles and privileges can be given to people, and passwords can be complicated and set to expire. When making the dashboard, the color scheme was kept the same so that a person with a visual disability could also use it. The guidelines for making web content accessible were made so that even people with disabilities can use it.

Project and Issue management

This project was handled using Agile Methodology. Here are the project plans and issues faced during the development of this project.

Project Plan Before

This was the project plan before the initiation of the project.

S.N.	Task	Start Date	End Date
1.	Learn and understand different data analytics techniques.	05/18/2022	06/01/2022
2.	Understand the application of data analytics in educational sector.	06/02/2022	06/09/2022
3.	Prepare datasets for analytics.	06/10/2022	06/15/2022
4.	Analyze data and extract useful informations for decision making.	06/16/2022	06/30/2022
5.	Report and document findings.	07/01/2022	07/08/2022
6.	Submit report.	07/09/2022	07/09/2022

Figure: project plan before

Updated Project Plan

The project plan was updated as shown in the image below till the completion of the project.

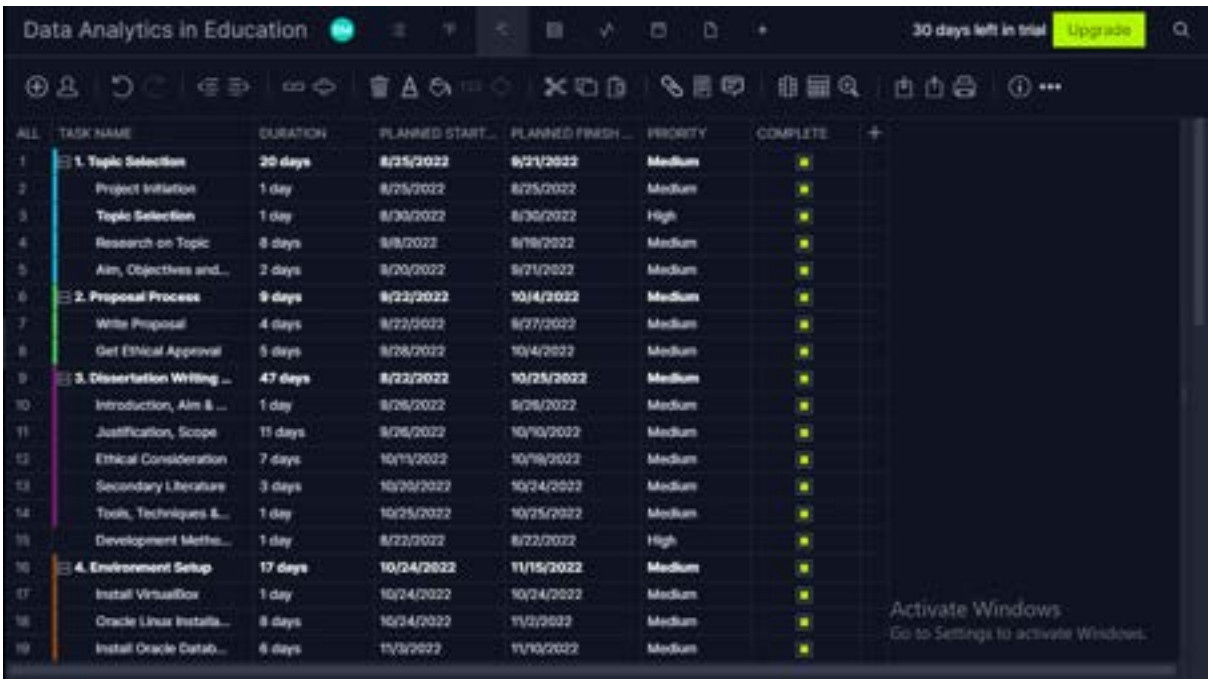

Figure: updated project plan 1

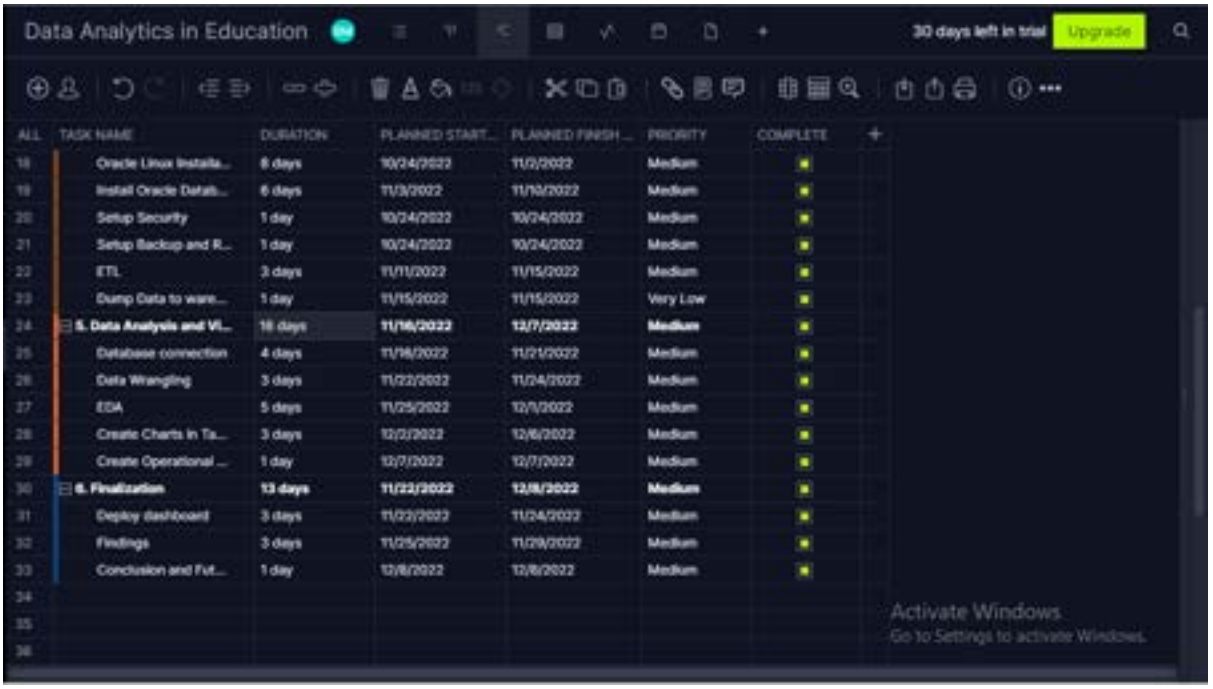

Figure: updated project plan 2

Issue Logs

These are some of the issues that were faced during the development of this project.

SN	Title	Priority	Resolution	Status
1	Backup Failure	HIGH	Resolved after re-configuration	Resolved
2	Primary key duplication	MEDIUM	Deleted duplicate values.	Resolved
3	Error loading image in tableau	LOW	Used to shape and color instead.	Resolved
4	Lack of proper knowledge	HIGH	Done a lot of research and guidance from the supervisor.	Resolved

Figure: issue logs

Conclusion

The report discusses how data analytics has been used to improve students' academic performance by enhancing the learning and teaching process. Desk-based research has been used from the beginning of the research process and throughout the dissertation writing process. The project was done using Agile Methodology for development. Before beginning the development process, various firm literature was reviewed and learned from. The system has evolved via the application of various tools, technologies, and approaches developed using CRISP-DM data strategies Beginning with the setup of Oracle Linux is developing a new level of dashboard. Different quality attributes benefit

from the system such as automatic storage management, backup and recovery, user and system security, and automation. When it comes to data extraction, cleansing, and loading, information obtained from several data sources has been mined. The tableau prep builder was used for data transformation. Furthermore, data was loaded using JDBC, which connects tableau prep to the data warehouse in the repository of data After that, it was linked to the tableau desktop for data analytics. Different analytical and visualization charts have been developed to show the progress and performance of the students. The administration can go through the executive support dashboard to make more precise decisions for academics and students. In conclusion, the administration can make appropriate decisions using different analytical methods, which helps in boosting the education system. Following the completion of the research, the established solution can still be updated. It can be improved and future investigation.

Recommendation and Future Work

There is always an opportunity for development in every field. A number of potential improvements to the system had to be left off due to a lack of time and money. In the same vein, the emphasis of the next research will be on a more in-depth investigation of the procedures involved in introducing new innovation strategies.

Data Breaches

The dashboards that have been visualized are put on Tableau's public server, where other users can also see them. This can lead to data breaches, so to avoid them, a private Tableau server can be purchased and display the charts and dashboards on it.

Web and Mobile Application

A web and mobile application can be made in the future with more features like text-to-speech and many more. This can make it easy and quick for users to analyze charts from anywhere.

Dashboard for Learners and Educators

Dashboards for both learners and educators can be made by showing their progress and how they are doing. Adding gamification to those dashboards can motivate them to improve even more. They also get a chance to improve their lacking skills.

PESTELS Analysis

A PESTEL analysis is a common way to look at the business environment in which a company operates. In the past, the framework was called a PEST analysis, which stood for Political, Economic, Social, and Technological. In more recent times, the framework was expanded to include Environmental and Legal factors as well (Peterdy, 2022).

Figure: pestels analysis

During the development of this project, PESTELS analysis was considered. Instability government can make changes in rules for data collection, so participants' consent was taken during data collection. It helps to improve students so, there might not be social and environmental problems. Also, everything was done following rules, so there might not be legal problems. In terms of technology, enterprise-level stable versions of the software were used and might not face problems.

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Appendix

Backup Script

```
#!/bin/bash
export ORACLE_HOME=/u01/app/oracle/product/11.2.0/db_1
export ORACLE_SID=orcl
PATH=$ORACLE_HOME/bin:$PATH
rman <<EOF
connect target sys/password@orcl
catalog rman/rman@catdb
RUN {
 ALLOCATE CHANNEL ch1 DEVICE TYPE DISK;
 Allocate channel ch2 device type disk;
 BACKUP DATABASE plus ARCHIVElog;
}
exit
EOF
```

Creating Backup Job

```
BEGIN
sys.dbms_scheduler.create_job(
job_name => '"SYS"."MONTHLY',
job_type => 'EXECUTABLE',
job_action => '/u01/app/backup.sh',
repeat_interval => 'FREQ=MONTHLY;BYHOUR=2;BYMINUTE=0;BYSECOND=0',
start_date => systimestamp at time zone 'America/New_York',
job_class => '"DEFAULT_JOB_CLASS"',
auto_drop => FALSE,
enabled => FALSE);
sys.dbms_scheduler.set_attribute( name => '"SYS"."MONTHLY"',
attribute => 'raise_events', value => dbms_scheduler.job_started +
dbms_scheduler.job_succeeded +dbms_scheduler.job_failed +
dbms_scheduler.job_broken + dbms_scheduler.job_completed +
dbms_scheduler.job_stopped + dbms_scheduler.job_sch_lim_reached
+dbms_scheduler.job_disabled + dbms_scheduler.job_chain_stalled);
sys.dbms_scheduler.enable( '"SYS"."MONTHLY"' );
END;
```

FDA setup query

```
conn sys/password as sysdba
create tablespace FB_Storage datafile '+DATA'  SIZE 1G;
create flashback archive default FB_Arch1 tablespace FB_Storage
retention 5 YEAR;

ALTER USER scott IDENTIFIED BY tiger;
ALTER USER scott account unlock;
grant flashback archive on FB_Arch1 to scott;
GRANT CONNECT,RESOURCE TO scott;

conn scott/tiger
alter table emp flashback ARCHIVE;

SELECT systimestamp FROM dual;
--07.04.2019 21:19:36.041 -04:00
delete from emp where deptno=10;
COMMIT;
select * from emp as of timestamp sysdate - 1/ (24*60) WHERE
deptno=10;
SELECT * FROM   emp where deptno=10;
select * from emp versions between
               timestamp sysdate- 1/(24*60) and sysdate
                                  where deptno=10;
```