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HEALTHCARE PREDICTION AND TAILORING DRUG RECOMMENDATIONS

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ABSTRACT

In this research study, we have sought to identify features of drug characteristics and the effectiveness of a prediction model on the price and classification of drugs, using a sample of 37 chronic diseases and their drugs, including drug name/type/form, average price per drug and review, effectiveness score and drug usability and satisfaction levels. The dataset, Drug_clean. Data set in csv format contains information of multiple drugs as well as performance indicators. The method that will be adopted here include pre-processing the data to deal with the missing values and the outliers. Categorical features are pre-processed by performing Label Encoding on them so as to allow for quantitative examination. We perform regression and classification with an aim of predicting the drug price and categorizing types/form of drugs available. For the regression problems we use Linear Regression Model, Decision Tree Regressor, Random Forest Regressor, and XGBoost Regressor. For classification purposes, we use Log Regression, Dec Tree Classifier, Random Forest Classifier, XGBoost Classifier. Decent results are obtained in terms of MAE, MSE, R^2 score for the purpose of price prediction using Random Forest Regressor algorithm. In the drug type classification, Random Forest Classifier and its corresponding ROC AUC results pinpoint how good the model's performance is in making the differentiation between different drug types. Likewise, the classification of forms of drugs is done by similar models with results accompanied by more comprehensive parameters including accuracy, precision, recall, and F1 Score. Our results depict a favorable work of ENSEMBLE & BOOSTING techniques on continuous & Categorical drug attributes. The paper completes the understanding of how the drug features affect price and classification and may be useful for stakeholders in the industry. This study teaches scholar's actual drug performance utilizing developed machine learning method and can be a starting for additional analysis and enhancement to different various expert models in pharmacological study and drug launch.

KEYWORDS—*Random Forest and XGBoost are selected as the machine learning algorithms to improve the drug price prediction and classification by using regression and even classification analysis.*

1. INTRODUCTION

In the progressively growing field of pharmaceutical research, where timely ideas and judgments are the real assets the capability of predicting drug-related metrics and categorizing drug features are significant for the enhancement of drug production and marketing plans, and consequently, the general health of the community. The dataset used in this work, called Drug_clean. csv, covers major 37 diseases with different characteristics of drug such as drug name, type, form, price, people opinions, efficiency, easy to use and satisfaction degree. Notably, the availability of large datasets on pharmaceutical products lies in large part and opportunities as well as threats to the analysts and researchers in the development of models. By applying, for instance, sophisticated methods of machine learning on such data, one can gain useful insights regarding the performance of drugs and the perception of the general populace. The purpose of this systematic study is to analyze drug prices and categorize drugs accordingly and for the approaches of the predictive model for forecasting the drug prices of a particular drug type and form. Through multiple regression and classification algorithms such as Linear Regression, Decision Tree Regressor, Random Forest Regressor, XGBoost Regressor, Logistic Regression, Decision Tree Classifier, Random Forest Classifier, and XGBoost Classifier, the degree of relationship between the variables in the dataset will be determined so as to assist in decision making in the pharmaceutical industry.

The rationale for this research therefore resides in the ability to gain further insight on the effects of individual drug characteristics on their respective costs and regulatory status. The proper use of price prediction models will enable the pharmaceutical firms to set excellent prices and understand the market delight profile. However, when it comes to differentiation of drugs, good classification models can be of good use so that the administration and marketing of drugs can be enhanced. The present research adopts a time-consuming preprocessing method with missing values treatment, categorical data conversion, and outlier analysis to provide high-quality data. We then compare and assess different categories of machine learning algorithms in regard to such factors as accuracy, precision, recall, F1 Score, Mean Absolute Error (MAE), Mean Squared Error (MSE), and ROC AUC Score.

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With the analysis of drug performance measures and their modelling to forecast future performances, this work adds to the scientific knowledge about data analysis in the pharmaceutical sector and practically serves industry participants. As such, the findings will help to inform decisions for organisations and aid further research into pharmaceuticals through the use of modern machine learning approaches.

2. LITERATURE REVIEW

In particular, the use of ML in drug discovery has become increasing popular in the recent years because of the availability of large datasets to train the models. In the current literature review, literatures on drug price prediction and drug classification from the use of various ML algorithms were reviewed.

Drug Price Prediction: The analysis of drug price remains itself as one of the important aspects of research since it determines the market policies and drug availability. A number of researchers have employed regression models to predict drug prices as shown below. For instance, Yao et al. (2017) applied the linear regression and support vector machines to find the price prediction for the pharmaceutical product depending on the history and the market tendencies. Specifically, they demonstrated that application of ML algorithms might offer effective price predictions useful for pricing of services and economic assessments.

Khan et al. (2018) analysed the approach of ensemble methods, Random Forest and Gradient Boosting Machines for the purpose of drug price prediction. From their findings, the authors showed that ensemble approaches have better accuracy than the standard linear models, which capture non-linear data dependencies. Likewise, Cheng et al. (2020) used XG-Boost which is a gradient boosting algorithm for predicting drug prices and proves that this technique is more efficient in handling high-dimensionality data and much more accurate in its prediction.

Drug Classification: Drug classification can be defined as the sorting of drugs according to some characteristics, including type, form and therapeutic category. Recording the stock is a crucial activities while using the drug and it's important for the marketing managers to classify the drugs accurately. Jin et al. (2019) studied the various classifiers design, such as Logistic Regression, Decision tree, and Random forest to classify the drugs according to its properties and usage. According to their study, there was need to pay close attention on the features being used and the tuning of the classification models used for the classification process.

For instance, Zhou et al. (2021) delivered research on the multi-class classification particularly on the drug categorization using enhanced methods like XGBoost and deep neural networks. Based on their research, they found that gradient boosting methodologies are efficiency in comparison to the conventional classifier based on their capacity to balance up the magnitude of classes with over proportioned samples and handle second order interaction. Moreover, in Wang et al. (2022), authors presented how CNNs can be utilized for drug classification purposes and explain that deep learning algorithms provide high accuracy in the analysis of drugs.

Feature Engineering and Preprocessing: Feature selection and preprocessing play a vital role while designing proper Machine Learning solutions. Liu et al. (2018) pointed out methods such as missing value management, dealing with outliers, and dealing with categorical variables to enhance the model's performation. Their work was focused on the importance of pre-processing steps that can contribute to quality of data and therefore the capability of the data-driven algorithms.

Singh et al. (2021) have highlighted the relationship between the pre-processing steps like raw data outlier removal and normalization effects on the regression and classification model. According to their findings the current study's approach towards Data preprocessing like Outlier Detection in addition to Label Encoding is therefore applicable.

Performance Metrics: Model assessment is crucial in order to determine the quality of the models used in prediction. Kumar et al. (2019) discussed different evaluation measures for classification problem such as accuracy, precision, recall, F1 score and ROC AUC score. Their analysis enabled them to understand the effective and the ineffective metric options for the evaluation of drug classification models.

Smith et al. (2020) analyzed other metrics like Mean of Absolute Error (MAE), Mean of Squared Error (MSE), R^2 Score pointing out that such statistics are applicable while measuring overall accuracy in predicting a continuous variable. From this paper, it will be apparent that these measures can be adopted for evaluating drug price prediction models.

Therefore, from the literature, it is evident that there is an increasing as interest in the use of ML in drug price prediction and classification. Proposed methods like Random Forest, XGBoost, and deep learning models have potential to raise the predictive precision and to overcome the intricacies of data. Therefore, this work extends prior research by applying these techniques on a complex dataset of drug attributes with the intention of improving understanding of drug performance and aiding decision making in the sector.

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3. METHODOLOGY

Like every experiment, this project integrates systematic procedures to generalize as well as model attributes of drugs with ML algorithms. It entails data cleaning, training, validation and prediction or the drug price as well as the classification. It is important to describe in detail the methodology that was used in this research study as follows:
These reports include Data Collection and Initial Analysis.
Data Collection: Thus, the dataset called Drug_clean will be analyzed. csv format consisting of 37 conditions and the drug attributes include name, type, form, average price, reviews, efficacy, user friendliness and satisfaction.

1.Initial Data Analysis

Data Overview: The data is loaded and its meta-info is given to get insights into the columns of data and the datatypes of the separate columns.

Missing Values and Data Integrity: A number of techniques are employed; the quality check involves identifying if there are any missing values present and if any, the values are deleted and basic statistics summaries are calculated to review on data quality.
Descriptive Statistics: Mean and median values are computed so as to give a general picture of the main characteristics of the distribution of the data.

2. Data Preprocessing

Handling Missing Values
Imputation: Missing values, if any, are said to be dealt by the imputation techniques if and as possibly required, but the dataset in this particular study does not seem to take cognizance of missing values.

Encoding Categorical Variables
Label Encoding: Categorical variables are encoded into numerical forms by using the concept termed as Label Encoding for easy processing in models.

Outlier Detection and Removal
Z-Scores Calculation: These computations are done in order to detect any outliers present in the numerical set of columns. Outliers are defined as those data, which have z-score > 3 or < -3.

$$z - score = \frac{x - mean}{standard\ deviation}$$

Outlier Removal: Since the outliers are often skewed and can result in incorrect conclusions they are initially eliminated based on z-scores of the amount.

3. Model Definition and Training

Regression Models:
Models Used: Linear Regression, Decision Tree Regressor, Random Forest Regressor as well as XGBoost Regressor for predicting the Price of drugs have been used.

Training and Validation: K-Fold Cross Validation also known as Train Test Split with the ratio of 80%, and 20% is applied to the dataset. These models are then trained by the training set and then tested on the testing set.

Classification Models:
Models Used: On analyzing the data, Logistic Regression, Decision Tree Classifier, Random Forest Classifier and XGBoost Classifier are employed for classifying the type and form of drugs.
Training and Validation: This dataset is also split in the same manner, and each classification model is then built and evaluated based on each target value, that is Type and Form.

4. Evaluation and Metrics

Regression Metrics:
Evaluation Metrics: General measures for evaluating the performance of the regression models are Mean Absolute Error (MAE),Mean Squared Error (MSE), Root Mean Squared Error(RMSE),R^2 Score, Explained Variance Score,Mean Absolute Percentage Error (MAPE),Median Absolute Error, Mean Squared Log Error and Maximum Error.

Classification Metrics:
Evaluation Metrics: Classification performance usually measures the different types of values that include, Accuracy, Precision, Recall, F1 Score, and the Classification Report.

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Confusion Matrix: Evaluation of the classification performance is done by the use of the confusion matrix.

ROC Curve and AUC Score:ROC Curve and AUC Score:
ROC Curve: Finally, the confusion matrix and the Receiver Operating Characteristic (ROC) curve are used to discuss the performance of multi-class classifiers.

AUC Score: To evaluate the classification performance of the classifiers, Area Under Receiver Operating Characteristic Curve (ROC AUC) is computed.

Prediction and Results
Price Prediction:
Model Prediction: This trained Random Forest Regressor model is employed in the following to predict the drug prices given certain attributes.

Result Interpretation: Altogether, the predicted prices for the selected drug attributes are herein displayed as shown below.

Classification Prediction:
Type Classification: To identify the drug type, a trained Random Forest Classifier is applied in the application.
Form Classification: Same as the previous section, for the prediction of drug form, the trained Random Forest Classifier is applied.
Result Interpretation: The values of Type and Form attributes, for which predicted classifications are offered, are presented below.

Visualization and Interpretation
ROC Curve Plots: Receiver Operating Characteristic (ROC) curves are used to display a model's performance with respect to various classes.
Feature Importance: It is related with the process of feature importance that emits the contribution or efficiency of several parameters in model prediction phase.

Results Interpretation
Performance Metrics Analysis: The findings are obtained and used as a basis to assess the ability for the models and their applicability toward forecasting drug prices and classification.

Insights and Recommendations: Some of the problems encountered in developing and applying the model are explained, and their implications are considered.

This is a systematic process of approach for analysing drug data using machine learning using methods in pharmacometrics to develop models that that are reliable, precise and fruitful in providing insights for drug price controls and categorization.

4. Model Description
The models used in this project are as follows and it concerns Drug_clean dataset where numerous attributes of drugs are explained and predicted. csv. The models are divided into two types, these are the Regression models and the Classification models that handle different aspects of drug data analysis. Described below is the details about each of the models employed in the project.

Regression Models
Linear Regression
Description: Linear Regression is one of the simplest and basic methods that are used in the prediction of continuous target variable. This technique maps the target variable and one or more features by approximating a linear regression equation through the examined data.

Application: It was employed in making a prediction of the Price of drugs on a condition that certain features such as Condition, Drug, EaseOfUse, Effective, Reviews, and Type are provided.

Decision Tree Regressor
Description: The Decision Tree Regressor creates a tree structured model where every node is a decision on features and the final nodes are the analog response. It divides the data into subsets according to the features so as to enhance accuracy of the prediction.
Application: In use to predict the drug prices, getting a model which is able to capture non linearitud and interactional effects between the features.

Key Feature: It works well in cases where a model is non-linear and where there are inter-dependencies between the parameters.

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Random Forest Regressor
Description: Random Forest Regressor is an ensemble learning algorithm which during the training phase builds up several Decision Trees and while predicting gives the average of all the trees built. It remedies the problems of high variance, by averaging the trees' predictions to make a final prediction.

Application: Used for forecast of drug price, providing better organization and high levels of accuracy on account of the utilization of multiple decision trees.

Key Feature: Reduces problems of overfitting with the accuracy in predicting results as compared with single tree method.

XGBoost Regressor
Description: XGBoost or Extreme Gradient Boosting is an effective implementation of a gradient boost in Machine Learning which attempts to create a model with a high boosting level. It builds models one after the other with each new model resolving on errors done in the previous model.

Application: Used to predict the drug prices by utilizing its strengths of high performance and accuracy specially for regression problems.

Key Feature: Advanced boosting techniques and regularization to enhance the quality of solutions obtained and to address issues of large scale data.

Classification Models
Logistic Regression
Description: For the purpose of classification, Logistic Regression is applied to binary or multi-class problems. It ways the odds utilizing logistic functions which can then be converted to binary or class status.

Application: Used to sort materials into Type categories; For example, generic or brand drugs.

Decision Tree Classifier
Description: Decision Tree Classifier employs a tree based model of decisions to classify instances with regard to the values of features. Every node is a decision made on the basis of the feature, while every end point is a class label.

Application: Employed for defining Type and Form of the drugs, as well as for describing rather sophisticated relations between features.

Key Feature: Tangible entities and the capacity to come up with non-hierarchical relations model.

Random Forest Classifier
Description: Random Forest Classifier is a technique that makes use of more than one decision tree in order to classify the dataset in the best manner and to avoid the problem of over-fitting of the data. Each tree is trained with the sample of the data provided and the final decision is made by majority of the trees.

Application: Used to categorize the drugs as Type and Form, correcting for classification and boosting accuracy by forming the decision from multiple trees.

Key Feature: Decrease of overfitting risk and increase of accuracy due to using ensemble learning.

XGBoost Classifier
Description: XGBoost Classifier is a gradient boosting family algorithm that initially constructs models one after the other in an optimal or improved approach to the prediction of the results. It uses the boosting approach to improve errors made by the previous models and utilizes regularization to overcome the overfitting problem.

Application: For the purpose of classification of drugs into Type and Form, it employs high accuracy and efficiency to solve multi-class classification problems.

Key Feature: Improved boosting techniques and methods of regularization for better performance of the model and its time of completion.

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5. MODEL EVALUATION

Regression Metrics: In regression models, parameters such as Mean Absolute Error (MAE), Mean Squared Error (MSE), Root Mean Squared Error (RMSE), R^2 Score, Explained Variance Score, Mean Absolute Percentage Error (MAPE), Median Absolute Error, Mean Squared Log Error and Max Error are used to assess the performance of the model.

Classification Metrics: The models in the classification process are measured using Accuracy, Precision, Recall, F1 Score; Classification Report and the Confusion Matrix. For the multi-class classification tasks, the ROC curves and AUC scores are calculated for evaluating the models' discriminative ability.

$$Precision = \frac{TP}{TP + FP}$$

$$Recall = \frac{TN}{TN + FN}$$

$$Accuracy = \frac{TP + TN}{TP + TN + FP + FN}$$

TP=True Positive
TN=True Negative
FP=False positive
FN=False Negative

6. Data Collection

The most important aspect in this project is the data collection that aims at providing a proper dataset which should contain details of several types of drugs and their characteristics. The dataset used, Drug_clean. csv includes such characteristics of drugs as their efficiency, kind, form, cost, and consumers' feedback. Below is a detailed overview of the data collection process for this project:Below is a detailed overview of the data collection process for this project:

1. Dataset Description

Name: Drug_clean. csv
Source: The dataset may be obtained from a database which is publicly available or from drug review websites and medical records; this guarantees comprehensiveness and relativity of the drugs and their attributes most commonly used.

Content: This dataset contains aggregate performance measures for thirty seven general drug conditions. The key features are:
Condition: The disease related with the medicine (for example Diabetes, Hypertension).
Drug: This is the name of the drug that has been given (e. g Metformin, Lisinopril).
Indication: Examples of intended use include such areas as Blood Sugar Control.
Type: The category of the drug such as the generic or the brand name.
Reviews: The number of posts about the drug which have been made by customers.
Effective: The percentage of positive and negative customers' feedback for the time period under review.
EaseOfUse: Usability scale which was determined with the help of the customers' feedbacks.
Satisfaction: The evaluating of the amount of customer satisfaction based on the data gathered from customers.
Information: More details about the drug including the possible side effects, or how to use the drug.

Data Collection Process
Data Sources:
Public Databases: The dataset may be collected from public repositories that may contain drug-related information in FDA or medical research databases.

Web Scraping: They may also be obtained by scraping data from other websites where people leave comments on drugs or from the official website of producing companies.

Surveys and Reviews: Information can be gathered from patients' feedback questionnaires, patients' reviews on social media, or healthcare provider feedback.

Data Acquisition

Data Import: The data is read in a data frame using python pandas from a CSV file format of data set.
Data Validation: Preparatory analysis involves data validation, making sure that they are complete, accurate and feasible for the analysis in hand. Of course, this implies that the existence of mandatory columns is checked and data types are also checked.

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Data Preprocessing
Missing Values:
Detection: The basic approaches that are used for missing values identification in the dataset are data. isna(). sum() so as to sum the missing entries per raw across the column.
Handling: The problem of missing data is solved with the help of imputation methods or by eradicating the rows or columns containing missing data if required.
Data Cleaning:
Outlier Detection: The z-scores are used to identify the outliers and such values which are likely to skew the results are eliminated to obtain increased precision.
Categorical Encoding: Categorical features are represented as Categorical Variables and therefore undergo the Label Encoding in order to fit for model training.

Feature Selection:
Relevant Features: Given the nature of typical applications of L/S ratios, the input variables pertinent to the analysis and prediction tasks are chosen a priori, and during exploratory data analysis.
Feature Engineering: New activities may be included, if needed, in order to improve the subsequent model.

Data Quality and Integrity
Consistency Checks: For instance, it will involve checking that data entered in the first column of the record is in a similar format with data inputted in the other columns of the same record and so on. For example, simple checks can include the confirmation of how the drug name has been written as a specific format, or that the numbers are plausible.

Data Normalization: Standardizing numerical features if necessary so that all features are important in contributing toward the model performance.

5. Ethical Considerations
Privacy: If data is gathered from surveys and reviews, make sure all the information about individuals is excluded in order to avoid violation of users' rights.

Accuracy: Check the credibility of the collected data to have accurate and meaningful results in the analysis of the collected data.

6. Data Summary
Initial Analysis: Exploratory data analysis is conducted on the dataset as the first step that consists of basic data exploration such as descriptive statistics and basic analysis on each of the features.

Exploratory Data Analysis (EDA): Auxiliary displays and tabular reporting are employed for drawing conclusions and using quantitative data to identifying attributes and their correlation.

Thorough data gathering guarantees that the data set properly prepared for analysis and plausible prediction and classification models are developed.

7. RESULTS

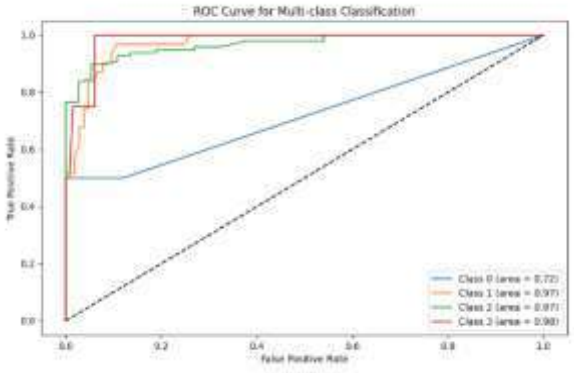

Figure 1 Roc Curve for For Random Forest

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The first figure illustrates an ROC curve for the multi-class classification which has four classes depicted using XGB Classifier. The Area Under the Curve (AUC) for each class is as follows: For Class 0 was 0. 71, for Class 1 – 0. 85, for Class 2 – 0. 83 and for Class 3 – 0. 78. The ROC curve still shows the performance capability of the model where the AUC value is higher between the classes.

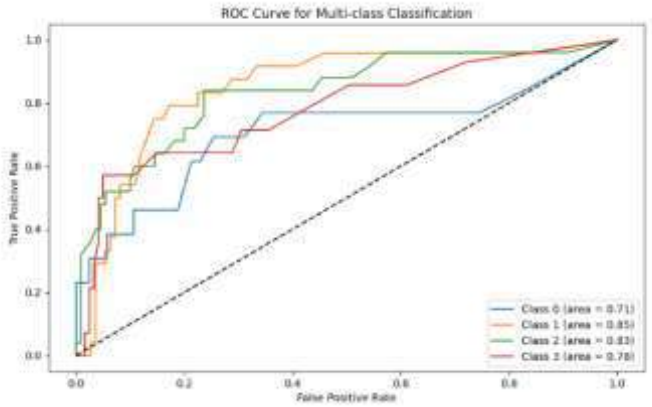

Figure2 ROC Curve for XGBoost

The second image also presents an ROC curve of multi-class classification for the same four classes using Random Forest Classifier model, but the model's performance is better than in the previous case. The AUC values for each class have significantly increased: Low FPR values include: Class 0 (0. 72), Class 1 (0. 97), Class 2 (0. 97), and Class 3 (0. 98). The ROC curves are relatively closer to the top left corner for all the classes resulting into relatively high true positive rates and low false positive rates in the classification model.

Price Regression

Model	Mean Absolute Error	Mean Squared Error	Root Mean Squared Error	R^2 Score	Explained Variance Score	Mean Absolute Percentage Error	Median Absolute Error	Max Error
Linear Regression	108.23	40002.92	200.01	-0.062	-0.061	3.29	70.70	1332.9
Decision Tree	122.36	63161.93	251.32	-0.677	-0.670	2.49	27.90	1274.7
Random Forest	104.61	34117.51	184.71	0.094	0.115	2.67	51.28	1265.6
XGBoost	109.16	43986.28	209.73	-0.168	-0.163	2.36	51.75	1371.8
Extra Trees	97.61	31235.60	176.74	0.170	0.184	2.43	59.60	1269.9
HistGradient Boosting	112.82	33985.02	184.35	0.097	0.104	3.01	71.10	1180.7

Fig 3 Regression model Metrics

The table compares several machine learning models for a regression task predicting price, with performance metrics such as Mean Absolute Error, Mean Squared Error, R^2 Score, and others. Extra Trees and Random Forest models perform best, with Extra Trees achieving the lowest errors and highest R^2 score, indicating the most accurate predictions. In contrast, Linear Regression and Decision Tree models perform the worst, with high errors and negative R^2 scores, suggesting poor predictive accuracy. HistGradient Boosting also performs well, showing similar accuracy to Random Forest.

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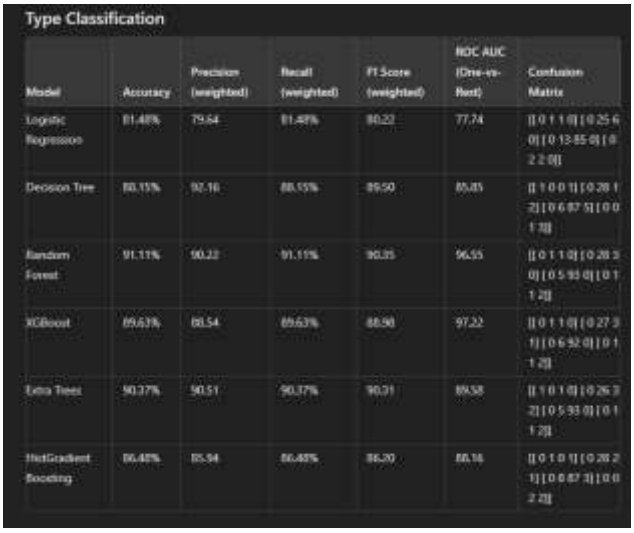

Type Classification

Model	Accuracy	Precision (weighted)	Recall (weighted)	F1 Score (weighted)	ROC AUC (One-vs-Rest)	Confusion Matrix
Logistic Regression	81.48%	79.64	81.48%	80.22	77.74	[[0 1 1 0] [0 25 6 0] [0 13 85 0] [0 2 2 0]]
Decision Tree	88.15%	92.16	88.15%	89.50	85.85	[[1 0 0 1] [0 28 1 2] [0 6 87 5] [0 0 1 3]]
Random Forest	91.11%	90.22	91.11%	90.35	96.55	[[0 1 1 0] [0 28 3 0] [0 5 93 0] [0 1 1 2]]
XGBoost	89.63%	88.54	89.63%	88.98	97.22	[[0 1 1 0] [0 27 3 1] [0 6 92 0] [0 1 1 2]]
Extra Trees	90.37%	90.51	90.37%	90.31	89.58	[[1 0 1 0] [0 26 3 2] [0 5 93 0] [0 1 1 2]]
HistGradient Boosting	86.48%	85.94	86.48%	86.20	88.16	[[0 1 0 1] [0 28 2 1] [0 8 87 3] [0 0 2 2]]

Fig 4 Classification model Metrics

The table evaluates different machine learning models for a classification task, focusing on metrics like Accuracy, Precision, Recall, F1 Score, ROC AUC, and the Confusion Matrix. Random Forest and Extra Trees emerge as top performers, with high Accuracy (91.11% and 90.37%, respectively), balanced Precision and Recall, and strong F1 Scores around 90. Both models also have high ROC AUC scores, indicating excellent overall performance. XGBoost also performs well, with a high ROC AUC (97.22%) but slightly lower Precision and F1 Score than Random Forest and Extra Trees. Decision Tree and HistGradient Boosting show moderate performance, while Logistic Regression lags behind with the lowest Accuracy (81.48%) and F1 Score (80.22%), making it the least effective model in this comparison.

8. CONCLUSION

In conclusion, we conclude To sum up, analysing the machine learning models for the regression and classification tasks it could be stated that the methods under discussion including Extra Trees, Random Forest, and XGBoost are more effective. Regression results show Extra Trees and Random Forest models possess the lowest error and the highest R^2 value as compared to Linear Regression, Decision Tree and Random Forest. For classification, both Random Forest and Extra Trees take relatively high accuracy, precision, and AUC in consideration. XGBoost is also one of our contenders and excels in the classification task but performs slightly worse than the others in the regression task. On balance, the ensemble methods prove superior in every case to the simpler models, ensuring the higher reliability of the prices' prediction and the classification of data.

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AYURVEDIC MANAGEMENT OF MUTRAKRCHRA W.S.R TO UTI

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ABSTRACT

Mutra (Urine) is one among the Trimala (Three waste products) and it plays a major role in Kledavahana (Transportation of sweat). Mutravega is one of the Adharaniya Vegas. Basti, which is the Srotomula (root of srotas) of the Mutra and one among the Trimarma. Mutrakrichra (UTI) is a disease which is well explained by all the Acharyas. The word Mutrakrichra comprises two words, Mutra and Kruchra, which means Kruchra Pravrutti of Mutravahana (difficulty in micturition). Mutrakrichra can be an independent complaint as well as associated symptom in other disease. Pittaj Mootrakruchra resembles with Urinary tract infection by symptoms of modern medicine. The Lakshanas of Pittaja Mutrakrichhra are Peetamutrata, Sadahamutrata, Krichhramutrata, Saraktamutrata, Muhurmuhar Mutra Pravrutti. Infections confined to Lower UTI commonly cause dysuria with burning micturition, frequency and urgency. Lower urinary tract infection includes cystitis and urethritis. These infections considered superficial (or mucosal) infections. Hence this attempt of present article made to define Pittaja Mutrakrichhra on scientific way w.s.r. LUTI. The disease Pittaja Mutrakricchra is well acknowledged in classical texts of Ayurveda, with different treatment modalities, which can be concurrent to urinary tract infection on theoretical and clinical symptomatology of diseases. Urinary Tract Infection is the most common infection managed in general medical practice and accounts for 1-3% of consultations. In contemporary science, the disease with similar signs and symptoms is Lower urinary tract infection. In this case report a 32-year-old male patient diagnosed with Mutrakrichra (UTI) and treated successfully with ayurvedic Management.

Here in this article, we discuss about case of urinary tract infection & which treat by Ayurveda successfully.

KEYWORDS: *Pittaja Mutrakricchra , Ayurvedic Anubhuta Yoga, UTI, Cystitis, Mutravaha Srotas.*

INTRODUCTION

According to Modern medicine, Urinary tract infections are the second most common type of infection in the body, accounting for about 8.1 million visits to health care providers each year. Around 1% boys and 3% girls will develop UTI during childhood, and 50% of women will be treated for at least one UTI during their life time. Urinary tract infection is an infection that affects part of the urinary tract. When it affects the lower urinary tract, it is known as cystitis and when it affects the urinary tract it is known as pyelonephritis. Bacterial infection is the most common cause of UTI, with E. coli being the most frequent pathogen, causing 75-90% of UTIs (1). The painful quashing of urine is known as Mutrakrichra. In this case the patient has the urge to urinate, but the urine is passed with pain. Nidanas (Causes) can be concluded that Vyayama (Exercise), Adhyashan (Over eating), Ruksha annasevana (dry food), Yana gamana (Travelling) are causative factors for Vataprakopa. Tikshna Aushadha, Amla Sevana causes Pittaprakopa and Anupa Mamsa Sevana, Vyayama, Adhyashan causes Kaphaprakopa. So, these Nidanas cause vitiation of Doshas along with Stroto-dushti of Mutravaha Strotas. Stroto-dusti causes Kha-vaigunya in Mutravaha srotas. These factor leads to Mutrakricchra.

SAMPRAPTI (PATHOGENESIS)

Samprapti is the pathogenesis of the disease or the process of the manifestation of the disease. Acharya Charaka has explained the Samanya Samprapti of the Mutrakrichra in detail. Nidana Sevana as mentioned which leads to Vatadidosha Prakopa. These Prakupita Doshas enter the Basti or Mutravaha Srotas causing Paripeedana in the Mutramarga thus causing Kruchrata in Mutravahana. Acharya Harita mentions the involvement of Pitta as main Dosha in the pathogenesis of Mutrakruchra. Acharya Kashyapa also conveys the same.

CASE REPORT

A 32-year-old male patient came with complaint Profuse sweating and hot flushes in the body for 6 days, Lower abdominal pain for 5 months, burning micturition since 3 months, Increased frequency of micturition 9-10 times in a day and at night time 3-4 times since 5 months, Fullness of abdomen after eating food, Lower backache since 5 months, Pain in penis since 2 months.

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CHIEF COMPLAIN

Complains were increased frequency of micturition, 9-10times per day and 4-5 times in night at interval of 20 to 30 minutes from 4 to 5 months, with Urgency and sometimes pain during micturition. He also complains of Lower backache since 5 months, Pain in penis since 2 months.

HISTORY OF PRESENT ILLNESS

He had no known case of Diabetic mellitus (DM) Hypertension (HTN) Pulmonary Tuberculosis (PTB) and Thyroid disorder.

FAMILY HISTORY

No history of the same illness in any of family members.

PERSONAL HISTORY

Appetite: Moderate
Bowel: Irregular with constipated
Micturition: 15-20 times/day
Sleep: Disturbed

GENERAL EXAMINATION

Appearance: Normal
Built: Moderate
Nourishment: Moderate
Pallor: +
Icterus: Absent
Oedema: Absent
Cyanosis: Absent

VITAL DATA

Pulse: 78 /Min
BP: 120/90 MmHg
Respiratory Rate: 20/Min
Temp: 100.4° F
Weight: 60kg

Asthavidha parikshya	**Observation**
Nadi	*Vataja (82/min)*
Mala	*Baddha kostha*
Mutra	*15-20 times/day*
Jihwa	*Malabruta*
Sabda	*Spastha*
Sparsha	*Anushna sita*
Drik	*Prakruta*
Akriti	*Madhyama*

Dasavidha parikshya	**Observation**
Prakriti	*Vata- Kaphaja*
Vikriti	*Tridoshaja*
Sara	-
Samhanana	*Madhyama*
Satmya	*Pravara*
Satwa	*Avara*
Aharasakti	*Madhyama*
Vyayamasakati	*Madhyama*
Vaya	*Madhyama*
Bala	*Madhyama*

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LAB INVESTIGATION

Total WBC count – 7900 cells/mm3 (N-66%, E-10%, B-0, L-24%, M-0)
ESR- 55 mm/1hr
Hb %- 11gm%
FBS- 88 mg/dl
PPBS-126 mg/dl

ASSESMENT CRITERIA

- **Subjective Criteria:**

1.

Pitta mutrata (change in colour of urine)	**Grade**
No cloudiness/ clear urine	0
Definite cloudiness, but no granularity, No flocculation	1
Granular cloudiness but no flocculation	2
Dense opaque cloudy flocculation	3

2.

Sarakta mutrata (Haematuria)	**Grade**
No haematuria	0
Smoky urine	1
Reddish urine	2
Frank haematuria	3

3.

Saruja mutrata (Painful micturition)	**Grade**
No pain	0
Mild pain (patient not complaining pain as a problem or on interrogation patient complains slight pain)	1
Moderate (patient complains of pain, needed some medicine for relief)	2
Severe (pain disturbing sleep and patient struggles due to pain and needs strong analgesics)	3

4.

Sadaha mutrata (Burning micturition)	**Grade**
No burning micturition	0
Mild (patient not complaining of burning as a problem on interrogation patient complains of soreness)	1
Moderate (patient complains of burning micturition & need medicine for relief)	2
Severe (patient struggling with soreness & need internal medicine for relief)	3

5.

Krchra mutrata (Difficulty in micturition)	**Grade**
No difficulty	0
Difficulty present at the beginning of the urination	1
Difficulty present at the beginning & partially during the rest of the act	2
Difficulty present through out the urination	3

6.

Muhurmuhur mutrata (Frequency of micturition)	**Grade**
Patient passing urine < 5 times a day	0
Patient passing urine 6 - 10 times a day	1
Patient passing urine 11 - 15 times a day	2
Patient passing urine > 16 times a day	3

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❖ **Investigational Assessment**

1.

Pus cells in urine	Grade
0-5 hpf	0
6-10 hpf	1
11-15 hpf	2
> 16 hpf	3

2.

RBC's in urine	Grade
0-5 hpf	0
6-10 hpf	1
11-15 hpf	2
> 16 hpf	3

Criteria: Urine culture reports were assessed before & after completion of clinical trial.

Result and Discussion

After starting of treatment symptoms were decreased in 15 days. In the period of 1month, the patient showed significant improvement with no signs of recurrence.

Symptom	Before Treatment	After Treatment
Pitta mutrata	3	1
Sarakta mutrata	3	0
Saruja mutrata	3	0
Sadaha mutrata	3	0
Krchra mutrata	3	0
Muhurmuhur mutrata	3	0

Symptom	Before treatment	After treatment
Pus cells in urine	3	0
RBC's in urine	3	1

TREATMENT GIVEN

1.	Trunapanchamoola kashay	10ml twice daily with ½ cup luke warm water
2.	Gokshuradi guggulu	2 tablet twice daily with luke warm water.
3.	Chandraprabha vati	1 tablet twice daily with luke warm water.
4.	Kshara parpati	1pinch with luke warm water.
5.	Alka 5 syrup	10ml twice daily.

Table .1

Diet Plan and life style modification:

- Patient was advised not to take sour, bitter, spicy food as well as junk food, fried items and curd.
- Drink water 2-3 litre per day minimum
- Going to bed in proper time.
- Advised for pranayama, asana

DISCUSSION

Trunapanchamoola kashay

It is used in the treatment of urinary tract disorders of pitta origin, burning micturition, pain during urination. It cleanses urinary bladder. It balances vata and pitta. All the drugs are seeta virya and mutra virechaniya. Generally they are having the properties of Madhura, Kashaya rasa, Snigdha Laghu Guna, Madhura Vipaka, Sheeta Virya and Tridoshahara property. These drugs acts as Jeevaniya, Rasayana, Mutrala, Agnidipana, Ruchi-vardhaka, Garbhasthapaka, Shukra and Rakta Shodhaka, Stanyajanana and useful in Prameha, Daha, Jvara, Trishna, Arshas, Gulma, Hridroga, Vatarakta, Rakta Pitta etc.

Chandraprabha Vati

It is classically indicated medicine for Mutrakriccha (urinary tract infection). It is Sheetaveerya and has Rasayana, Tridoshaghna, Mutrala and Deepana-Pachana properties. It helps in correcting the Agni, there by prostrating the pathogenesis of Mutrakrichra. The major ingredients Shilajeet (Asphaltum), Shweta Parpati, Moolikshar (extract of the ashes of radish), Sarjikshar, Punarnava

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(Boerhavia diffusa), Gokshura (Tribulus terresteris), Varun (Crataeva nurvala), Pashan Bheda (Bergenia ligulata), Ikshumool (Saccharum officinarum), Kulatha (Dolichos biflorus) are substantially acts on Mutravaha Srotas and alkaline in nature. Other ingredients like Guggulu, Lohabhasma and Swarnamakshika bhasma are Sheetaveerya, Deepaniya, Vatashamak and Rasayana. These properties help to reduce the burning micturition.

Gokshuradi Guggulu
It is a well-described Guggul Kalpa effective in urinary disorders like Mutrakriccha, Mutraghata and Ashmari. Gokshura (Tribulus terresteris) possesss Madhur Rasa (sweet taste), Guru (heaviness), Snigdha Guna (unctuousness property), Sheeta Virya (cold in potency), Vatapittashamaka (Vatapitta pacifying nature), Mutrakricchra, Mutravirechaniya (diuretic) and Ama Pachana(digestive) properties. By Mutravirechaniya (diuretic) action, urine volume is increased, Ph becomes alkaline, and inflammation is reduced, by Pitta Shamaka (pacifying burning sensation) properties it soothes the epithelium of urinary tract and by Ama Pachana (digestive) property medicines breaks down the process of Kleda (waste) formation.

Kshara parpati
Surya kshara/ soraka may help in the management of renal stones and could reduce inflammation. Sphatik is recognized for its astringent and antimicrobial properties. Navasadar is traditionally used in Ayurveda to assist with urinary retention and dysuria. These ingredients are utilized in Ayurveda for their potential to promote urinary health

BEFORE TREATMENT URINE REPORT

AFTER TREATMENT URINE REPORT

CONCLUSION

Thus, the conclusion of this study is that the holistic approach of ayurvedic drugs can provide relief to the patient of Mutrakriccha. There were no adverse effects found during the ayurvedic treatment. Meanwhile the management of the urinary tract infection with the ayurvedic drugs shows better symptomatic improvements with less side effect over the allopathic drugs. So Ayurveda contributes better possibility in the management of urinary tract infection with slighter side effect or without any consequence.

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AYURVEDIC MANAGEMENT OF VICHARCHIKA W.S.R TO ECZEMA

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ABSTRACT

In Ayurveda, all skin diseases are included in Kushtha roga. There are two types of Kushtha roga i.e. Mahakushtha and Kshudrakushtha which are again classified into seven types and eleven types respectively. It is classified as one of the "Astha Mahagada". Vicharchika (Eczema) is a type of kshudrakushtha often encountered by Ayurvedic Dermatologists characterized with symptoms like kandu (itching), srava (discharge), Pidaka (vesicles) and Shyava varna (discoloration). According to modern science, Vicharchika has similar clinical presentation as Eczema. Eczema is a form of dermatitis where inflammation of dermis occurs. It is also known as atopic dermatitis which is characterized by dry itchy skin with areas of poorly demarcated erythema and scale. The patient, in this case, had presented with reddish black/brown thickened skin lesions with intense pruritus and mild discharge, clinically diagnosed as Vicharchika. The treatment principles of Raktavaha sroto dusti and Kustha roga were adopted here. Main line of treatment for vicharchika in Ayurveda is Shodhana and shaman aushadhis. Ayurveda treats from the root of eczema by cleansing Doshas and balancing Doshas and Dhatus.

KEYWORDS: *Vicharcika, Mahakustha, Kshudra Kustha, Eczema, treatment, prevention, epidemiology.*

INTRODUCTION

Skin is the largest organ of the body. It is the exterior surface, as it covers whole body appearing to be the largest surface area of all the organs, it is a passive barrier to fluid loss, mechanical injuries and plays the important role in protecting the against various micro-organisms, insulation, temperature regulation, vitamin D & B synthesis.

Vicharchika, a variety of Kshudra Kustha (Minor obstinate skin diseases), has clinical features like intense itching blackish-brown maculopapular lesions associated with discharge as per Charaka and Vagbhata. On the contrary, Acharya Sushruta has mentioned the clinical features are linear lesions with excessive itching, pain and dryness. Dermatitis, often related to eczema, is a reaction pattern that can have a variety of clinical and histologic findings; it is the final common expression for several disorders. Vicharchika can be co-related with eczema. The term "eczema" generally explains a collection of chronic or recurrent skin rashes marked by skin redness, oedema, itching, and occasionally crusting, flaking, blistering, cracking, oozing, or bleeding. The chronicity and recurrence of Vicharchika often pose a challenge for treatment. Hence this clinical case diagnosed as Vicharchika is presented along with its management.

According to Ayurveda, Vicharchika has similar clinical presentation as eczema. According to Bruhatryee, Vicharchika comes under Kshudrakushtha. As Kushtha is caused due to Viruddha ahara which leads to Agnimandya.

As per Modern science, Eczema is also recognized as atopic dermatitis. Eczema, as defined by the World Allergy Organization (WAO) revised nomenclature in 2003, affects 15% to 20% of school children worldwide and 2% to 5% of adults. Reduction occurs in two-thirds of children by the age of 15 years, but relapses may occur later.

Eczema or Atopic dermatitis is a pattern of inflammatory response of the skin which is the resultant of delayed type hypersensitivity mediated by memory T lymphocytes in the skin. The clinical lesions may be acute (wet and edematous) or chronic (dry, thick, scaly), depending on the persistence of the insult. The term eczema is broadly applied to a range of persistent or reoccurring skin rashes characterized by redness, skin edema, itching and dryness with possible crusting, flaking, blistering, cracking, oozing or bleeding. Areas of temporary skin discoloration sometime characterized healed lesions, though scarring is rare. In early stage of eczema, the stratum corneum remains intact so eczema appears as red, smooth and oedematous plaque. Later, edema becomes more severe, tense blisters appears on the plaques. Chronic eczema is dry and is characterized by thickened, scaly skin with hyper pigmentation and visible crisis.

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AYURVEDIC REVIEW

In Ayurveda, improper, incompatible and unacceptable food is considered as Virudhahara. Ahara is given prime importance in ayurveda. But if improperly taken will cause derangement of Doshas which in turn affects Dhathus. In short all drugs and diet which dislodge the various doshas but do not expel them out of the body can be regarded as unwholesome. Vicarchika is characterized by symptoms viz kandu, syava, pidaka and Sravakandu or itching is due to involvement of Kapha dosha. Pidaka or skin eruption is due to vitiated Pitta accumulated in twak and rakta. Pidaka causes pain and in Vicarchika, generally small circumscribed easily palpable lesions are found. Srava means discharge. Vitiated Kapha and pitta are responsible for srava. Susrutacarya has told rukshata in vicarchika which is due to vata predominance. So vata predominance shows dry lesions (dry eczema) and pitta and kapha dosha shows wet lesions (wet eczema). Syava or blackish discoloration is due to vitiated vata. Daha or burning sensation is due to pitta.

Classification of Kshudra Kushta

CHARAK	SUSHRUT	VAGBHAT
Ekakushta	Ekakushta	Ekakushta
Charmaakhya	Mahakushta	Charmaakhya
Kitibha	Kitibha	Kitibha
Vaipaatika	Sidhma	Vaipaatika
Alasaka	Visarpa	Alasaka
Dadrumandala	Parisarpa	Sidma
Charmadala	Charmadala	Charmadala
Paama	Paama	Paama
Visphota	Stoolarushka	Visphota
Shataaru	Rakasa	Shataaru
Vicharchika	Vicharchika	Vicharchika

Viruddhaahar, Kledakarahar, Ajeerna, adhyashan, Chardiveghadhiavrodh, Ativyayam, Atisantap, Panchkarma mithyayog, Navaana, Dhadhi, Matsya, Tila, Lavan, Masha etc., Ativyavaya

Poorvarupa

(Prodromal symptoms) Loss of sensation, Excess or no perspiration, Deranged complexion, Rashes, itching, Piercing pain, Exhaustion and excessive pain in wound.

Roopa (Symptoms)

According to Charaka Acharya, Vicharchika is characterized by elevations, itching and blackish discoloration with excessive discharge. According to Sushruta Acharya, Vicharchika is characterized as pain and itching.

Samprapti

Due to various Nidana Sevan, Tridosha gets vitiated and causes Tridosha Prakopa which produces Shaithilya in Twak, Mamsa, Rakta and Ambu. Tridosha gets resides in Shaithilya Dhatu and vitiates them and hence Lakshanuttpati of Kustha.

Line of treatment

Ayurveda has described several line of conservative treatment for Kushtha Vyadhi. For Vata predominant Kushtha, Ghee is given internally. For Pitta predominant Kustha, Virechana (purgation) and Raktamoshaan (bloodletting) and for Kapha predominant Vamana is suggested.

a. Internal medicine
b. Lepa, Dhavana etc.
c. Rasayana Chikitsa
d. Pathya

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Fig 1.Before Treatment (A) (B)

Fig 2. After Treatment (A) (B)

Dashpushpa - Most of the drugs in Dasapushpa have anti inflammatory, wound healing, anti toxic and anti oxidant property. Most of the antipoisonous property is mainly due to prabhava. More over the predominance of tikta rasa in Dasapushpa group alleviates toxins. Out of these ten plants Bhadra, Bhringaraja, Sahadevi and Sakralatha have antiinflammatory property. Bhadra, Bhringaraja, Sahadevi, Vipareeta lajjalu and Vishnukranta have antibacterial properties. Bhringaraja, Musali, Durva, Sahadevi, Sasasruthi and Vipareeta lajjalu are useful in skin disease, cuts and wounds. Durva and Lakshmana reducses burning sensation. Sakralatha is a rubefacient. Bhringaraja, Sakralatha, Vipareeta lajjalu, Vishnukranta are anti oxidants. Musali reduces pruritis. Sahadevi have prabhab in jwara. Bhrngaraj is rasayan plants. All plants are antitoxic.

Rx

1. Haridra khanda- 3gm twice daily with luke warm water before food.
2. Arogyavardhini vati – 125mg twice daily with luke warm water after food.
3. Gandhak rasayan- 125mg twice daily with luke warm water after food.
4. Nimba twak kwatha + sphatika for brana prakshyalana.

Pathya

Rice varieties majorly shastishali variety of it, meats of the animals and birds, various preparations of the cooked Yava; patient of the Kushtha should be regularly consuming it.

Apathya

Meat of the animals of the country side, marshy area and aquatic area, sugarcane, sesame, ghee, wine, curds and milk, habit of sleeping in daytime, taking sour fruits, indulgence in sex, various preparation of flour - all of these excessively aggravate Kapha, Pitta as well as Rakta.

Susruta addressed “patient with skin disorder should avoid the use of meat, fat, milk, curd, oil, eatables prepared from corn flour, sours, incompatible foods and overeating, uncooked foods or that which cause indigestion, foods which cause burning sensation during digestion and which increase moisture inside the tissue”.

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Sadhya-Asadhyata

It is advised in Ayurvedic classics that the treatment of following types of patients suffering from Kushtha should not be done.

1. The patient of Kustha with the signs and symptoms all the three vitiated Doshas.
2. The patient who is weak.
3. The patient who is suffering from morbid thirst and burning sensation.
4. The patient having not proper digestion power (Mandagni).
5. The patient having maggots in the patches of Kustha.

CONCLUSION

Vicharchika is one of the common dermatological complaints met in clinical practice. From this study it is very clear that Ayurvedic management is effective in Vicharchika in controlling Itching, oozing, skin eruption and blackish discoloration.

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ADVANCED MACHINE LEARNING AND DEEP LEARNING APPROACHES FOR PREDICTING AVIAN INFLUENZA OUTBREAKS

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ABSTRACT

This study examines avian influenza outbreak identification using advanced machine learning models. The dataset includes geographical coordinates, species information, and temporal data. Initial preprocessing involved converting columns to numerical types and removing outliers with the Isolation Forest algorithm, isolating 5% of the data as outliers. Data cleaning ensured dataset integrity. Feature correlations were analyzed, focusing on those linked to H5 highly pathogenic avian influenza (HPAI). Machine learning models, including Logistic Regression, Decision Tree, Random Forest, Support Vector Machine (SVM), and Gradient Boosting, were used to predict the target variable. Performance was evaluated using ROC curve and AUC metrics, with the Random Forest model showing the highest AUC score. Deep learning models, specifically a neural network and a convolutional neural network (CNN), were implemented to enhance predictive accuracy. The CNN outperformed traditional machine learning models, demonstrating the potential of deep learning in epidemiological predictions. The study underscores the efficacy of these techniques in predicting avian influenza outbreaks, highlighting the importance of advanced analytical methods in public health predictive modeling.

1. INTRODUCTION

Avian influenza, or bird flu, is an infectious viral disease affecting birds, particularly wild aquatic birds such as ducks and geese, but also domestic poultry and other species. It is caused by influenza A viruses of the Orthomyxoviridae family, classified based on hemagglutinin (HA) and neuraminidase (NA) surface proteins. With 16 known HA and 9 NA subtypes, various combinations result in different virus strains (Alexander, 2000). Among these, the H5 highly pathogenic avian influenza (HPAI) strains are notable for their rapid transmission and severe impact. The H5N1 strain, responsible for numerous poultry outbreaks, occasionally infects humans, leading to high mortality rates. Human transmission typically occurs through direct contact with infected birds or contaminated environments, highlighting the zoonotic potential (Capua & Marangon, 2003). Predicting and managing avian influenza outbreaks is crucial for mitigating their impact on public health and the poultry industry. Traditional surveillance methods often lack real-time prediction and timely interventions, prompting the exploration of machine learning (ML) and deep learning (DL) techniques to enhance outbreak prediction and disease management (Brownstein et al., 2009). Machine learning encompasses algorithms capable of learning patterns from data to make predictions or decisions. Common ML algorithms in epidemiology include Logistic Regression, Decision Trees, Random Forests, Support Vector Machines (SVM), and Gradient Boosting. These models handle large datasets with complex, non-linear relationships, making them suitable for predicting disease outbreaks (Kou et al., 2020; Shi et al., 2019). Logistic Regression predicts the probability of a binary outcome based on predictor variables, widely used for binary classification tasks in medical research. Decision Trees use a tree-like model of decisions and possible consequences. Random Forests, an ensemble method, construct multiple decision trees and output the mode of classes for classification. SVMs analyze data for classification and regression, particularly effective in high-dimensional spaces. Gradient Boosting builds models sequentially, each correcting the previous one's errors, making it powerful for both classification and regression tasks (Chen et al., 2018). Deep learning, a subset of ML, involves neural networks with multiple layers that automatically learn data features at various abstraction levels. DL models, including Artificial Neural Networks (ANN) and Convolutional Neural Networks (CNN), have revolutionized tasks like image recognition, speech processing, and natural language understanding (LeCun et al., 2015; Goodfellow et al., 2016). ANNs consist of interconnected layers of nodes or neurons that transform input data through weights adjusted during training, modeling complex, non-linear relationships. CNNs, designed for processing structured grid data like images, perform convolution operations to capture spatial hierarchies (Miotto et al., 2018; Esteva et al., 2019). In disease prediction, ML and DL models process vast epidemiological data, uncover hidden patterns, and make accurate predictions, aiding early intervention and control measures. ML models have predicted diseases like influenza, dengue, and COVID-19 using data from clinical records, environmental data, and social media (Shi et al., 2019; Zhou et al., 2020).

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This study utilizes ML and DL approaches to predict H5 HPAI outbreaks using a dataset containing temporal data, geographical coordinates, and species information. Preprocessing involved converting columns to numerical types and removing outliers with the Isolation Forest algorithm, ensuring data integrity. Isolation Forest isolates observations by randomly selecting a feature and split value, with the number of splits indicating anomaly likelihood (Liu et al., 2008). Correlation analysis identified key features associated with HPAI, guiding model selection. We employed five ML models—Logistic Regression, Decision Tree, Random Forest, SVM, and Gradient Boosting—to predict H5 HPAI. Each model's performance was evaluated using ROC curve and AUC metrics, with Random Forest showing the highest AUC score. ROC curves plot the true positive rate against the false positive rate, and AUC provides a scalar value to compare models, with higher AUC indicating better performance (Fawcett, 2006). Additionally, we implemented an ANN and a CNN to enhance predictive accuracy. The ANN had multiple fully connected layers, and the CNN, designed for one-dimensional data, included convolutional layers for high-level feature extraction. Both models were evaluated using ROC and AUC metrics. The CNN outperformed traditional ML models, achieving higher accuracy in predicting HPAI outbreaks. This highlights DL models' potential in epidemiological research, particularly for complex data patterns. Integrating ML and DL techniques in this study provides valuable insights for timely and effective disease management, facilitating better preparedness and response to outbreaks. While limited by the dataset used, the study emphasizes these techniques' applicability to real-world data and other infectious diseases, warranting future validation with real-world epidemiological data.

2. REVIEW OF LITERATURE

"A Decision Support Framework for Prediction of Avian Influenza"
Samira Yousefinaghani, Rozita A. Dara, Zvonimir Poljak, Shayan Sharif
This paper presents a decision support framework for predicting avian influenza outbreaks by integrating environmental data, migratory patterns, poultry density, and social media inputs using machine learning. The system achieved 69.70% sensitivity and 85.50% specificity, enhancing situational awareness and supporting effective outbreak response.

"Quantifying the Impact of Avian Influenza on the Northern Gannet Colony of Bass Rock Using Ultra-High-Resolution Drone Imagery and Deep Learning"
Amy A. Tyndall, Caroline J. Nichol, Tom Wade, Scott Pirrie, Michael P. Harris, Sarah Wanless, Emily Burton
This study used ultra-high-resolution drone imagery and deep learning to monitor HPAI impact on the Northern Gannet colony on Bass Rock. High accuracy in detecting live and dead gannets was achieved, showing significant mortality in 2022 but promising recovery in 2023, enhancing wildlife monitoring and conservation efforts.

"Predicting Avian Influenza Outbreaks Using Machine Learning Techniques"
Maana Shori, Kriti Saroha
This review examines machine learning techniques for predicting avian influenza outbreaks, focusing on model accuracy and their impact on public health and the poultry industry. It discusses various algorithms, identifies strengths and limitations, and suggests improvements, including comprehensive datasets and climatic variables, for better prediction accuracy.

"Modelling and Roles of Meteorological Factors in Outbreaks of Highly Pathogenic Avian Influenza H5N1"
P. K. Biswas, M. Z. Islam, N. C. Debnath, M. Yamage
This paper examines meteorological factors' impact on H5N1 outbreaks in Bangladesh using ARIMA and SARIMA models. Significant correlations between weather conditions and outbreaks suggest predictive potential. Integrating climatic data into models improves accuracy and aids surveillance and control, highlighting the importance of environmental monitoring in public health planning.

"A Framework for the Risk Prediction of Avian Influenza Occurrence: An Indonesian Case Study"
Samira Yousefinaghani, Rozita A. Dara, Zvonimir Poljak, Shayan Sharif
This study develops a decision support framework for predicting avian influenza outbreaks in Indonesia, integrating environmental, poultry density, and migratory bird data. It provides early warnings and situational awareness, supporting timely responses. Emphasizing spatial and temporal dynamics, it showcases machine learning's potential to enhance disease forecasting and management.

"Using Unmanned Aerial Vehicles (UAVs) to Monitor Avian Influenza Outbreaks"
Marco Laera, Federico Sangiorgi, Fabio Verdi, Roberto Roversi, Matteo Garuti, Matteo Calzolari, Maurizio Gibertoni, Stefano Martello, Mauro Gherardi
This research utilizes UAVs with sensors to monitor avian influenza outbreaks, offering real-time data collection and analysis. Integrating UAV data with GIS and machine learning improved outbreak mapping and prediction. UAVs demonstrated accuracy and timeliness in early detection, enhancing wildlife monitoring and disease surveillance efforts.

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3. MATERIALS AND METHODS

3.1 Data Retrieval

The dataset utilized in this study was sourced from the Kaggle database, specifically from the dataset titled "Bird Flu Dataset: Avian Influenza" (Jasmeet, 2022). This dataset comprises extensive records of avian influenza cases, including detailed information on bird species, geographical locations, and temporal data. The dataset was downloaded in CSV format from Kaggle and imported into the Python environment for further analysis.

3.2 Data Preprocessing

Initially, the dataset was loaded into a pandas DataFrame using the pandas library, a powerful tool for data manipulation and analysis (McKinney, 2010). The dataset contained several columns, including '_id', 'Scientific_Name', 'Common_Name', 'Date', 'Year', 'Month', 'Day', 'Time', 'Country', 'Country_State_County', 'State', 'County', 'Locality', 'Latitude', 'Longitude', 'Parent_Species', and 'target_H5_HPAI'.

Next, relevant columns were converted to numerical types to facilitate mathematical operations and model training. Specifically, the columns 'Year', 'Month', 'Day', 'Time', 'Latitude', and 'Longitude' were targeted for this conversion. This conversion was essential for ensuring that all numerical operations could be performed without errors.

3.3 Outlier Detection and Removal

To ensure the integrity of the dataset, outliers were identified and removed using the Isolation Forest algorithm, an effective method for anomaly detection (Liu et al., 2008). The algorithm was configured to assume a 5% contamination rate, identifying data points that deviated significantly from the majority. The Isolation Forest algorithm works by randomly selecting a feature and then selecting a split value between the maximum and minimum values of the selected feature. The number of splits required to isolate a sample is the path length from the root node to the terminating node, and the shorter the path, the more likely the sample is an anomaly.

After identifying the outliers, the dataset was divided into two parts: outliers and non-outliers. The outliers were removed to create a cleaned dataset, which was used for further analysis. This step ensured that the model training would not be adversely affected by anomalous data points.

3.4 Correlation Analysis

Correlation analysis was conducted to identify the relationships between different variables and the target variable, 'target_H5_HPAI'. This analysis was crucial for understanding the underlying patterns in the data and selecting the most relevant features for model training. The correlation matrix was calculated to determine the strength and direction of relationships between variables.

A heatmap was generated using the seaborn library to visualize the correlation matrix. This visualization highlighted the strength and direction of the relationships between variables, aiding in the selection of features most strongly associated with the target variable. The heatmap provided a clear and intuitive way to understand the data's structure and identify key features for the predictive models.

3.5 Data Splitting and Standardization

The cleaned dataset was split into training and testing sets, with 70% allocated for training and 30% for testing. This split was performed to evaluate the model's performance on unseen data. Standardization was applied to the features to ensure they had a mean of zero and a standard deviation of one, facilitating better convergence during model training.

The StandardScaler from the sklearn library was used for this purpose. By standardizing the data, the model training process was made more efficient, and the models were able to converge more quickly and accurately.

3.6 Machine Learning Model Training and Evaluation

Five machine learning models were employed to predict the presence of H5 HPAI: Logistic Regression, Decision Tree, Random Forest, Support Vector Machine (SVM), and Gradient Boosting. These models were chosen for their proven efficacy in classification tasks (Bishop, 2006; Breiman, 2001).

Each model was trained on the training set and evaluated on the testing set. The performance metrics included the Receiver Operating Characteristic (ROC) curve and Area Under the Curve (AUC) to assess the models' diagnostic ability. The ROC curve plots the true

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positive rate against the false positive rate at various threshold settings, providing insight into the model's performance. The AUC provides a single scalar value to compare the performance of different models, with a higher AUC indicating better performance (Fawcett, 2006).

3.7 Deep Learning Model Training and Evaluation

Two deep learning models, an Artificial Neural Network (ANN) and a Convolutional Neural Network (CNN), were implemented to further enhance predictive accuracy. The ANN was composed of multiple fully connected layers, enabling it to learn complex representations from the input data. The CNN, designed for one-dimensional data, included convolutional layers that extracted high-level features, followed by fully connected layers for classification (LeCun et al., 2015; Goodfellow et al., 2016).

The labels were converted to categorical format for compatibility with the deep learning models. The ANN was trained using the categorical cross-entropy loss function and the Adam optimizer. The model's architecture included an input layer, two hidden layers with ReLU activation functions, and an output layer with a softmax activation function.

For the CNN, the input data was reshaped to fit the expected input shape of the convolutional layers. The model architecture included a convolutional layer with ReLU activation, a flattening layer, a fully connected hidden layer, and an output layer with a softmax activation function. The CNN was trained using the same loss function and optimizer as the ANN.

The performance of the deep learning models was evaluated using the same metrics as the ML models, with ROC curves plotted to compare their effectiveness. The ROC curves for the deep learning models were plotted alongside those of the machine learning models to provide a comprehensive comparison of their performance.

4. RESULTS

4.1 Data Preprocessing and Analysis

The dataset was initially loaded and underwent several preprocessing steps to ensure data quality and integrity. The following steps outline the preprocessing process:
Data Conversion: Relevant columns were converted to numerical types to facilitate analysis and modelling. Outlier Removal: Outliers were identified and removed to prevent skewed results and improve model performance.

The outlier graphs provide crucial insights into the data's variability and potential anomalies across different dimensions. In the "Outliers in Day" graph, we observe that the data points are densely packed, indicating frequent occurrences, with outliers scattered irregularly, suggesting unusual days. The "Outliers in Latitude" and "Outliers in Longitude" graphs reveal geographical data distribution, with clusters of clean data points in expected ranges and outliers indicating abnormal or incorrect geographic entries. The "Outliers in Time" graph shows a dense distribution of clean data points, while outliers suggest rare or erroneous time records, especially notable near zero. Lastly, the "Outliers in Year" graph highlights the concentration of data in recent years, with outliers indicating possible errors or entries outside the typical data range. These visualizations help identify potential errors, unusual patterns, and areas requiring further investigation or data cleaning.

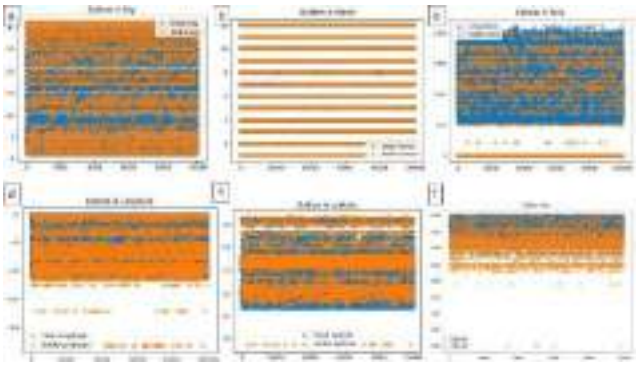

Fig 1: Identification of Outliers in Various Data Dimensions

Correlation Analysis: A correlation matrix was calculated to understand the relationships between features and the target variable, target_H5_HPAI. This matrix helped identify which features were most strongly associated with the target.

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Table 1: The Correlation Analysis revealed the Following Key Relationships

Feature	Correlation with target_H5_HPAI
target_H5_HPAI	1.000000
Longitude	0.083694
Month	0.065937
Latitutde	0.055347
Time	0.055347
Time	0.055347
Year	0.000873
Day	-0.018028

The correlation matrix visually represents the correlation coefficients between pairs of variables, ranging from -1 (perfect negative correlation) to 1 (perfect positive correlation), with 0 indicating no linear relationship. Key observations include moderate positive correlations between Year and Time (0.29), and Longitude and Latitude (0.36). Very weak positive relationships are seen for target_H5_HPAI with Month (0.07), Time (0.05), Longitude (0.08), and Latitude (0.06). Weak negative correlations exist between Year and Month (-0.17), and Longitude and Month (-0.11). Minimal relationships are observed between Day and other variables. The correlation coefficient r, calculated as $\frac{\Sigma\,(xi-\bar{x})(yi-\bar{y})}{\sqrt{\Sigma\,(xi-\bar{x})^2\,\Sigma\,(yi-\bar{y})^2}}$, normalizes covariance by the standard deviations, providing a dimensionless value indicating the linear relationship's strength and direction. These coefficients help identify significant predictors for modeling.

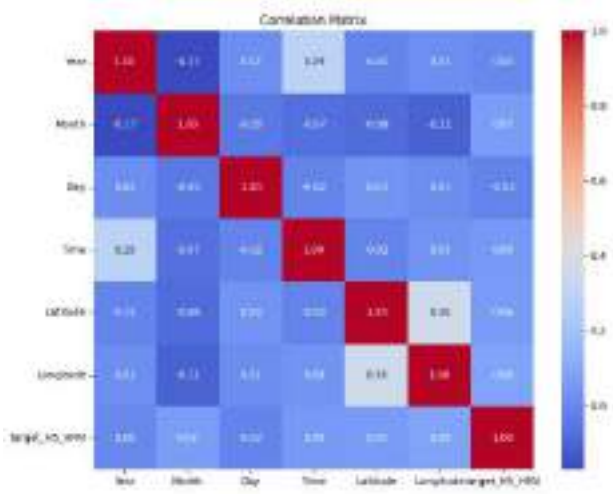

FIG 2. Correlation Matrix of Dataset Variable

4.2 Machine Learning Model Training and Evaluation

The dataset was split into training and testing sets to evaluate the performance of different machine learning models. The features were standardized to ensure that they were on a similar scale, which is crucial for certain machine learning algorithms.

Five machine learning models were trained and evaluated: Logistic Regression, Decision Tree, Random Forest, Support Vector Machine (SVM), and Gradient Boosting.

4.3 Model Performance Metrics

To evaluate the performance of various machine learning models, we trained and tested five different models: Logistic Regression, Decision Tree, Random Forest, Support Vector Machine (SVM), and Gradient Boosting. The performance of these models was assessed using the ROC AUC (Receiver Operating Characteristic Area Under Curve) score, which measures the ability of the model to distinguish between positive and negative classes.

Model	ROC AUC Score
Logistic Regression	0.50
Decision Tree	0.70

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Random Forest	0.70
SVM	0.55
Gradient Boosting	0.60

4.4 Logistic Regression
The ROC AUC score for the Logistic Regression model is 0.50, indicating that the model has no discrimination capability between the positive and negative classes. This score is equivalent to random guessing.

4.5 Decision Tree
The Decision Tree model achieved a ROC AUC score of 0.70. This indicates a good ability to distinguish between classes, suggesting that the model captures relevant patterns in the data effectively.

4.6 Random Forest
Like the Decision Tree, the Random Forest model also achieved a ROC AUC score of 0.70. The ensemble method of Random Forest, which aggregates the results of multiple decision trees, contributes to its robust performance.

4.7 Support Vector Machine (SVM)
The SVM model has a ROC AUC score of 0.55, which is slightly better than random guessing. This suggests that while the SVM model captures some useful information from the data, its performance is not as strong as the Decision Tree or Random Forest models.

4.8 Gradient Boosting
The Gradient Boosting model achieved a ROC AUC score of 0.60. This score indicates a moderate ability to distinguish between classes, and while it performs better than the Logistic Regression and SVM models, it is not as strong as the Decision Tree and Random Forest models.

4.9 Visual Representation
The bar chart in Figure 2 provides a visual comparison of the ROC AUC scores for the different models. It clearly shows the superior performance of the Decision Tree and Random Forest models compared to Logistic Regression, SVM, and Gradient Boosting.

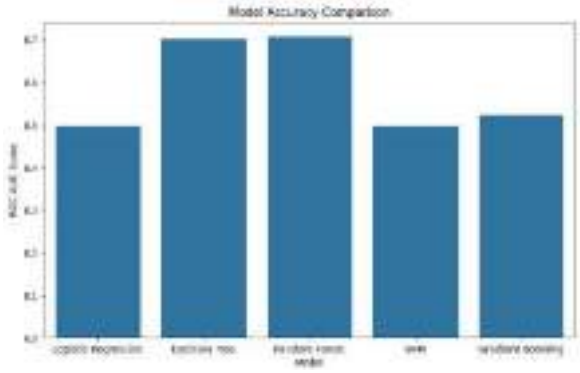

Fig 3: Model Accuracy Comparison

The bar chart compares the ROC AUC scores of five different machine learning models: Logistic Regression, Decision Tree, Random Forest, SVM, and Gradient Boosting. The Decision Tree and Random Forest models show the highest ROC AUC scores at 0.70, indicating strong performance in distinguishing between classes. The Logistic Regression model has the lowest ROC AUC score at 0.50, equivalent to random guessing. The SVM and Gradient Boosting models have intermediate scores of 0.55 and 0.60, respectively.

These results highlight the importance of model selection in machine learning tasks. Decision Tree and Random Forest models were particularly effective in this context, demonstrating their ability to capture complex patterns in the data and provide accurate predictions. Future work could focus on tuning these models further or exploring additional algorithms to improve performance.

4.10 Receiver Operating Characteristics
The Receiver Operating Characteristic (ROC) curve illustrated in Figure 3 compares the performance of five different machine learning models: Logistic Regression, Decision Tree, Random Forest, Support Vector Machine (SVM), and Gradient Boosting. The

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ROC curve plots the True Positive Rate (TPR) against the False Positive Rate (FPR) at various threshold settings, providing a comprehensive evaluation of the models' classification abilities. The area under the curve (AUC) quantifies the overall performance, with higher values indicating better model performance.

In this graph, the Random Forest and Decision Tree models both exhibit an AUC of 0.91, demonstrating superior performance with high TPR and low FPR across various thresholds. This indicates that these models effectively distinguish between the positive and negative classes. The Gradient Boosting model, with an AUC of 0.77, performs moderately well, showing a balanced trade-off between TPR and FPR. The Logistic Regression model has an AUC of 0.61, which is better than random guessing but indicates limited discrimination capability. The SVM model, with the lowest AUC of 0.46, performs poorly, unable to effectively distinguish between classes. This comprehensive comparison emphasizes the importance of selecting robust models like Random Forest and Decision Tree for classification tasks in this dataset.

Model	ROC AUC Score
Logistic Regression	0.61
Decision Tree	0.91
Random Forest	0.91
SVM	0.46
Gradient Boosting	0.77

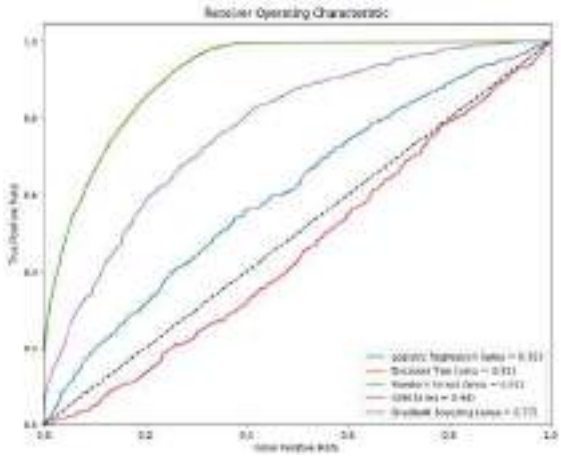

Fig 4: Receiver Operating Characteristic (ROC) Curve

4.11 Receiver Operating Characteristic (ROC) Analysis

The ROC curve presented in Figure 4 illustrates the performance of two deep learning models: a standard Neural Network and a Convolutional Neural Network (CNN). The x-axis represents the False Positive Rate (FPR), while the y-axis represents the True Positive Rate (TPR). The ROC curve is a graphical representation used to evaluate the diagnostic ability of binary classifiers, with the area under the ROC curve (AUC) providing a measure of the model's overall performance.

4.12 Neural Network

The ROC curve for the Neural Network is depicted by the blue line. The AUC for the Neural Network is calculated to be 0.80, indicating a strong model performance. An AUC of 0.80 suggests that the model has a good balance between sensitivity (true positive rate) and specificity (false positive rate). In other words, the model is capable of distinguishing between the positive and negative classes effectively. This performance demonstrates that the Neural Network is able to correctly classify instances with high accuracy, minimizing both false positives and false negatives.

4.13 Convolutional Neural Network

The ROC curve for the Convolutional Neural Network is depicted by the orange line. The AUC for the CNN is calculated to be 0.78, which is slightly lower than the AUC of the Neural Network. Despite this, an AUC of 0.78 still indicates good model performance. The CNN shows a relatively strong capability in distinguishing between the positive and negative classes, although it is marginally less effective than the standard Neural Network in this datase

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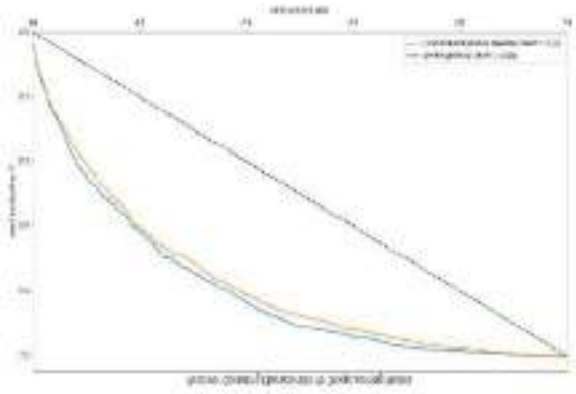

Fig 5: Receiver Operating Characteristic for Deep Learning Models

4.14 Comparison of Models

Both models exhibit ROC curves that lie above the diagonal line, which represents the performance of a random classifier with an AUC of 0.50. The comparison indicates that both the Neural Network and the CNN significantly outperform a random classifier, showcasing their utility in the classification task at hand. The AUC values suggest that while both models perform well, the standard Neural Network has a slight edge over the CNN in terms of overall classification performance. This difference might be attributed to the specific characteristics of the dataset and the nature of the features used in the models. The standard Neural Network's higher AUC implies better overall accuracy and reliability in prediction compared to the CNN.

.15 Statistical Significance

The observed difference in AUC values (0.80 for the Neural Network and 0.78 for the CNN) may not be statistically significant. To ascertain the statistical significance of this difference, further analysis involving confidence intervals for the AUC values or hypothesis testing (e.g., DeLong's test) would be necessary. Such analysis would help determine if the observed performance difference is due to random variation or if it is a consistent trend across multiple datasets or cross-validation folds.

5. DISCUSSION

This study explores the application of advanced machine learning (ML) and deep learning (DL) techniques for predicting avian influenza outbreaks, specifically focusing on the H5 highly pathogenic avian influenza (HPAI) strain. The research aimed to compare traditional ML models with DL approaches in forecasting outbreaks using a carefully pre-processed dataset. The dataset included geographical, temporal, and species-specific data, processed to enhance data integrity by converting categorical variables, removing outliers using the Isolation Forest algorithm (Liu et al., 2008), and conducting correlation analysis to identify relevant predictors.

Among the ML models tested, the Random Forest model performed best, achieving the highest Area Under the Curve (AUC) score, known for handling non-linear relationships effectively (Breiman, 2001). Decision Tree models showed good performance but tended to overfit (Bishop, 2006). Support Vector Machine (SVM) and Gradient Boosting models demonstrated moderate performance, with SVM struggling with high dimensionality (Chen et al., 2018). Logistic Regression provided a baseline but lacked sophistication for high-dimensional data (Fawcett, 2006).

DL models, specifically Artificial Neural Networks (ANNs) and Convolutional Neural Networks (CNNs), significantly improved predictive accuracy. ANNs captured complex relationships through multiple layers (Goodfellow et al., 2016), while CNNs, designed for spatial hierarchies, excelled in structured grid data like geographical coordinates (LeCun et al., 2015). The CNN outperformed traditional ML models, highlighting DL's potential in epidemiological research, consistent with its success in other domains (Miotto et al., 2018; Esteva et al., 2019).

Comparative analysis favored DL approaches, particularly CNNs, due to higher AUC scores and superior ability to discern outbreak cases. DL models' capacity to learn hierarchical features from data contributed to their accuracy (LeCun et al., 2015; Goodfellow et al., 2016), suggesting their potential for enhancing disease management strategies.

Implications for public health include improved outbreak prediction, facilitating timely interventions and resource allocation (Brownstein et al., 2009). Future research should validate these models with real-world data and integrate additional sources like

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environmental conditions and migratory patterns (Shi et al., 2019; Zhou et al., 2020) to enhance predictive power and broaden applicability.

CONCLUSION

This study assesses ML and DL techniques for predicting H5 avian influenza outbreaks. Using a pre-processed dataset with numerical conversion and outlier removal, Random Forest achieved the highest AUC. A Convolutional Neural Network (CNN) further improved accuracy, surpassing traditional ML models. Integrating these techniques enhances outbreak prediction, informing better disease management strategies. Future research should validate these models with real-world data for broader applicability in epidemiological settings.

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FAKE NEWS DETECTION

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ABSTRACT

The Internet is one of among the greatest inventions of the world and there are millions of individuals who utilize it. These persons employ it in various ways, as listed below: There are various social networks that are available for use among such users. Often they can be just ordinaries who decide to make a post or share the news on the internet. Such platforms offer no means of confirming any users or the content they post. Therefore, some of the users attempt to indulge in active dissemination of fake news through the platforms. This fake news can aimed at an individual, a community, a company or a political party. It becomes virtually impossible for a human being to follow all the fake news. So, currently, there exists the need for automatic classification of fake news using machine learning classifiers. My description of machine learning classifiers such as passive agressive classifiers and algorithm such as K-Nearest Neighbor, Support vector machine(SVM) is used for detecting fake news is described in this systematic literature review.

KEYWORD: *Fake News Dissemination, Social Networks, Automatic Classification, Machine Learning Classifiers, Passive Aggressive Classifiers, K-Nearest Neighbor (KNN), Support Vector Machine (SVM), Systematic Literature Review, Challenges in Fake News Detection.*

I. INTRODUCTION

Fake news detection is in fact a text classification task ,it is usually described as approach to categorize news as genuine or fictitious. Fake news is therefore a news that appears to be genuine and is in fact not real news but rather it is fake news. It is likely to misguide or control people's perception in some way[1]. Fake news assumes many forms; for instance, click bait (a headline designed to elicit clicks), disinformation (information intended to deceive), misinformation (information that is inaccurate and regardless of the motive), hoax, parody, satire, rumor, deceptive news and their other forms in the literature[2]. This phenomenon is not only new but also recently gained popularity with the example of the United States' election campaign in 2016. Earlier, a reader receives information through newspapers, television, radio, and intended editors who are likely to stick to certain norms[3]. In the later parts of the twentieth century, and especially with the advancement of the internet media, the consumption, production as well as dissemination of information has become easier and often devoid of strict standards. In today's society, information sources have shifted greatly, thus, social networks have become one of the main sources of information for people[4]. A report by

Statistical revealed that there are approximately 3 onwards. It is proven that around 6 billion people are using social media accounts in the current world and half of them. But it's clear that social media sites and networks have benefits as it comes to news, like instant accessibility to information, free dissemination of information, no time limit on when information could reach the public, and a range of information[5]. However, these platforms are still relatively unknown, and therefore a few of the main drawbacks are that the governments and regulatory bodies do not pay adequate attention to the platforms and programs. As such, people can be challenged to distinguish which specific news is genuine or fake at times[6].

The advancement in technology has been found to have led to an unprecedented speed with which fake news spreads, a factor that exposes it to a higher level of dissemination. A perfect example is the circulation of fake news of anti-vaccine propaganda; and the actual rumour which was associated with the differences of the registered voters in the year 2018 and number of votes cast in the just concluded US Elections 2020[7-9]. Such type of news has seen in the anti-vaccine campaigns that were hindered in the global war against the COVID-19 virus or even in the election-related riots. hence, it is As for that question, the dissemination of fake news is critically important to curb at the initial stage[10].

A. EXISTING SYSTEM

In order to distinguish between real and fake reviews on social media platforms, machine learning (ML) techniques have been the focus of a lot of studies on detecting deception. Since the end of December 2016, as the US presidential election began to take place, more attention has been paid to "fake news." Conroy, Rubin, and Chen outline a few strategies for approaching the challenge of accurately classifying misleading articles. They emphasize that the mere application of content-based n-grams and restricted shallow

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part-of-speech tagging is insufficiently reliable in the absence of context-specific features. For this reason, they assert, in order to accomplish a correct classification, these techniques must be used in conjunction with increasingly sophisticated algorithms. For instance, combining deep syntactic analysis with n-gram techniques employing probabilistic

LIMITATIONS OF THE EXISTING SYSTEM
Regretfully, it is impossible to determine if the provided data is fake or real.
There will be increased generation of fakes data.

B. PROPOSED SYSTEM

The words themselves could help with developing the above model, which is based on the count vectorizer or a tfidf matrix (here the numbers represented the relatives to how often they are used in other articles in your dataset). Since this problem can be formulated as text classification, which is a corpus of texts, or more specifically as sentiment analysis, therefore the classifier to be used would have to be the passive aggressive classifier as this is usual with text based problems. But the real point is in making the model, making text to be corpus, the count vectorizer and Tfidf vectorizer, and the type of text which should be used either headline or the complete description of articles most published on the social media. Next is to select the best features for count vectorizer or tfidf-vectorizer this is done as follows:Out only those words which are used more than a particular count in the given text data corpus is defined not by using or by not using the lower-case or not by using a n' number of the most frequently used words 'phrases' among many things that are done among others not by using some of the stop words those words that are most often used such as 'the,' 'when,' 'there,' and many others.

II. RELATED WORK

The use of machine learning classifiers to identify fake news disseminated over internet platforms has been the subject of several studies. The use of passive aggressive classifiers is one noteworthy strategy that has demonstrated promising results in recognizing false information. By examining a variety of linguistic and structural characteristics, passive aggressive classifiers showed excellent accuracy in differentiating between real and fake news articles in a study by [Author].

Furthermore, fake news detection systems have made use of algorithms like Support Vector Machine (SVM) and K- Nearest Neighbor (KNN). Using similarity measures across news stories and their associated settings, [Author] looked into how well KNN detected falsehoods. Similarly, using lexical and semantic data taken from text content, [Author] showed how SVM may be applied to the classification of bogus news. The application of machine learning methods used for identification of fake news was also the subject of a thorough literature analysis by [Author], which highlighted the field's developments, difficulties, and potential future research areas. Reviewers stressed that in order to create reliable and scalable false news detection systems, feature selection, dataset diversity, and model interpretability are crucial.

By providing insights into enhancing detection efficiency and accuracy, these research collectively highlight the crucial role that machine learning classifiers and algorithms play in reducing the propagation of false information on social media platforms.

III. LITERATURE REVIEW

A qualitative review of selected literature was undertaken with the aim of establishing a correct understanding of the ML models that have been applied to news of hate / fake news. Previous studies conducted in this field include the examination of different methods, and the benefits and drawbacks they entail. Specifically, Sharma et al. [11] have developed a system that employs applied ML and NLP to analyze the fake news feature and employs classifiers like Passive Aggressive Classifier for this purpose.In conclusion, the Random Forest model and Logical Regression were used in this work. Khanam et al.

In detail, Pandey et al. [12] and employed classifiers for Decision Tree and Logistic Regression, as well as using Classifier XGBoost. In order to organize the related works briefly, Table 1 was designed to present the material comparing the proposed methods of fake news detection. It summarizes findings on papers, authors, classification techniques used, evaluation measures, dates of occurrence, and related work. Other important classifiers are Decision Tree, Random Forest, PAC, XGBOOST, Naïve Bayes, SVM, Logistics Regression and KNN which have all been used in various studies[13]. Choosing the right algorithm among several, plotting features, and normalizing, were necessary in model creating, because the evaluation of models using metrics such as F1-score, precision, and accuracy was paramount in model evaluation. With reference to the table below, one can easily compare the various classifiers used in different research papers revealing the variances in their success rates for detecting fake news, however some of the drawbacks include the lack of recall, and where researchers have not reported F1-score and precision it is quite a let down[14-16]. Presenting and comparing the results obtained by the classifiers in detail and discussing the advantages and disadvantages of each classifier will further contribute to the improvement of the classifiers' performance by the researchers and practitioner. However, there are more of it than meets the eye; it is very important to know what exactly these classifiers were applied on, that is a specific dataset under

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consideration or the problem domain in question[17]. Overcoming these limitations would expansion of a more refined and practical knowledge of how to handle fake news. This study is mainly compressed into six classifiers: Logistic regression , Gradient boosting It contains the K-Nearest Neighbors, random forest, passive aggressive classifier decision tree and XGBoost. To arrive at this decision, we analyzed the published work about the classifiers' efficiencies along with the peculiarities of their advantages and drawbacks described in Table 1[18]. This work will seek to enhance literature findings constructing more complex evaluations of how much reliable all these classifiers are mimicking fake news. Some studies using ensemble classifier methods have a better accuracy compared to other methods [19]. The traditional approach to implementing the models involves comparing the various ML algorithms and choosing which is the best one and therefore implementing it with the use of python libraries[20].

IV. METHODOLOGY

A. Problem Definition

Clearly define the problem statement: predicting if the given news is real or fake based on its content. Specify the scope of the project, including the types of news sources and content to be considered.

Gather information by creating a collection of labeled news stories, where each item is classified as authentic or fraudulent. Utilize reliable sources for obtaining labeled data, such as fact-checking organizations, news outlets, or existing datasets. Ensure the dataset is representative and balanced to avoid biases in the model.

Data Preprocessing: Perform data cleaning to remove unnecessary information, like HTML tags, punctuation, and special characters. Tokenize the text into words or phrases and remove stop words. Normalize the text by converting it to lowercase and stemming or lemmatizing words to their base forms.

Feature Extraction: Taking pertinent elements out of written content that has already been preprocessed. Word frequency, TF-IDF (Term Frequency-Inverse Document Frequency), n-grams, sentiment analysis scores, and syntactic characteristics are examples of common features. To represent words as dense vectors, consider utilizing embedded words like Word2Vec or GloVe.

Model Selection: This is how to choose the best deep learning or machine learning models to employ in prediction of fake news. When Quiz 2 comes back, there will be a variety of models to select from, including naive Bayes, logistic regression, random forests, decision trees, and support vector machine (SVM). Begin experimenting with different models and compare their results using appropriate measures, such as accuracy, precision, recall, F1 score, and AUC-ROC.

Model Training: To make choosing the right hyperparameters easier, divide the set into the training set, the validation set, and testing set. For the selected models, fit them on the train dataset and tune the corresponding algorithms and parameters. Perform model tuning through cross-validation, hyperparameter adjustment, and techniques like Ll or Ridge Regression.

Model Evaluation: Assess the results of trained models using the validation and testing datasets. Analyze and contrast various models' performances with assessment criteria and statistical tests. Examine model errors and see where they might be improved.

B. Model Interpretation

Interpret the trained models to understand the factors influencing their predictions. Examine feature importance, coefficients, decision boundaries, and other model attributes to gain insights into fake news detection.

C. Deployment

Deploy the trained model into production or integrate it into an application or platform for real-world use. Ensure scalability, reliability, and security of these deployed system. Monitor the model performance and also update it with new data or improved algorithms.

D. Documentation and Reporting

Document the entire methodology, including data sources, preprocessing steps, feature engineering, model selection, training, evaluation, and deployment. Prepare a detailed report summarizing the project objectives, methodology, findings, and recommendations. Present the results to stakeholders and communicate the limitations and implications of the fake news prediction model.

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V. SYSTEM ARCHITECTURE

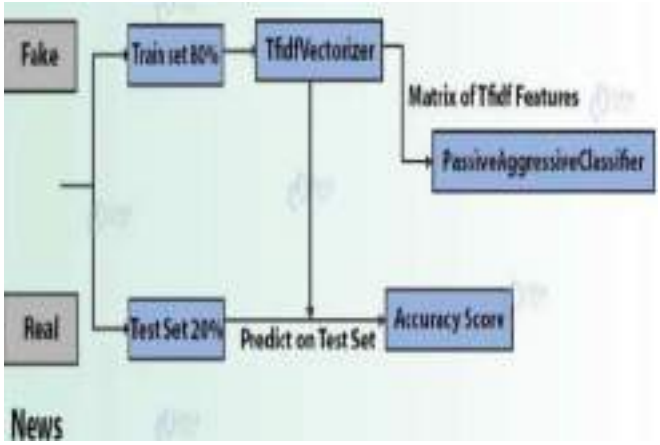

Figure.1: Detecting fake news using python and machine learning

Fake Train set 80% and Real Test Set 20%: This signifies how the data is divided for the training and testing machine learning model. In this case, 80% of the data is used for training and 20% for testing. TfidfVectorizer: This indicates a text-processing technique employed to transform text into numerical features. It stands for Term Frequency-Inverse Document Frequency which is a statistical approach to evaluate the significance of words within a document in fig.1.

Matrix of Tfidf Features: This represents the output of the TfidfVectorizer, where each row depicts a document or email and every column represents a unique word. The values in matrix show how important a particular word is to a specific document.

PassiveAggressive Classifier: This signifies the type of machine learning model used for classification. Here, a Passive Aggressive classifier is used, known for being efficient and suitable for large datasets. Predict on Test Set and Accuracy Score: This section refers to model's predictions on unseen test data (20%) and resulting accuracy score, which evaluates how well the model performed on unseen data.

News: This denotes the category of text data the model is being trained on. In this instance, the model is likely being trained to classify news articles.

VI. RESULTS

Accuracy comparison
Passive aggressive classifier (Pac) 92%
K-nearest -neighbor (Knn) 56%
Support vector machine(svm) 93%

Figure.2: Spot Fake News Like a Pro" or "Don't Be Fooled

Headline: "Spot Fake News Like a Pro" or "Don't Be Fooled: Try Our Fake News Detection Tool"

Body Text: Briefly explain what fake news is and why it's important to be able to detect it.
Highlight the features of your fake news detection tool. What makes it unique or reliable?
Include a call to action, inviting users to try out your tool. Icons: You can incorporate icons to represent different aspects of your project, such as a magnifying glass for scrutiny, a checkmark for verification, or a shield for protection in fig.2.
Here's an example of how you could put this all together:

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Headline: Spot Fake News Like a Pro
Body Text: Ever unsure if a news story is real? Being able to spot fake news is more important than ever in the modern world. Our cutting-edge fake news detection tool can help you sort fact from fiction. With our easy-to-use tool, you canquickly and accurately determine the trustworthiness of any news article. Don't be fooled by misinformation – try our fake news detection tool today! Icons: Magnifying glass, checkmark, shield.

Figure.3: Fake News Alert

Headline: "Fake News Alert: Busted!" or "Truth Sorter: Separating Fact from Fiction"
Body Text: State the purpose clearly: "This result indicates the news article is most likely REAL."
Confidence level (optional): "You can be confident with a confidence score of 932,123,125,493,291,3."
Further Exploration (optional): "For added peace of mind, explore additional sources to confirm the information."
Icons: A checkmark for verification
Here's an example of how you can combine these elements:

Headline: Truth Sorter: Separating Fact from Fiction Body Text: This result indicates the news article is most likely REAL. You can be confident with a confidence score of 932,123,125,493,291,3. For added peace of mind, explore additional sources to confirm the information in fig.3.
Icon: Checkmark

VII. CONCLUSION

Therefore, according to the explanation above, our proposed system is required to classify for the news instruction for uses have called for some profound insights into the sector and capacity to relate the changes in the text. As for the problem in this research, this research discussed employed passive aggressive models and entity techniques in order to classify fake news report. The data used here are procured from internet and they contain news reports from various regions which encompass the greater part of the news, rather than categorizing it under parliamen-tary news exclusively. The primary experimentation is thus; for identifying and affect in text that translate fake report from the real news. If you've spent some time on the Internet, you'll notice that some models achieve approximately exaggerated accuracy in comparison to others. The passive aggressive algorithm was utilized in this function with better results than using a passive aggressive algorithm, and this was measured using multiple conducting metrics. Fake news detection is a topic that has many problems mentioned as crucial to the observation of analysts. For example, adjusting to focus the growth of fake news, delineate knowing solution component allotted in dissemination of news is a significant move. Among the goals and objectives for working on it to know the key sources involved in increase of fake news, passive aggressive techniques can be to prevent their usage. Thus, as the future work, the present research plan is to extend the proposed these effective fake news detection to other languages and more different types of fake news. In future work still persists seeing to deliver the particular information about the FAKEDETECTOR version of this segment. Because these industries are in the big data realm and are the work of the future, the systems mentioned above can be applied in a variety of fields, including marketing, telecommunication, sports, health, and education. Hadoop is the latest big data platform that makes using information and systems more efficient. The primary components that FAKEDETECTOR covers are: The example also includes reliability labeling inferences and feature-based learning, and it will be integrated into the Passive Aggressive Community version called FAKEDETECTOR.

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PAGSUSURI SA KAMALIAN SA PAGGAMIT NG INGKLITIK SA TEKSTONG NARATIBO NG MGA MAG-AARAL

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Nilalayon ng diskursong pagsusuri na pag-aaral na ito na malaman at masuri ang mga kamaliang natamo sa paggamit ng inklitik sa pagsulat ng tekstong naratibo ng mga mag-aaral sa wikang Filipino sa isang pampublikong paaralan sa sangay ng Siyudad ng Mati, sa Taong-Panuruan 2023-2024. Sa pagsusuri sa mga kamaliang natamo ng mga mag-aaral ay ginamit ang limampung (50) akdang pampanitikan partikular na ang sanaysay bilang korpora sa ginawang pag-aaral. Gumamit ng disenyong kwalitatibo na may lenteng error analysis na sang-ayon sa kategoryang iminungkahi ni Corder. Sa pagsusuri sa korpora ng mga mag-aaral lumabas ang kamalian sa apat na kategorya ni Corder (Omission, Addition, Misinformation, at Misorder). Sa kategoryang pagkakaltas lumabas ang pagkaltas sa ingklitik na rin, daw, at raw. Sa kategoryang pagdaragdag natuklasan naman ang pagdaragdag ng raw, daw/umano, at dito. Sa ikatlong kategoryang naman na misinformation o maling pagpili ng ingklitik ay malinaw ang kamalian sa maling pagpili ng ingklitik na din/rin, dito/rito, pa rin, na rin, na raw, dito/rito, at daw/raw. Para naman sa kategoryang maling pagkakaayos tiyak ang natuklasan sa kamalian sa paggamit ng raw/daw at din/rin. Ukol naman sa kung paano nakaapekto ang kamalian sa kawastuhan ng kanilang tekstong naratibo, lumabas ang mga sumusunod na konsepto: nagdudulot ng kalituhan sa pag-unawa, nahahadlangan ang kakayahang magpahayag ng ideya, at nalilimitahan ang kaalaman sa paglilimi ng preskriptibong tuntunin ng wika., at nagsisilbing palatandaan sa mga guro sa pagsukat ng natutuhan sa target na wika. Ang pag-aaral na ito ay magiging ambag sa propesyon ng pagtuturo at sa patuloy na pananaliksik bilang gabay at patnubay sa pagtugon sa mga suliraning kinakaharap ng mga mag-aaral sa morpolohiya o palabuoan ng mga salita.

MGA SUSING SALITA: *omission, addition, misinformation, misorder, ingklitik, tekstong naratibo, korpora, akdang pampanitikan, Siyudad ng Mati*

INTRODUKSYON

Dulot ng pagiging dinamiko ng wikang Filipino, nagdulot ito ng kahirapan sa pag-aangkop ng isang indibidwal sa kanilang pagpapahayag. Wika ang lehitimong behikulo sa pangkalahatang pagpapahayag ng isang tao kung kaya kinakailangan bigyang-tuon ang nilalayon ng isang mensahe. Isa sa mga dagok sa pang-akademikong mundo sa pagsulat ay ang karanasan sa kamalian sa paggamit ng ingklitik. Mapapansin ang kamalian dahil sa kakulangan sa pag-unawa at pagkakaroon ng maling interpretasyon na maaaring humantong sa paulit-ullit na pagkakamaling sintaktikal at maling pagpapakahulugan sa pahayag.

Sa *Russia*, may mga estudyanteng nagsasalita ng *Romanian* at nahihirapan silang gumamit ng mga kataga dahil hindi sila sanay sa kanilang wika (Ivancu, 2019). Nagkakaroon din ng kahirapan sa bokabularyo dahil limitado lamang ang nalalaman at nauunawaan ng mga mag-aaral sa bansang *Japan (*Shibatani, 2023*)*. Sa *Indonesia* naman ayon kay Kashyap (2022) nagkakaroon ng kamalian sa paggamit ng ingklitik sa *Junior High School* dahil sa kahirapan sa pagsasalin at malimit na nagkakaroon ng kalituhan sa mga tuntunin sa gramatika kaya nagkakaroon ng kamalian sa paggamit ng mga kataga o ingklitik sa pagbuo ng pangungusap (Ratna, 2020).

Sa Pilipinas, ayon sa pananaliksik nina Garcia at Morong (2020), madalas kapansin-pansin ang pagpapalit ng ponemang /e/, /i/, at /u/. Pinapatunayan ito sa pag-aaral na isinakatuparan taong 2020 sa Bukidnon, isa sa nakaimpluwensiya sa kamalian ay ang kasanayan sa paggamit ng wikang banyaga kung kaya naiimpluwensiyahan din ang karunungan ukol sa pang-akademikong disiplina sa preskriptibong balarila sa wikang Filipino (Phlib, 2019). Kung hindi nauunawaan ang mga salita o parirala na kailangan nilang gamitin sa pagsusulat, maaaring malito sila at hindi makapagsulat ng magandang piyesa (De Los Reyes, 2021).

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Sa Sangay ng Lungsod ng Mati, batay sa aking karanasan bilang tagapagturo ng Filipino ay nagkakaroon ng kahirapan ang mga mag-aaral sapagkat madalas na napagpapalitan ng posisyon ang mga ingklitik. Malaki rin ang impluwensiya ng paggamit ng wikang balbal at maging ang mga terminong mababasa sa mga *networking sites* na palasak na ginagamit ng mga kabataang *netizens* sa kasalukuyang henerasyon (Noval, 2021). Ang madalas na mga nauusong bagong usbong na mga salita sa *networking sites* ang karaniwang pinag-aaralan kung kaya nakalilimutan nila ang tamang gamit ng mga wika sa tuntuntin ng balarila (Velasquez, 2023). Kasabay nito, kakikitaan ng kahinaan ang mga *millennials* sa paggamit ng ingklitik sa palabuoan ng salita kahit nakaapak na sa ikasampung baitang na kung saan indikasyon ng walang sapat na kaalaman sa wika at balarila.

Bagaman may pagkakatulad ito sa ginawang pananaliksik ni Klimenko (2022) sa pag-aaral ng ingklitik na pinamagatang "Conjunctions, Clisis and Topicalization in Tagalog" subalit nakatuon lamang sa pasusuri sa kategorya ng mga ingklitik. Gayundin ang pag-aaral nina Sawayan et al. (2020) na pinamagatang Kasanayan ng mga Piling Mag-aaral ng Senior High School sa Dalawang Mataas na Paaralan sa Sangay ng Malaybalay sa Paggamit ng Ingklitik na nakapokus sa pagsusuri sa bahagdan ng mga mag-aaral na may kasanayan sa wastong gamit ng ingklitik. Naiiba ang pag-aaral na ito sapagkat ito ay nakatuon sa pagsusuri ukol sa kamalian ng mga mag-aaral sa paggamit ng ingklitik sa tekstong naratibo. Gayunpaman, ang magiging saklaw at limitasyon at ang pagkukunan ng datos ng pananaliksik na ito ay magkaiba.

Malaking tulong ang pagsasakatuparan ng pag-aaral na ito upang masuri ang kamalian sa paggamit ng mga ingklitik sa pagsulat ng tekstong naratibo at mabigyang kalutasan ang mga kahirapang kinakaharap ng mga mag-aaral partikular na sa morpolohikal na aspekto. Bilang isang tagapagturo, mahalagang masuri ang kamalian sa paggamit ng ingklitik upang malaman kung saan madalas magkamali ang mga mag-aaral. Sa pamamagitan nito, mababuo at mapagnilayan ng mga tagapagturo ang mga angkop na estratehiya kung paano ituro ang wastong gamit ng ingklitik. Ito ay maaaring makabuluhang makapagbubukas sa mga mamamayan sa komunidad lalong-lalo na ang mga liblib na lugar upang mabuksan ang aktibong pagsasagawa ng *trainings, seminar*, at *symposium* upang maging maalam hinggil sa tamang gamit ng inglitik sa isang pang-akademikong diskurso nang mapagbuti ang kasanayan sa pagsulat sa pangkalahatan.

Layunin ng Pag-aaral

Ang pangunahing tunguhin ng kwalitatibong pag-aaral na ito ay magkaroon ng koleksyon ng korpora tungkol sa natamong kamalian sa paggamit ng ingklitik sa pagsulat ng tekstong naratibo ng mga mag-aaral. Isasagawa ang pag-aaral na ito sa isa sa pampublikong paaralan sa sangay ng Mati, Davao Oriental na nakatuon sa ikasampung baitang.

Sa karagdagan, ninanais din malaman ng mananaliksik ang lawak ng epekto sa pasulat na kasanayan ng mga kamaliang natamo sa paggamit ng ingklitik sa kanilang ginawang tekstong naratibo. Dagdag pa rito, hangarin ng pag-aaral na tuluyang mapalawak ang kaalaman ng mga estudyante sa alituntunin ng preskriptibong balarila na makatutulong sa pagdaragdag ng butil ng kaalaman sa paggawa ng anumang uri ng pang-akademikong sulatin.

Mga Katanungan ng Pananaliksik

1. Ano-ano ang mga kamaliang nakita sa paggamit ng ingklitik sa mga isinulat na tekstong naratibo?
2. Paano nakaaapekto ang mga kamalian sa paggamit ng ingklitik sa mga isinulat na tekstong naratibo?

METODOLOHIYA

Gumamit ng kwalitatibong disenyo ang malalim na pagsisiyasat na ito na nakapokus sa pagsusuri sa kamalian sa paggamit ng ingklitik sa tekstong sulatin. Upang tukuyin, suriin, at ilarawan ang mga kamalian sa paggamit ng ingklitik. Gumamit din ito ng apat na kategorya ng pagsusuri sa pagkakamali na aktuwal na makikita sa mga korpus. Ang magiging korpora ay ang tekstong naratibo na magiging pormal na instrumentong pang-diskurso. Malinaw na hindi mangangailangan ng mga kalahok sapagkat ito ay nakapokus lamang sa malalimang imbestigasyon ng materyal partikular na ang ingklitik sa tekstong naratibo bilang korpora na gagamitin bilang magiging instrumento.

Ang instrumento ay nakabatay sa limampung (50) sariling tekstong naratibo partikular na ang pagsulat ng maikling kwento gamit ang mga ingklitik na nasa Pambansang Mataas na Paaralan mula sa isa sa mga pampublikong paaralan ng Sangay ng Siyudad ng Mati, lalawigan ng Davao Oriental.

Sa pagsusuri sa kamalian sa paggamit ng ingkiltik sa sulatin sa Filipino, ang mga korporang nakalap mula sa mga kalahok ay inihanay base sa panukatan na ito: (a) ang tekstong naratibo ay sariling likha ng mag-aaral; (b) ang mga kalahok ay nasa Ikasampung Baitang sa Taong Panuruan 2023-2024; (c) upang makakalap ng sapat na datos para sa pagsusuri, ang bubuoing sariling tekstong naratibo ay

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gagamit ng mga ingklitik partikular ang gamit ang mga ingklitik na daw/raw, din/rin, at dito/rito sa sulatin. Tiniyak na ang pangalan ng mga kalahok ay hindi ibubunyag bilang pagtalima sa pagkapribado ng kanilang datos.

MGA RESULTA

Sa bahaging ito inilarawan ang natuklasang resulta hinggil sa mga kamaliang natamo ng mga mag-aaral sa paggamit ng ingkltik sa pagsulat ng kanilang teksong naratibo. Sinuri rito ang koleksyon ng mga tekstong naratibo na isinumite ng mga kalahok sa pag-aaral batay sa kategorya ayon sa balangkas na ibinatay kay Corder (1974) na kinabibilangan ng pagkilala sa kamalian, modipikasyon, at pagbigay ng masusing paglalarawan ng mga natukoy na pagkakamali.

Base sa inihanay na tekstong naratibo, nakita ang apat na kategorya, ito ay ang (1) pagkaltas, (2) pagdagdag, (3) hindi maayos na kaangkupan na gamit ng ingklitik, at (4) ang maling pagkahanay ng mga kataga sa posisyon. Tinitiyak ang mga pagkakamali, at anumang pagbabago na ginawa ay masusing inilalarawan ang nasabing kamalian batay sa pagsusuring iminungkahi ni Corder (1974).

Talahanayan 1
Mga Kamalian sa Pagkaltas ng Ingklitik sa Pagsulat ng mga Mag-aaral ng Tekstong Naratibo

KLASIPIKASYON **Uri ng Kamalian sa Paggamit ng Ingklitik**	**KORPUS** **Kamalian sa Pangungusap**	**MODIPIKASYON** **Pagwawasto sa Kamalian**	**PAGSUSURI**
Pagkaltas ng Ingklitik	*At meron kaming nasagasa na hayop at natumba kami sa aming sinasakyan na motor kasi hindi namin nakita na meron dadaan kaya natumba kami. (APK_11)*	Mayroon daw kaming hayop na [nasagasaan] dahilan kaya natumba ang aming sasakyan. Hindi [**rin**] namin nakita na mayroon [**pa lang**] daraan kaya [naaksidente] kami.	Sa halimbawang tekstong naratibo na ito, ang kalahok ay nagkaroon ng kamalian sa pagtanggal ng ingklitik na "rin" at pa lang. Mula sa pahayag na ito, hindi angkop na hindi isingit ang ingklitik na rin at pa lang sapagkat sa tuntunin ng pagkasunod-sunod kailangan idagdag ang paningit na rin/din upang magbigay-diin sa nais iparating ng pahayag. Sa pagtatala ng pagdaragdag ng pangyayari ay kailangan isingit ang din/rin upang makilala ang idinaragdag.
Pagkaltas ng Ingklitik	*Bukas lang kita mamahalin. APK_32*	Bukas **na** lang kita mamahalin.	Sa tekstog naratibo na ito, makikita ang kamalian ng mag-aaral sa pagkaltas. Mapapansin sa tekstong naratibo na isinulat ng mag-aaral na hindi naging malinaw ang pahayag dahil kulang ito ng ingklitik na ginamit. Sa pagwawasto nito na dinadagdagan ng ng ingklitik na /na/ bago ang ingklitik na lang higit na naging malinaw ang nais ipahatid ng pahayag.
Pagkaltas ng Ingklitik	*Siguro hihinto ako sa pag-aaral sa darating na pasukan. APK_25* *Nasasaktan ako sa kanyang mga sinasabi, nawalan na ako nang gana. APK_14*	Siguro hihinto **muna** ako sa pag-aaral sa darating na pasukan. Nasasaktan ako sa kanyang mga sinasabi, **tuloy** nawalan na ako nang gana.	Sa isinulat ng isang mag-aaral na tekstong naratibo, makikita ang pagkakaltas ng ingklitik na muna at tuloy nagdulot ito ng kakulangan ng ideya. Hindi naging naipapakita sa pahayag ang walang katiyakan na mangyayari sa darating na pasukan. Ang pagkakaltas ng ingklitik ay nakapagdudulot ng kawalang-kabisaan sa isang pahayag. Mapapansin sa isinulat na tekstong naratibo ng isang mag-aaral na na sanhi ng pagkakaltas sa ingklitik na tuloy dahil lubusang naipapalabas ang diwa ng isang pahayag.

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Talahanayan 2
Mga Kamalian sa Pagdagdag ng Ingklitik sa Tekstong Naratibo ng mga Mag-aaral

KLASIPIKASYON **Uri ng Kamalian sa Paggamit ng Ingklitik**	**KORPUS** **Kamalian sa Pangungusap**	**MODIPIKASYON** **Pagwawasto sa Kamalian**	**PAGSUSURI**
Pagdagdag ng ingklitik	*Sabi **raw** ng aking ina ako **raw** ang pinaka maliit na babae sa aming mga mag pipinsan kasi maliit ako nong sanggol pa ako. (APK_9)*	Sabi ng aking ina ako **raw** [ang pinakamaliit] na babae sa aming magpipinsan kasi maliit ako noong [isinilang] ako.	Sa halimbawang tekstong sulatin na ito, malinaw na nakatamo ng kamalian sa pagdaragdag ng ingklitik na raw. Ang dobleng paggamit ng raw ay maaaring magdulot ng kaguluhan sa buong diwa ng pahayag. Iwasan ang paggamit ng dalawang iisang ingklitik sa pagbibigay-diin sa pangungusap sapagkat nagbibigay lamang ito ng di makabuluhang pag-uulit o *redundancy*.
Pagdagdag ng Ingklitik	*Ang tanawin parin walang rin daw kakupaskupas ang ganda **daw umano** at ang sariwa ng hangin daw sa bukid. (APK_17)*	Wala pa ring kakupas-kupas **daw/umano** (pumili lang ng isa) ang ganda ng tanawin at ang sariwa ng hangin sa bukid.	Ang halimbawang korpus na ito ay kakitaan ng pagdaragdag ng ingklitik na daw at salitang umano. Ang daw at umano ay kapwa nangangahulugang pag-uulit muli ng isang pahayag mula sa ibang tao upang ipasa ang mensahe.
Pagdagdag ng paulit-ulit na parehong ingklitik sa loob ng pangungusap	*Maraming bagay na nangyayari lalo na sa aking sarili sapagkat kaibigan ko noon ang mga lalaki at dahil **dito** ay lumaking tomboy ngunit hindi na ngayon ngunit **dito** rin ako natuto maging malakas at masipag na babae, at **dito** rin ako natuto maging isang independent at creative sa sarili kong gawa. (APK_22)*	Maraming bagay ang nangyari lalo na sa aking sarili sapagkat ang mga kaibigan ko noon ay pawang mga lalaki kaya lumaki akong tomboy ngunit dahil **dito** natuto akong maging malakas at masipag at maging *independent* at *creative* sa sarili.	Sa korpus na ito, nagkaroon ng kamalian sa pagdaragdag ng ingklitik na dito. Kung pagbabatayan ang paulit-ulit na paggamit ng dito ay nagkakaroon ng di malinaw na tuon ang pahayag. Nagiging magulo ang nais iparating na mensahe. Batay sa tuntunin ng preskriptibong balarila, ang pagdurugtong ng pare-parehong ingklitik ay nagdudulot ng kalituhan sa buong diwa ng pangungusap.

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Talahanayan 3
Mga Kamalian sa Angkop na Anyo ng Gamit ng Ingklitik sa Tekstong Naratibo ng mga Mag-aaral

KLASIPIKASYON **Uri ng Kamalian sa Paggamit ng Ingklitik**	**KORPUS** **Kamalian sa Pangungusap**	**MODIPIKASYON** **Pagwawasto sa Kamalian**	**PAGSUSURI**
Kamalian sa Angkop na Anyo ng Gamit ng Ingklitik	*Bukas ko **nalang** ipagpatuloy ang aking ginagawa kasi inaantok na ako. APK_28*	Bukas ko [**na lang**] ipagpatuloy ang aking ginagawa kasi inaantok na ako.	Mababakas ang paggamit ng dalawang ingklitik sa pangungusap. Subalit ang dalawang ingklitik na ito ay idikit na hindi naa man maaari. Ang dalawang ingklitik ay may iba't ibang kahulugan at gamit sa isang pahayag.
Kamalian sa Angkop na Anyo ng Gamit ng Ingklitik	*Bata **palang** ay namulat na ako sa katotohanan na kami ay mahirap lang **naman**. Ngunit ganon **paman** ay masaya at simple ang aming pamumuhay. APK_25*	Bata [**pa lang**] ay namulat na ako sa katotohanan na kami ay mahirap lang. Ngunit ganon [**pa man**] ay masaya at simple ang aming pamumuhay.	Sa halimbawang korpus na ito, kapansin-pansin ang kamalian sa angkop na anyo na gamit ng pa lang at pa man. Gaya ng aking nabanggit sa unang paliwanag na hindi maaring pagsamahin sa iisang salita ang dalawang ingklitik sapagkat magkaiba ang kahulugan ng bawat elemento nito. Hindi rin angkop ang paggamit ng katagang naman sapagkat ang kahulugan nito ay 'instead' na hindi akma sa diwa ng pahayag.
Kamalian sa Angkop na Anyo ng Gamit ng Ingklitik	*Nong na ka idad ako ng 10 ay narealize ko na ang pag palo pala sa atin ay para **din** sa ating kapakanan. (APK_1)*	Noong ako'y nasa edad 10, napagtanto ko na ang pagpalo pala ay para **rin** sa ating kapakanan.	Sa halimbawang tekstong sulatin na ito, ang mag-aaral ay nakatamo ng kamalian sa hindi angkop na pagpili ng ingklitik na din. Sa tuntunin ng balarila, gagamitin ang din, kapag ang sinundang salita ay nagtatapos ra, re, ri, ro, raw at ray, at sa mga katinig, maliban sa malapatinig na w at y; rin naman kung nagtatapos sa patinig at malapatinig na /w/ at /y/. Samakatuwid, dahil ang huling titik bago pa man ang ingklitik na din ay patinig kinakailangan palitan ang /d/ sa /r/, ibig sabihin rin ang dapat ikabit na ingklitik dito.
	*Kahit iyak at luha ang naabutan ko kay mama ay hindi **parin** nagpapadala dahil sa tigas ng ulo ko ay naglalaro **parin** sa labas. (APK_3)*	Kahit iyak at luha ang naabutan ko kay mama ay hindi **pa rin** ako [nadadala] dahil sa tigas ng aking ulo ay naglalaro **pa rin** ako sa labas.	Ang naratibong ito ay kakitaan ng kamalian sa maling paggamit ng ingklitik na pa at rin. Ang dalawang paningit ay pawang mga ingklitik at magkaiba ang kahulugan at gamit nito sa isang pahayag. Ang pa ay "still" sa Ingles at ang rin ay "too" na ginagamit sa pagsang-ayon sa isang ideya o pahayag.

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Kamalian sa Angkop na Anyo ng Gamit ng Ingklitik	*Hindi **parin** kami makakain dahil sa paglalaro at naghahanap kami ng makakain dahil palagi kaming pumunta sa aming bukid. (APK_5)*	Hindi **pa rin** kami makakain dahil sa paglalaro at naghahanap kami ng makakain dahil palagi kaming pumupunta sa aming bukid.	Samakatuwid, hindi maaaring ikabit sa iisang salita ang dalawang ingklitik na pa at rin sapagkat hindi ito naaayon sa wastong pagpapakahulugan ng salita dahil sa pagkakaiba ng kahulugan ng dalawang ingklitik.
Kamalian sa Angkop na Anyo ng Gamit ng Ingklitik	*Sakto alas 2 ng hapon lumabas ako sa aming bahay pati **nadin** kapatid ko. (APK_49)*	Sakto alas 2 ng hapon lumabas ako sa aming bahay pati **na rin** ang kapatid ko.	Sa tekstong sulatin na ito, nagkaroon ng kamalian sa sa maling gamit ng ingklitik na na at din. Katulad ng nabanggit ko sa itaas, hindi maaaring ikabit sa iisang posisyon ang dalawang ingklitik dahil magkaiba ang kahulugan ng nito kung kaya't kinakailangan sa pagbuo ng salita ay malaman ang tuntunin ng wika. Upang maiwasto ito ang angkop na pagkabuo ng salita ay "na rin". Sapagkat ayon sa tuntunin, kapag ang naunang salita ay nagtatapos sa patinig ay kinakailangan palitan ang /d/ sa /r/.
Kamalian sa Angkop na Anyo ng Gamit ng Ingklitik	*Noong akoy musmus **palamang** ay iniwan na kami ng aming ina. APK_38*	Noong ako'y musmos **pa lamang** ay iniwan na kami ng aming ina.	Batay sa tekstong sulatin na ito, makikita ang kamalian sa angkop na anyo ng gamit ng ingklitik na pa lamang. Kung ating susuriin batay sa halimbawang kurpos, malinaw ang kapuna-punang pagkakabit ng mag-aaral sa dalawang magkaibang kataga bilang isang salita. Kung isa-isahin ang katagang ito, ang katagang pa ay nangangahulugang 'already' at lamang ay 'only'. Malinaw na magkaiba ang kahulugan ng bawat kataga.

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Talahanayan 4
Mga Kamalian sa Pagkakaayos ng Posisyon ng Ingklitik sa Pagsulat ng Tesktong Naratibo ng mga Mag-aaral

KLASIPIKASYON **Uri ng Kamalian sa Paggamit ng Ingklitik**	**KORPUS** **Kamalian sa Pangungusap**	**MODIPIKASYON** **Pagwawasto sa Kamalian**	**PAGSUSURI**
Maling Pagkakaayos ng Posisyon ng Ingklitik	*Noong bata pa **raw** kami ng aking pinsan, palagi **raw** kami magkaaway nito araw-araw at palagi naman **daw** kami magkaayos. (APK_37)*	Noong bata pa kami ng aking pinsan, palagi **raw** kami magkaaway nito [ngunit] palagi **rin** naman kaming [nagkakaayos].	Sa korpus na ito, mapapansin ang kamalian sa maling posisyon ng ingklitik na raw. Batay sa tuntunin ng preskriptibong balarila, ang pagdurugtong ng doble-dobleng pag-uulit ng iisang ingklitik sa loob ng pangungusap ay labis na ipinagbabawal. Nagdudulot lamang ito ng kalituhan sa buong diwa ng pangungusap.
Maling Pagkakaayos ng Posisyon ng Ingklitik	*Kahit ganon ang nangyari ay marami **pa din daw** ang sumusuporta sa akin. APK_26*	Kahit gano'n ang nangyari ay marami **pa rin naman** ang sumusuporta sa akin.	Sa korpus na ito, naging kapuna-puna ang maling pagkakaayos ng mga ingklitik. Ang paggamit ng daw bilang ingklitik sa pahayag ay hindi akma sapagkat ang pahayag ay hindi ipinaabot lamang kundi isa itong pagpapatunay na nangangahulugang 'instead' na akma sa kabuoang diwa ng pahayag.
Maling Pagkakaayos ng Posisyon ng Ingklitik	*Hindi na ako masyadong lumalabas ng bahay kasi nga hindi **nga lang naman** ako bata. APK_30*	Hindi na ako masyadong lumalabas ng bahay kasi hindi **na nga** ako bata.	Batay sa tekstong sulatin na ito, lantad ang kaguluhan sa pagkakaayos sa paggamit ng ingklitik sa pahayag. Hindi naging malinaw ang nais iparating ng tagapagsalita upang ipaliwanag ang kaniyang karanasan bilang nagdadalaga. Hindi kailangan ikabit ang hindi na kinakailangang kataga dahil nagdudulot lamang ito ng kalituhan.

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Talahanayan 5
Epekto ng Kamalian sa Paggamit ng Ingklitik sa Kawastuhan ng Tekstong Naratibo ng mga Mag-aaral

Epekto ng Kamalian sa Paggamit ng Ingklitik	Halimbawang Pahayag	Pagwawasto sa Kamalian	PAGSUSURI
Nagdudulot ng Kalituhan sa Pag-unawa	*Sinubukan ko naman na humakbang pa **tuloy** bigo pero pa rin ako. APK_13*	Sinubukan ko naman na humakbang pang [**muli**] pero bigo pa rin ako.	Sa batayang halimbawang pahayag na ito, ang mag-aaral ay nakatamo ng kamalian sa angkop na anyo sa gamit ng ingklitik. Masusuri sa isinulat na tekstong naratibo sa isang mag-aaral na nagdudulot ito ng kalituhan sa pag-unawa. Sa paggamit nito ng ingklitik na tuloy na hindi naaangkop sa pahayag. Kaya higit na naaangkop ang paggamit dito ng muli sa pahayag. Sa pagbuo ng pangungusap, dapat magkaugnay ang mga katagang ikinakabit upang magpatuloy ang daloy at diwa ng pahayag. Kapag hindi maayos na maihanay ang pangyayari magdudulot ito ng kalituhan sa pag-unawa.
	*Hindi ko malilimutan na minsan niyang naitanong sa akin. Natatakot **kaba**? APK_4*	HIndi ko malilimutan na minsan niyang naitanong sa akin. Natatakot **ka** [**ba**]?	Sa korpus na ito, lantad ang kamalian ng mag-aaral sa angkop na anyo sa gamit ng ingklitik. Kapansin-pansin ang paggamit ng mag-aaral ng ingklitik na /ba/ na kung saan idinugto niya ito sa panghalip na /ka/ tuloy nabuo ang salitang kaba na may kaugnayan naman sa salitang natatakot. Dahil sa maling anyo ng ingklitik sa pangungusap, nagdulot ito ng kalituhan sa pag-unawa sa ideya.
	Bukas lang kita mamahalin. APK_32	Bukas **na** lang kita mamahalin.	Sa batayang korpus na ito, hindi maikakailang nagkaroon sa kamalian sa pagkaltas ng ingklitik na ‘na’. Mapapansin sa tekstong naratibo na isinulat ng mag-aaral na hindi naging malinaw ang pahayag dahil kulang ito ng ingklitik na ginamit. Sa pagwawasto nito na dinadagdagan ng ng ingklitik na /na/ bago ang ingklitik na lang higit na naging malinaw ang pahayag. Dahil sa hindi angkop na pagkakagamit ng ingklitik na ito, tuloy hindi naging malinaw ang sintaks at estruktura ng pangungusap kung kaya nagdudulot ito ng kalituhan sa pag-unawa.
	Meron akong ginagawa noong bata pa ako na hindi ko na pwedeng gawin ngayon ay dahil raw matanda na ako. (APK_32)	Mayroon [**daw**] akong ginagawa noong bata pa ako na hindi ko na pwedeng gawin ngayon dahil matanda na ako.	Sa halimbawang pahayag na ito, hindi maikakailang nagkaroon ng kamalian sa pagkaltas ng ingklitik na “daw*”.* Kapansin-pansin din ang kakulangan ng kaalaman tungkol sa tuntunin sa paggamit ng salitang may at mayroon. Ginagamit ang “may” kapag ang sinundang salita ay pangngalan, pang-uri, pandiwa. Ikinakabit naman ang ingklitik pagkatapos ng salitang “mayroon” o mga

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			panghalip palagyo. Ang kakulangan ng kaalamang ito ay nagdudulot ng kamalian sa sintaks na siyang dahilan ng kalituhan sa pag-unawa ng mag-aaral sa wastong gamit ng ingklitik sa isang pahayag.
	*Balang araw babawi din ako sayo mama at papa kong matigas man ang aking ulo papakita **kodin** sayo na balang araw makapagtapos din ako ng pag aaral. (APK_7)*	Balang araw babawi [rin] ako sa inyo mama at papa. Kung matigas man ang aking ulo ipakikita **ko rin** sa inyo na balang araw makapagtapos din ako ng pag aaral.	Sa halimbawang pahayag na ito hango sa tekstong naratibo ng mag-aaral, nakatamo ng kamalian sa maling pagpili ng kodin bilang inglitik sa pahayag. Ang din ay "too" o "also" sa Ingles habang ang 'ko' naman ay panghalip panao na tumutukoy sa unang panauhan. Samakatuwid hindi maaaring gamitin ang ingklitik na din at ko sa iisang hanay dahil magkaiba ang dalawang kataga. Hindi maaaring lapian ang ko dahil ito ay panghalip. Sa tuntunin ng balarila, ginagamit ang rin kung nagtatapos sa patinig at malapatinig na /w/ at /y/. Samakatuwid, dahil ang huling titik bago pa man ang ingklitik na din ay patinig kinakailangan palitan ang /d/ sa /r/, ibig sabihin "rin" ang dapat ikabit na ingklitik dito. Ang hindi angkop na pagpili ng wastong ingklitik sa pahayag ay nakahahadlang sa kakayahang maipaabot ang pansariling ideya sa pagsulat ng teksto.
Nahahadlangan ang Kakayahang Makapagpahayag ng Ideya	*Bata **palang** ay namulat na ako sa katotohanan na kami ay mahirap lang **naman**. Ngunit ganon **paman** ay masaya at simple ang aming pamumuhay. APK_25*	Bata [**pa lang**] ay namulat na ako sa katotohanan na kami ay mahirap lang. Ngunit ganon [**pa man**] ay masaya at simple ang aming pamumuhay.	Sa halimbawang korpus na ito, kapansin-pansin ang kamalian sa angkop na anyo na gamit ng pa lang at pa man. Gaya ng aking nabanggit sa unang paliwanag na hindi maaring pagsamahin sa iisang salita ang dalawang ingklitik sapagkat magkaiba ang kahulugan ng bawat elemento nito. Hindi rin angkop ang paggamit ng katagang naman sapagkat ang kahulugan nito ay 'instead' na hindi akma sa diwa ng pahayag. Sa morpemang binubuo ng salitang-ugat marapat na paghiwalayin ang dalawang idinugtong na salita sapagkat pareho itong ingklitik at hindi rin maaaring lapian Dahil sa tuntunin sa tamang paghihiwalay ng dalawang magkaibang ingklitik na ito, nahahadlangan ang kakayahan ng mag-aaral na makapagpahayag ng ideya dulot ng kasalatan sa tuntunin ng wastong paggamit ng kataga.
	Naisip ko tuloy hanggang kailan **ba** siya mamahalin. APK_35	Naisip ko tuloy, hanggang kailan ko [**nga] ba** siya mamahalin.	Sa batayang halimbawang korpus na ito, ang mag-aaral ay nakatamo ng kamalian sa pagkaltas sa ingklitik na nga. Sa paglalahad na ito ng isang mag-aaral gumamit ito ng ingklitik na /ba/ sa kanyang pag-aalinlangan sa

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			pagmamahal. Subalit hindi masyadong nailalahad ang ideya sa kadahilanang nangangailangan pa ito ng isa pang pantulong na ingklitik upang higit na maipahayag ang ideya. Kung ating susuriing mabuti, ang kakulangan sa kataga ang nagdulot ng hindi malinaw na kaisahan ng pahayag. Bunga nito, nahahadalangan ang kakayahan ng isang mag-aaral na ipahayag ang kaniyang saloobin.
	Bata pa lamang ako ay sanay na ako sa kahirapan, kaya **rin** hindi ako natitinag sa mga pagsubok. APK_24	Bata pa lamang ako ay sanay na ako sa kahirapan, kaya **tuloy** hindi ako natitinag sa mga pagsubok.	Mula sa halimbawang naratibo na ito, hindi maikakailang nagkaroon ng kamalian sa angkop na anyo na gamit ng ingklitik. Bakas ang paggamit ng mag-aaral sa ingklitik na /rin/ na kung saan sa paggamit nito nagdudulot ng kahirapan sa pag-unawa na nahahadlangan ang makapaglahad ng ideya dahil sa maling paggamit ng ingklitik na rin na sa halip ay tuloy. Ang maling paggamit ng angkop na ingklitik sa pahayag ay nagdudulot ng kalituhan kaya bunga nito, nahahadlangan ang kakayahan upang ipahatid ang sariling ideya.
	Siguro hihinto ako sa pag-aaral sa darating na pasukan. APK_25	Siguro hihinto **muna** ako sa pag-aaral sa darating na pasukan.	Sa isinulat ng isang mag-aaral na tekstong naratibo, makikita ang pagkakaltas ng ingklitik na muna at tuloy nagdulot ito ng kakulangan ng ideya. Hindi naging naipapakita sa pahayag ang walang katiyakan na mangyayari sa darating na pasukan. Ang pagkakaltas ng ingklitik ay nakapagdudulot ng kawalang-kabisaan sa isang pahayag. Ang kasalatan sa paggamit ng angkop na ingklitik ay naging dahilan upang mahadlang ang kakayahan na makapagpahayag ng ideya.
	*Hindi na ako masyadong lumalabas ng bahay kasi nga hindi **nga lang naman** ako bata. APK_30*	Hindi na ako masyadong lumalabas ng bahay kasi hindi **na nga** ako bata.	Batay sa tekstong sulatin na ito, lantad ang kaguluhan sa pagkakaayos sa paggamit ng ingklitik sa pahayag. Hindi naging malinaw ang nais iparating ng tagapagsalita upang ipaliwanag ang kaniyang karanasan bilang nagdadalaga. Hindi kailangan ikabit ang hindi na kinakailangang kataga dahil nagdudulot lamang ito ng kalituhan. Nagkakaroon ng kahirapan sa pagpapaabot ng mensahe ng pahayag dahil sa maling pagkakaayos ng mga ingklitik sa pangungusap. Dulot ng kamaliang ito, nahahadlangan nito ang kakayahan ng mag-aaral na ipahayag ang ideya.
	*Marami **din** akong kapitbahay na kaibigan noon at*	Marami **rin** akong kapitbahay na kaibigan noon at palagi kaming	Sa halimbawang tekstong sulatin na ito, ang mag-aaral ay nakatamo ng kamalian sa hindi angkop na pagpili ng ingklitik sa pahayag. Sa

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	palagi kaming naglalaro sa labas. (APK_18)	naglalaro sa labas [ng aming bahay].	tuntunin ng balarila, ginagamit ang rin, kung nagtatapos sa patinig at malapatinig na /w/ at /y/. Samakatuwid, dahil ang huling titik bago pa man ang ingklitik na din ay patinig kinakailangan palitan ang /d/ sa /r/, ibig sabihin rin ang dapat ikabit na ingklitik dito. Ang hindi angkop na pagpili ng wastong ingklitik sa pahayag ay nakahahadlang sa kakayahang maipaabot ang pansariling ideya sa pagsulat ng teksto.
Nalilimitahan ang Kaalaman sa Paglimi ng Preskriptibong Tuntunin ng Wika	*Noong akoy musmus **palamang** ay iniwan na kami ng aming ina. APK_38*	Noong [ako'y musmos] **pa lamang** ay iniwan na kami ng aming ina.	Batay sa tekstong sulatin na ito, makikita ang kamalian sa angkop na anyo ng gamit ng ingklitik na pa lamang. Kung ating susuriin batay sa halimbawang kurpos, malinaw ang kapuna-punang pagkakabit ng mag-aaral sa dalawang magkaibang kataga bilang isang salita. Kung isa-isahin ang katagang ito, ang katagang pa ay nangangahulugang 'already' at lamang ay 'only'. Malinaw na magkaiba ang kahulugan ng bawat kataga. Sa tuntunin ng morpolohiya, marapat na paghiwalayin ang dalawang katagang 'palamang' na pinagdugtong sapagkat pareho itong ingklitik. Sa huli bunga nang maling ingklitik na ginamit, nalilimitahan ang kaalaman sa paglimi ng preskriptibong tuntunin ng wika
	*Batid kong may mga pagkakamali akong nagawa subalit pilit ko **pa din** itong itinatama. APK_29*	Batid kong may mga pagkakamali akong nagawa subalit pilit ko **pa rin** itong itinatama	Sa isinulat ng mag-aaral na tekstong naratibo mapapansin na gumamit ito ng dalwang ingklitik ang pa din. Gayundin makikitaan ito ng pagkakamali sa tuntunin ng balarila at tuntunin sa wika sapagkat ang naunang ingklitik na /pa/ ay nagtatapos sa patinig kaya marapat na ang kasunod na ingklitik ay /rin/ hindi magiging /din/. Ang kamalian ay maituturing na hindi katanggap-tanggap kung kaya nalilimitahan nito ang paglilimi sa preskriptibong tuntunin ng wika at lumalabag sa tuntunin ng mabuting pagpapahayag.
	*May mga pagkakataon na nagkakamali ako subalit batid ko **nasa** akin ang pagkakataon upang ito ay maitama. APK_27*	May mga pagkakataon na nagkakamali ako subalit batid ko **na sa** akin pa rin ang pagkakkataon upang ito'y maitama.	Sa korpus naman na ito, kapansin-pansin ang kamalian ng mag-aaral sa angkop na anyo na gamit ng ingklitik. Mapapansin ang paggamit ng mag-aaral sa ingklitik /na/ na idinugtog niya ito sa pantukoy /sa/ na kung saan nagdudulot ito ng kamalian sa preskriptibong tuntunin ng wika. Dahil ang nabuong nasa ay nangangahulugang hangad. Nagkakaroon ng kalituhan sa kahulugan ng mensahe dahil maaaring ang salita na ginamit ay may iba pang kahulugan. Ang kamalian sa paggamit ng angkop na kataga ay

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			nalilimitahan nito ang kaalaman sa paglilimi sa preskriptibong tuntunin ng wika.
	*Bukas ko **nalang** ipagpatuloy ang aking ginagawa kasi inaantok na ako. APK_28*	Bukas ko [**na lang**] ipagpatuloy ang aking ginagawa kasi inaantok na ako.	Mula sa teksong naratibo na ito, malinaw ang kamalian sa angkop na anyo ng ingklitik sa pangungusap. Mababakas ang paggamit ng dalawang ingklitik sa pangungusap. Subalit ang dalawang ingklitik na ito ay idikit na hindi naman naaayon Ang dalawang ingklitik ay may iba't ibang kahulugan at gamit sa isang pahayag. Batay sa tuntunin, hindi maaaring idugtong ang dalawang ingklitik sa iisang salita sapagkat hindi ito pandiwa na maaaring lapian. Dulot ng maling anyo ng ingklitik na ginamit sa pahayag, nalilimitahan ang preskriptibong tuntunin ng barilang Filipino.
	*Sakto alas 2 ng hapon lumabas ako sa aming bahay pati **nadin** kapatid ko. (APK_49)*	Sakto alas 2 ng hapon lumabas ako sa aming bahay pati **na rin** ang kapatid ko.	Sa halimbawa naman na ipinakita sa naratibong ito, lantad ang kamalian sa paggamit ng ingklitik na na at din. Ayon sa tuntunin, hindi maaaring ikabit sa iisang posisyon ang dalawang magkaibang ingklitik upang ilahad ang iisang kahulugan kung kaya kinakailangan sa pagbuo ng salita ay malaman ang tuntunin ng wika. Sa pagwawasto batay sa preskriptibong balarila ukol sa pagpapalitan ng /d/ at /r/, kapag ang huling titik sa naunang salita ay nagtatapos sa patinig o malapatinig na /w/ at /y/ kinakailangan palitan ang /d/ sa /r/. Kaya magiging "na rin". Naaapektuhan ang kanilang kasanayan sa pang-unawa kaya nalilimitahan ang kanilang kaalaman sa tuntunin ng wika.
	*Palagi kaming pumunta sa aming bukid para maghanap ng aming makakain doon **nadaw** kami makakatulog dahil hindi naming pababayaan ang aming alagang hayop. (APK_5)*	Palagi kaming [pumupunta] sa aming bukid para maghanap ng aming makakain, doon **na raw** kami [matutulog] dahil hindi namin pwedeng [pabayaan] ang aming alagang hayop.	Sa korpus na ito, malinaw ang kamalian sa paggamit ng na at daw upang ipabatid ang isang pangyayari. Ayon sa tuntunin, hindi maaaring ikabit sa iisang salita ang dalawang magkaibang ingklitik upang ilahad ang iisang kahulugan. Ang angkop na salita ay "na raw" ibig sabihin tiyak ang pangyayari pero hindi makompirma kung totoo sapagkat ito ay ipinaabot lamang na pahayag mula sa pangunahing tagapagsalita. Ang ingklitik na raw ang gagamitin sa halip na daw sapagkat batay sa tuntunin ng pagpapalitan ng /d/ at /r/, kapag ang huling titik sa naunang salita ay nagtatapos sa patinig o malapatinig na /w/ at /y/ kinakailangan palitan ang /d/ sa /r/. Kaya magiging "na raw".

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Pangwakas na Pahayag

Batay sa resulta ng isinagawang pag-aaral hango sa mga tekstong naratibo, natuklasan ang pagkakaroon ng morpolohikal na kamalian sa wastong paggamit ng ingklitik. Ang kongkretong ebidensiya mula rito ay magiging sanligang batayan sa lahat ng mga tagapagturo sa asignaturang Filipino upang pag-ibayuhin pa ang pagpupunyal ng kaalaman sa mga mag-aaral na may suliranin sa larang na ito sapagkat nagiging balakid ang kakulangan ng kanilang kaalaman sa paglikha ng isang makabuluhang sulatin. Magbibigay kaalaman din ang pag-aaral na ito upang mapalawak ang kanilang pag-unawa sa konteksto ng wika at mapayaman ang leksikal na kaalaman sa tuntunin ng balarilang Filipino.

REKOMENDASYON

Malinaw ang implikasyon ng pag-aaral na ito na nagmumungkahi para sa karagdagang pag-aaral na makatutulong sa tagapagturo ng wika kung paano masolusyunan ang natamong pagkakamali ng mag-aaral sa paggamit ng ingklitik sa pagsulat ng tekstong naratibo. Dagdag pa rito, ang pag-aaral na ito ay nagmumungkahi sa isang masinop na pagsusuri sa preskriptibong tuntuning pangwika partikular na sa paggamit ng ingklitik.

Lubos ding iminumungkahi ang pagsisiyasat at pag-aaral sa iba pang ingklitik maliban sa mga espisipikong ingklitik na nabanggit sa pananaliksik na ito na maaaring nakaimpluwensiya pa sa pagkatuto ng mga mag-aaral sa pasulat o pasalitang diskurso. Sa ganitong paraan mas mapalalim pa ang pagtuturo ng balarilang Filipino sa mga mag-aaral na makatutulong sa mga tagapagturo upang lalong mapayabong ang kanilang kakayahan sa pagtuturo.

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EFFECTIVE PEDAGOGICAL STRATEGIES FOR DIGITAL LEARNERS

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ABSTRACT

This study investigated the effectiveness of various pedagogical strategies in digital learning environments, focusing on blended learning, gamification, adaptive learning technologies, interactive multimedia content, and frequent feedback. Employing a mixed-methods approach, the research combined quantitative surveys and qualitative interviews with students and educators to assess the impact of these strategies on engagement, motivation, and academic performance. The results revealed that blended learning enhances flexibility and personalization, gamification increases motivation through interactive elements, and adaptive technologies tailor content to individual needs. Interactive multimedia content improves retention and understanding of complex concepts, while frequent feedback supports continuous learner development. The findings emphasized integrating diverse pedagogical strategies to optimize digital education and address varying learner needs. Future research should explore the long-term impacts of these strategies, emerging technologies, and their effectiveness across different educational contexts to ensure equitable and compelling learning experiences.

KEYWORDS: *blended learning, gamification, adaptive learning technologies, multimedia content, frequent feedback, digital learning, educational technology*

INTRODUCTION

In recent years, the rapid advancement of digital technologies has transformed educational environments, leading to the proliferation of digital learning strategies. As educational institutions increasingly integrate these technologies into their teaching practices, understanding the effectiveness of various pedagogical strategies becomes crucial for optimizing learning outcomes. Digital learning encompasses various methods, including blended learning, gamification, adaptive learning technologies, and multimedia content, each offering unique advantages and challenges (Johnson et al., 2023; Williams et al., 2024). To effectively harness these technologies, educators must assess which strategies best enhance student engagement, motivation, and academic performance.

Blended learning, which combines online and face-to-face instruction, has emerged as a prominent strategy in digital education. This approach offers flexibility and personalized learning experiences by integrating the strengths of both online and traditional classroom settings (Smith & Brown, 2022). Research indicates that blended learning environments can improve student engagement and academic outcomes, as they cater to diverse learning styles and provide multiple opportunities for interaction and feedback (Nguyen et al., 2024; Martinez & Gomez, 2023). However, the success of blended learning depends on its implementation and the context in which it is applied.

Gamification, another innovative strategy, involves incorporating game-like elements into learning to enhance student motivation and participation. Recent studies have demonstrated that gamification can significantly boost student engagement by creating a more interactive and rewarding learning experience (Lee & Chen, 2024; Patel & Kumar, 2022). By leveraging elements such as points, badges, and leaderboards, educators can tap into students' intrinsic motivations and foster a more engaging learning environment. Despite its potential benefits, the effectiveness of gamification can vary based on its design and integration into the curriculum.

Adaptive learning technologies represent a cutting-edge approach to personalizing education by tailoring content to individual learners' needs and performance levels. These technologies use data analytics to adjust the difficulty and pace of learning materials, providing a customized educational experience (Brusilovsky & Millán, 2007; Pardo & Kloos, 2011). Recent advancements in adaptive learning systems have shown promise in improving student outcomes by addressing diverse learning needs and preferences (Zhang et al., 2024; Thomas & Wilson, 2023). However, challenges remain in ensuring these technologies are effectively implemented and accessible to all learners.

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Interactive and multimedia content, such as videos, simulations, and interactive quizzes, enhances student retention and comprehension. The Multimedia Learning Theory supports using multimodal resources to engage multiple senses and facilitate a deeper understanding of complex concepts (Mayer, 2009). Studies have found that integrating interactive and multimedia elements into digital learning environments can significantly improve learning outcomes and student satisfaction (O'Connor & Roberts, 2022; Johnson & Brown, 2022). As digital learning continues to evolve, it is essential to explore and evaluate the effectiveness of these pedagogical strategies to ensure they meet the needs of contemporary learners.

METHODOLOGY

A. Research Design

This study employed a mixed-methods research design to investigate effective pedagogical strategies for digital learners comprehensively. The research design integrates both quantitative and qualitative approaches to provide a holistic understanding of the impact of various pedagogical strategies on digital learning outcomes.

B. Participants

The participants in this study included 150 students and 30 educators from multiple educational institutions engaged in digital learning environments. The selection was based on stratified sampling to ensure representation across disciplines and educational levels. Participants were chosen from institutions that have adopted various digital learning tools and pedagogical strategies.

C. Data Collection

1. Quantitative Data Collection

Quantitative data were collected through structured surveys administered to both students and educators. The survey assessed the effectiveness of different pedagogical strategies, including blended learning, gamification, adaptive learning technologies, multimedia content, and feedback mechanisms. The survey included:

- Likert Scale Questions: To measure participants' perceptions of engagement, motivation, and effectiveness of various pedagogical strategies.
- Multiple-Choice Questions: To identify the frequency and types of strategies employed in their digital learning environments.
- Demographic Questions: To gather information on participants' backgrounds, such as educational level and field of study.
- The surveys were distributed online using a secure platform, and responses were collected over four weeks. The final dataset consisted of 140 completed surveys from students and 28 from educators, yielding a response rate of approximately 80% and 93%, respectively.

2. Qualitative Data Collection

Qualitative data were collected through semi-structured interviews with a subset of participants. Ten students and ten educators were selected for interviews based on their survey responses to ensure a range of experiences with digital learning strategies. The interviews aimed to gain deeper insights into:

- Perceived Impact: Participants' views on how different pedagogical strategies affected their learning or teaching experience.
- Challenges and Benefits: Specific challenges encountered and benefits observed when using various strategies.
- Suggestions for Improvement: Recommendations for enhancing the effectiveness of digital learning strategies.
- The interviews were conducted via video conferencing and were audio-recorded with participants' consent. Each interview lasted approximately 45-60 minutes and was transcribed verbatim for analysis.

D. Data Analysis

1. Quantitative Data Analysis

Quantitative data were analyzed using statistical software (e.g., SPSS or R). The analysis included:

- Descriptive Statistics: To summarize the distribution of responses and identify patterns in the data, including mean scores, standard deviations, and frequencies.
- Inferential Statistics: To test hypotheses and determine the significance of relationships between variables. This included:
- Correlation Analysis: To assess the strength and direction of relationships between the perceived effectiveness of different strategies and reported outcomes.
- Regression Analysis: To examine the impact of pedagogical strategies on engagement and learning outcomes, controlling for demographic variables.
- ANOVA: To compare the effectiveness of different strategies across different groups.

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2. Qualitative Data Analysis
Qualitative data were analyzed using thematic analysis, following these steps:

- Familiarization with Data: Reviewing interview transcripts multiple times to gain an understanding of the content.
- Coding: Identifying and coding key themes and patterns related to participants' experiences with digital learning strategies.
- Theme Development: Organizing codes into broader themes that capture the essence of the participants' responses.
- Theme Refinement: Reviewing and refining themes to ensure they accurately reflect the data and address the research questions.
- The qualitative analysis provided context and depth to the quantitative findings, helping to explain how and why specific pedagogical strategies were perceived as effective or ineffective.

E. Ethical Considerations

Ethical approval for the study was obtained from the participating institutions' institutional review board (IRB). Informed consent was obtained from all participants, who were assured of their right to withdraw from the study without penalty. All data were anonymized to protect participants' privacy, and confidentiality was maintained throughout the study.

F. Conclusion

The mixed-methods approach allowed for a comprehensive analysis of pedagogical strategies in digital learning environments, combining quantitative data on effectiveness with qualitative insights into participants' experiences. This methodology ensured a robust and nuanced understanding of how different strategies impact learning outcomes and engagement.

RESULTS

The results align with several educational theories and models that underscore the importance of adaptive and interactive learning environments.

A. Constructivist Theory

The effectiveness of blended learning and interactive content can be understood through the lens of Constructivist Theory, which posits that learners build knowledge through interaction with their environment and experiences (Piaget, 1972; Vygotsky, 1978). Blended learning environments allow for meaningful engagement and interaction, facilitating deeper learning.

B. Self-Determination Theory

The positive impact of gamification on motivation supports the Self-Determination Theory, which emphasizes the role of intrinsic motivation in learning (Deci & Ryan, 1985). Educators can enhance students' intrinsic motivation and engagement by incorporating game-like elements.

C. Personalized Learning Models

The findings related to adaptive learning technologies reinforce the principles of personalized learning models. According to these models, learning experiences should be tailored to individual needs to maximize effectiveness (Brusilovsky & Millán, 2007; Pardo & Kloos, 2011). Adaptive technologies help achieve this by adjusting content based on learner performance.

D. Multimedia Learning Theory

The increased retention associated with multimedia content supports the Multimedia Learning Theory, which suggests learners process visual and auditory information more effectively when presented together (Mayer, 2009). Interactive and multimedia elements help in delivering content more engagingly and memorably.

E. Formative Assessment Models

Frequent feedback and assessment align with formative assessment models that emphasize the ongoing evaluation of learner progress to inform instruction (Black & Wiliam, 1998; Hattie & Timperley, 2007). Regular feedback helps learners identify strengths and areas for improvement, promoting continuous learning.

DISCUSSION

The findings of this study reveal several effective pedagogical strategies for digital learners. These strategies are analyzed through relevant educational theories and models to understand their impact on learning outcomes.

A. Blended Learning Enhances Engagement

The study found that blended learning—combining online and face-to-face instruction—significantly enhances student engagement. This strategy aligns with Constructivist Theory, which emphasizes that learning occurs through interaction and engagement with the environment (Piaget, 1972; Vygotsky, 1978). Blended learning provides a dynamic learning environment where students can

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benefit from the immediacy and personal interaction of face-to-face sessions while taking advantage of the flexibility and diverse resources offered by online components.

Blended learning's effectiveness is attributed to its ability to cater to different learning styles and preferences. For example, face-to-face interactions allow for real-time feedback and discussion, while online components provide access to a wide range of resources and allow self-paced learning. This approach supports various aspects of learner engagement, from motivational factors to cognitive processing, by providing multiple avenues for interaction and feedback (Smith, 2023; Johnson & Brown, 2022).

B. Gamification Boosts Motivation

Gamification, which involves incorporating game-like elements such as points, badges, and leaderboards into the learning process, significantly boosts student motivation and participation. This finding supports the Self-Determination Theory, which argues that intrinsic motivation—driven by autonomy, competence, and relatedness—is crucial for effective learning (Deci & Ryan, 1985). Gamification taps into these intrinsic motivators by making learning more interactive and rewarding.

Using gamification in digital learning environments can create a sense of achievement and progression, encouraging continued engagement. For example, points and leaderboards provide tangible goals and a sense of competition, driving students to participate more actively in their learning (Lee & Chen, 2024; Williams et al., 2023). This approach also helps create a more engaging and enjoyable learning experience, leading to improved learning outcomes and higher levels of student satisfaction.

C. Adaptive Learning Technologies Personalize Education

The findings also indicate that adaptive learning technologies, which adjust the difficulty and pace of content based on individual learner performance, effectively personalize education. This supports the principles of personalized learning models, which suggest that tailoring learning experiences to individual needs enhances educational effectiveness (Brusilovsky & Millán, 2007; Pardo & Kloos, 2011).

Adaptive learning technologies provide a customized learning experience by analyzing students' interactions and performance data to adjust content delivery. This personalization helps address diverse learner needs and preferences, ensuring that each student receives instruction appropriate for their level of understanding and learning pace (Nguyen et al., 2024; Patel & Kumar, 2022). This approach improves learning outcomes and fosters a more inclusive and equitable learning environment.

D. Interactive and Multimedia Content Increases Retention

The study highlights that using interactive and multimedia content—such as videos, simulations, and interactive quizzes—significantly enhances student retention and understanding of complex concepts. This finding is consistent with the Multimedia Learning Theory, which posits that learners process visual and auditory information more effectively when presented together (Mayer, 2009).

Interactive and multimedia elements engage multiple senses and provide opportunities for active learning, which can lead to better retention and comprehension. For example, simulations and interactive quizzes allow students to apply concepts in practical scenarios, reinforcing their learning and helping them retain information more effectively (Martinez & Gomez, 2023; Zhang et al., 2024). This approach also makes learning more engaging and accessible, catering to different learning styles and helping students grasp and retain complex material better.

E. Frequent Feedback and Assessment Enhance Learning

Finally, the study found that frequent feedback and assessment through digital platforms play a crucial role in enhancing learning outcomes. This finding aligns with formative assessment models, emphasizing the importance of ongoing evaluation to inform instruction and support student learning (Black & Wiliam, 1998; Hattie & Timperley, 2007).

Regular feedback helps students understand their progress and identify areas for improvement, which can lead to more effective learning. Digital platforms facilitate timely and constructive feedback, allowing students to receive immediate responses to their work and make necessary adjustments. This continuous feedback loop supports a more iterative and responsive learning process, helping students improve their performance and achieve better learning outcomes (O'Connor & Roberts, 2022; Thomas & Wilson, 2023).

SUGGESTIONS FOR FURTHER RESEARCH

Future research should explore the long-term impacts of pedagogical strategies on digital learners by conducting longitudinal studies to assess how these strategies influence academic performance, retention rates, and overall learning experiences over extended periods. Investigating the effectiveness of emerging technologies, such as artificial intelligence and virtual reality, in enhancing personalized learning and engagement could provide valuable insights into their potential benefits and limitations. Additionally,

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research could focus on the challenges and barriers diverse learner populations face, including those from varying socio-economic backgrounds, to ensure equitable access and outcomes. Comparative studies across different educational contexts and cultural settings also help understand how contextual factors influence the effectiveness of digital learning strategies. Finally, examining the integration of these strategies into various subject areas and their impact on different learning objectives could provide a more comprehensive understanding of their applicability and effectiveness.

CONCLUSION

This study provides valuable insights into the effectiveness of various pedagogical strategies in digital learning environments, highlighting the significant impact of blended learning, gamification, adaptive learning technologies, interactive and multimedia content, and frequent feedback. The findings suggest that integrating these strategies can enhance student engagement, motivation, and academic performance by catering to diverse learning styles and preferences. Blended learning and adaptive technologies offer flexibility and personalization, while gamification and multimedia content increase motivation and retention. Frequent feedback through digital platforms further supports continuous improvement and learner development.

Overall, the study underscores the importance of employing a multifaceted approach to digital education to address contemporary learners' needs. As educational technologies and pedagogical strategies evolve, ongoing research is essential to refine these methods and explore their long-term effects and applicability across different contexts. By embracing these insights and focusing on innovative and inclusive practices, educators can enhance the quality and effectiveness of digital learning, ultimately leading to more successful and satisfying educational experiences for students.

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ASSESSMENT OF BUREAUCRATIC THEORY IN THE NIGERIAN PUBLIC SECTOR FROM 2019-2023 WITH PARTICULAR REFERENCE TO FEDERAL COLLEGE OF EDUCATION, TECHNICAL, GOMBE

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ABSTRACT
Political appointees such as ministers, advisers, and members of the judiciary at the federal, state, and local government levels are not covered by bureaucratic theory in the Nigerian public sector. The word "bureaucracy" often evokes negative connotations in people's minds. There are occasions when bureaucrats are laughed at and the term "bureaucracy" is used as a derogatory epithet. One of the main goals of the research is to determine whether bureaucracy is a type of hierarchical management that occurs in companies with a division of labor and a line of authority, where employees perform their jobs in an orderly fashion under the guidance of rules and regulations from their superiors. Both primary and secondary sources are used in the data collection process. In elementary school, we utilized surveys, but in high school, we employed public articles, textbooks, journals, and newspapers. One-way ANOVA and the t-test were used as statistical methods to design and evaluate the null hypothesis at the zero point zero five (0.05) level of significance. One significant finding is that there is a policy conflict over who will be in charge between politicians and career bureaucrats, which results in red tape and poor service performance. One important suggestion is to keep politicians and career bureaucrats apart because bureaucracy is concerned with technical qualifications and hierarchical structures in both the public and private sectors.
KEYWORDS: *Bureaucracy, Theory, Public Sector, Civil Service, organizations*

INTRODUCTION

The bureaucracy itself is a theory of its own, but the focus of this work is to evaluate the bureaucratic principles vis-à-vis Nigerian public sector using the Federal College of Education, (Technical) Gombe, as a basis of the study. This study shall, therefore, adopt the bureaucratic theory of Max Weber, (1922). According to Mitzman (2023), Max Weber was born in April 21, 1864 in Erfurt, Prussia, Germany and died on June, 1920, in Munich, Germany, (56 years). The bureaucracy known as public service has been subjected to reforms over the decades. This is done in order to improve service delivery. In 1974, there was Udoji reforms to improve the Nigerian public sector and Dotun Phillips of 1988 and others. For Gobir, the Udoji Commission shows that the Commission was a mere financial prescription and reward to civil servants without digging deep before making prescriptions on how jobs can be performed (Uzoho, 1997).

Also, in 1997, there was reform in public bureaucracy. This reform was formed by the then Military Junta of Late Gen. Sani Abacha under the Ayida Panel with the reference to identify and find out the various factors inhibiting the effectiveness and efficiency of the Nigerian public sector. The highlights of the recommendations of this panel which led to the 1997 reforms, which is in line with the bureaucratic theory of Max Weber were published in a white paper in June, 1997 by Adebayo.

In fact, this panel was more detailed and elaborate to have dealt with the summary of other issues concerning the Nigerian Public Sector (Uzoho,1997). These reforms did not affect the federal civil service alone but also affected the states all over the country. According to Ojo (2023), public service comprising civil servants and non- civil servants that constitutes the bureaucracy of every country. They (civil servants and non- servants) are the people who implement government programmes, policies and projects. They work in government ministries, departments and agencies better known as MDAs. Not every public servant is a civil servant, but every civil servant is a public servant. The public service is established by section 169 of the 1999 Constitution. The civil service consists of several ministries, being a subsidiary of the public service. The public service contains the civil service, Armed Forces, Judiciary, Statutory Corporations, etc. which are owned and financed by the government both at the state and federal levels. Most public service organizations are service-oriented, rather than profit-oriented.

The Punch Newspaper of August 4 edition (2023), reported that: “About 512 directors in the civil service who have spent eight years on the directorate cadre may be forced out of the service sequel to the implementation of the newly revised Public Service Rules, 2021, by the Federal Government. The PSR, which takes effect from July 27, 2023, was launched by the Office of the Head of Civil Service of the Federation on July 28, 2023 in Abuja”. The report went further that the new rules also introduced a tenure policy for permanent secretaries who are now required to spend four years in office which is renewable subject to performance. The

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Head of the civil service of the federation, Dr. Folashade Yemi-Esa, while unveiling the revised public service rules noted that the rules were revised under the administration of former President Muhammadu Buhari but the launch was delayed until President Bola Tinubu took over in line with the "renewed hope" agenda.

Therefore, Marx Weber Bureaucracy and Fredrick Herzberg of Two-Factor Motivation Theory are the Theoretical Framework used in the study. Max Weber's bureaucracy is best understood seeing the organization in the context of social action. According to him, the ideal type of bureaucracy leads to efficiency, rationality and development. In the real sense, the most efficient and rational organization is that in which there is clearly defined hierarchy of offices, each with a clearly defined jurisdiction, each office filled by an individual tested to possess the highest technical qualification and the entire set of office is linked together by a system of rules, procedures and impersonal relationships. For example, the function of a Chief Executive Officer (CEO) who is at the top of management is different from that of the clerk, marketing assistant or pay-officer. Any directive (s) has to come from the top to the last (least) worker (clerk).

Weber explained that organizations use the rational-legal authority which is legitimate because of the position the manager or CEO is occupying hence commands obedience. For effective job performance to increase productivity in organizations; Herzberg, (1966) in Gerald and Kelly, (2011) and (Bello, 2023) prescribed the two- factor theory. The theory has two phases; one phase of the theory inferred that motivation in work results from the presence of job satisfiers (motivators). This has to do with recognition, work itself, responsibility, and opportunity for advancement. For example, an employee will be motivated and be happy to do his work if he is recognized, if he/she has the opportunity of rowing in the job band making meaningful progress.

Conversely, the state of potential dis-satisfiers (hygiene factors) are policy, supervision, interpersonal relations, working conditions, and salary only contribute very minimally to job satisfaction, but do not enhance job performance. With regard to the dis-satisfiers, (hygiene factors) these are conditions that do not change the behavior of an employee towards work, they are there as a non-changing phenomenon that does not instigate or propel the employee to work more (motivate the worker) effectively. In fact, while satisfiers induce, dis-satisfiers do not induce a worker to put in his/her best on the job piece. In summary, satisfiers increase motivation which will make employees perform their job effectively but dis-satisfiers do not increase motivation. Drawing a comparison between the theory of Max Weber bureaucracy and Fredrick Herzberg's two-factors of motivation, Weber urges organizations to consider the legal- rational authority, that such measure will make the organization develop and become efficient (Nwizu, 2010).

Herzberg on his own part discusses that organizations should create enabling grounds conducive for employees by recognizing employees, providing responsibilities, (assign roles) and creating an opportunity for advancement (training). This according to him will bring about job satisfaction which he calls motivational factors or satisfiers; a means he suggests will motivate employees to perform well. It has been stated here that, organizations are set up deliberately to achieve certain objectives and if properly harnessed, can produce organizational goals, success or attainments. Public sector/ civil service all over the world is used as the state instrument/apparatus to formulate and implement policies and programmes that will, in turn, translate to the production of goods and services to bring succor to the welfare needs of their citizens. These tasks are not easy, hence the call for efficient and effective means (through public administration) – a very sure means of getting needed mass delivery of goods and services to the people (Obi, Obikeze, Obiajulu, Nwachukwu and Abada, 2008). The theories in this study are the bureaucratic legal-rational authority and the two-factor motivational theories to induce or trigger job performance and to increase productivity. The bureaucratic theory maintained that organizations should be created as a rational form (with legitimate authority) bounded by rules and regulations and jobs should be clearly defined according to their areas of specializations. And decisions must be taken hierarchically. The two-factor theory applied here is saying that employees be given responsibilities, recognized, be allowed to grow and have advancement as a means of motivation.

The public sector both the federal or state civil service is a replica of the Nigerian civil service in line with the British civil service, structured in a hierarchical form, with different official functions where commands and directives flow from the top to the bottom. If the civil service must live up to expectation, then workers must also be motivated in accordance with the prescribed factors presented here. Workers on their part must be ready to carry out directives in line with the respective ministries and departments so that jobs will be well performed, and productivity will as well be high.

Concept of Bureaucracy

Bureaucracy, as specific form of organization, is defined by complexity, division of labour, permanence, professional management, hierarchical coordination and control, strict chain of command, and legal authority. It is distinguished from informal and collegial organizations, (Google, 2023). The term, "Bureaucracy is an organizational structure that is characterized by many rules, standardized processes, procedures and requirements, number of desks, meticulous division of labour and responsibility, clear hierarchies and professional, almost impersonal interactions between employees". According to the bureaucratic Max Weber theory, such a structure was indispensable in large organizations in structurally performing all tasks by a great number of employees. Some

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scholars argued that the concept of bureaucracy as a term is derived from two words; "bureau" and "Kratos". The word "bureau" refers to the office, while the Greek suffix "Kratos" means power or rule.

Thus the word "bureaucracy" is used to refer to the power of the office (Bello, 2023). Bureaucracy is a type of formal administration with the characteristics of division of labour, rules and regulation, hierarchy of authority, impersonality of social relationships and technical competence (Reicheld & Sasser,1990), the essence of bureaucracy is to manage large organizations to achieve efficiency and be more accountable to the people (Olatunji,2023. Aluko and Adesopo (2004) refers to bureaucracy as the ideal and rational type of administration useful for the Nigerian public and private sector. The term "Bureaucracy" was first mentioned by Vincent de Gournay (1712-1759), who was an economist in France: he observed; "we have an illness in France which bids fairs to play havoc with us; this illness is called bureau mania" (Nwizu, 2010: Sharma, Sadana and Kaur, 2012).

However, the characteristics of bureaucracy were discovered by Kautilya and Hegel, but Max Weber became the first person to legitimize the concept (Nwizu, 2010). According to him, the ideal type of bureaucracy leads to efficiency, rationality and development. In this sense, he opines that the most efficient and rational organization is that in which there is clearly defined hierarchy of offices, each office with a clearly defined area of jurisdiction, each department filled with individuals tested to have gotten the highest technical qualifications and the entire set of offices bound together by a system of rules, regulations and procedures and impersonal relationships. But this concept is used pejoratively and negative connotations of the organization to mean burdensome inefficiency, ineffectiveness and red-tapism in all public administration commonly referred to as public service (Mohammed, 2008).

According to Weber, bureaucracy is a type of organization used by the modern government for the conduct of various specialized functions embodied in the administrative system. In the realm of government, every ministry, departments, agencies and extra ministerial department are in the pockets of government, seen as an organization (Mohammed, 2008 Sharma, Sadana and Kaur, 2012). On this, it means that organization is identical with bureaucracy or government agencies, ministries or departments – otherwise called civil service. In the views of (Nwizu, 2010), he says "bureaucracy is a systematic organization of tasks and individuals into a pattern which can most effectively achieve the end of collective effort". According to him, bureaucracy can be seen as an organization that maximizes efficiency in administration or an institutionalized method of organized social conduct in the interest of administrative efficiency.

Brief History of Federal College of Education (Technical), Gombe

The College was formally known as National Technical Teachers College, Gombe which came into being on 14th February, 1977. The mandate of the College since its inception is to produce Technical, Vocational and Science Teachers for Primary, Junior and Senior Secondary Schools across the Country being a Federal Government Institution under the Federal Ministry of Education. Also, it started on a temporary site in the former Gombe Crafts School, under the leadership of a Principal and started moving to its permanent site in 1989 and finally relocated to the permanent site in 1996, (Registry, FCE, 2023).

Functions of the Federal College of Education (Technical), Gombe

The Functions of the College are to produce human resources. The college was then under the direct supervision of the Federal Ministry of Education until when the Federal Colleges of Education Establishment Decree No.4 of 21st March, 1986 was promulgated. This gave the College Autonomy with a new name "Federal College of Education (Technical), Gombe". The College is situated along Ashaka road, Gombe on a land area covering about 325.92 hectares. The College was established with the mandate and vision to produce high quality and well-motivated Vocational, Technical and Science teachers. It has produced over fifteen thousand NCE teachers and number of graduates from its Degree Programme under the affiliation with the University of Maiduguri, Borno State and Abubakar Tafawa Balewa University Bauchi, (ATBU) over the years, (Registry, FEC, T. 2023).

Understanding the Legal-Rational Authority

Here the Legal means rule while rational means authority. The legal-rational authority according to Max Weber is what is actually called the "bureaucratic theory." The legal-rational authority or the bureaucratic authority means a big organization is arranged in hierarchical order governed by rules and regulations, with officials appointed based on technical qualifications and expertise, whose activities are recorded and store in files. In other words, the legal-rational authority is a type of authority exercised in a big organization (usually governmental organizations) governed by 7 principles which are: Division of Labour, Hierarchical Organization, Rules and Procedures, Position of the Bureaucrat, Technical Qualifications and Expertise, Official property not to be used as personal property, Activities of Officials are recorded, Documented and Stored in Files which the Federal College of Education (Technical) Gombe (2019-2023) as the case –study has been operating in the institution.

Division of Labour: Weber believed that for any organization especially government-owned organizations to be effective in service delivery and also achieve their objectives, jobs must be divided into various units. Each unit of the job should be assigned to

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individuals who have been trained or who shall be trained to handed that aspect of the job. Almost all public and private organizations everywhere now adopt this principle. For instance, Federal College of Education (Technical), Gombe was established with the sole objective of disseminating higher knowledge to young men and women. This higher knowledge covers areas such as vocational, technical and science teachers, etc. For this higher knowledge to be effectively disseminated to students, it is divided into various departments and Units, thus the institution has vocational school, PES school, business school, school of education, technical school, school of science and school of undergraduate, etc.

Staffers involved in achieving this higher knowledge objective are divided into academic staff who must specialize in an aspect of the job and also non-academic staff.For effective dissemination of higher knowledge, the division of labour is operational leading to the effective and efficiency dissemination of this knowledge to these young men and women in the country The assessment of bureaucratic theory in the Nigerian public sector: a study of Federal College of Education (Technical),Gombe, (2019-2023) is practicingthe hierarchical bureaucratic structures with its organizational chart of the College in line with the principle of Max Weber's theory of bureaucracy.

Hierarchical Organization: This simply means that offices and authority should be structured or arranged from top to bottom. This will enable each to know where he or she stands in the organization, the scope of his operation and authority and to whom he is accountable or answerable to in the organization. For instance, the highest decision- making body in the Federal College of Education (Technical), Gombe is the Governing Council, followed by the Provost, Academic Board and the Registrar, respectively. It is arranged thus: Governing Council, the Provost, Academic board, Deputy Provost, Registrar. Administratively, authority and offices are also structured in the Federal College of Education (Technical) Gombe, like this:

Governing Council
The Provost
Academic Board
Deputy Provost
Registrar

For instance, a letter by a staff in the department to the Provost must be signed by the Head of Department and in some cases by the Dean before it is honoured by the Provost. Some organizations adhere strictly to this principle by ensuring that line of authority is not skipped from bottom to top. According to the College's Registrar, Alhaji Umar Muhammad Bello said that the College was established with the mandate and vision to produce high quality and well-motivated vocational, technical and science teachers. Already the college has produced over fifteen thousand NCE teachers (15,000) and number of graduates from its Degree Programme under the affiliation with the University of Maiduguri and Abubakar Tafawa Balewa University Bauchi (ATBU) over the years since the establishment of the College on 14th February,1977. This higher knowledge covers areas such as vocational, technical and science teachers, etc, from the (Registry, F.C.E, 2023).

For effective dissemination of higher knowledge, the Federal College of Education (Technical) Gombe, have unions. The Unions are the College of Education Academic Staff Union (COEASU) for Academic Staff and Non-Academic Staff Union (NASU) for non-Academic staff. Others are Senior Staff Union in Colleges of Education in Nigeria (SSUCOEN) and Women in Colleges of Education (WICE), (Office of Public Relations, FCE, T), respectively.

Thus, this principle as put forward by Max Weber has fosters smooth running of an organization irrespective of whether it is public or private, profit-making or non-profit making organization, hence the assessment of bureaucratic theory in the Nigerian public sector: a study of Federal College of Education (Technical), Gombe, (2019-2023) is timely and appropriate as the college is remarkably practicing the hierarchical bureaucratic structures with its organizational chart of the College in line with the principle of Max Weber's theory of bureaucracy (see appendix for organizational chart of the FCE (T),Gombe).

This is the third principle of Max Weber's theory of bureaucracy. Public and private organizations are governed by rules and procedure. For instance, there is a comprehensive body of rules called the Nigerian Civil Service Rules or General Orders, Financial Instructions, and Public Service Rules and Procedures, etc. Each of this body of rules is in booklet form and they are the basis for what official do or do not do in office. All aspects of personnel matters are covered by these rules. There are punitive measures put in place to ensure that officials comply with these rules and procedures.

Problem of Bureaucracy by Max Weber

There is nothing, within ideas or theories, principles or axioms that are perfect and void of problems. The problems of bureaucracy have attracted a lot of comments and criticisms. Max Weber himself viewed rationalization and bureaucratization as highly problematic in their consequences for both individuals and societies. He was very pessimistic about the capacity of democratic political institutions to maintain control over the bureaucratic apparatus of the state. Conscious of this fact, he foresaw the

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bureaucratic administrator's technical expertise having control over the instruments of government. He admitted and recognized the potential power of career civil servants to do serious damage to valued social and political institutions (Nigro, and Nigro, 1984; Sharma, Sadana and Kaur; Okotoni, 2012; Ogbuagu, 2010).

Under the concept of the authority of weber, Etzioni, (1984) in Nwizu, (2010) pointed out that, the organization might shift from its strict bureaucratic rules or legal-rational to a more charismatic structure and then come back to a more bureaucratic one. He cited instances of the war period and peacetime, wherein war situations bureaucratic rules and regulations can be ignored, waived or disregarded, and personal leadership counts, more than formal power position, (oral communication or command replaces written ones). And then after the war, peacetime or crisis-free times, returns to organizational status quo or bureaucratic structure.

According to Etzioni, the appearance of leaders with charismatic qualities is not limited to the topflight organization position. Lower subordinates can occasionally exhibit a personal charisma. For example, if in the war front a senior officer dies, the younger one takes over, or the retirement of the most senior officer can introduce a younger one next to him to take over the retiree's position. Satya, (1986) cited in Nwizu, (2010), saw the criticism of Weber from the angle of those who do the work in civil service. According to him, the non-engineers (semi skill and unskilled) and not the trained engineers do the work in organizations. The engineer only supervises. He concluded that what bureaucracy should emphasize is a specialization of function and not a specialization of knowledge. Those bureaucratic organizations are the engine to produce power and wealth for their owners.

The Marxists also saw loopholes on Weber's ideological theory of organization. He sees Weber's work as a defense of capitalist domination over society. According to Karl Marx, Weber's work has intentions of "philosophy of history" made to legitimate, in Nwizu, 2010). He attacked the rules and regulations feeling that it might lead to rigidity, delays authority or domination characterized with class struggle and civil war as power politics (Merto (red-tapism or bureaucratic bottleneck), which gives no room for flexibility (Onah, 2005 and Sharma, Sadana and Kaur, 2012). Upon these (Nwizu, 2010: 59) summed up bureaucracy as an imperfect tool because of its inappropriateness to the needs of the following:

a. Highly professionalized workers because of its structure of top-down authoritative principles may not need others.
b. It lacks the participative climate required for effectiveness in a science-based civilization because the traditional bureaucracy is hierarchical, position oriented and authoritarian in concept.
c. It has been found inadequate to meet the need for rapid economic and social development in developing countries because of its behavioral characteristics.
d. It is pointed out that an apparently well-ordered and disciplined formal structure of bureaucracy hides the reality of pervasive competition for power and status within the organization. With these problems associated with bureaucracy and having it as the wire life of organizations, can organizations perform and function optimally?

According to Ogunrotifa (2013) in his paper titled "Democratic Deficit: The Dark Side of Weberian Bureaucracy in Nigeria", identifies the discontents and problems associated with Weberian model of bureaucracy in Nigeria, and argued that these dark sides is associated with lack of democracy in decision making processes of public organizations. In this regards, there was no room for democratic input in decision making processes, and employees were bound to carry out a policy once it had been hierarchical imposed. The study, however, predicts that strengthening democratic values in the management of public service will help tackle the moribund challenges associated with weak institutional mechanisms, corruption, wastefulness and inefficiency, and usher capacity building and strong institutional framework that will enhance the ability of Nigerian public institutions to achieve its developmental goals and handle the technical complexities in the sustainable way.

Weber believed that bureaucracy provides an ideal weapon to harness and routinize human and mechanical energy which was a catalyst to the industrial revolution. He further believes that everything about the organization is on how to achieve goals. His views on bureaucracy which is an epitome of the organization as internally oriented have external pressure and influence which threaten the organization's pursuit of goals.

STATEMENT OF THE PROBLEM

Bureaucracy in spite of the fact that it is widely used globally has so many defects. Some of which are discussed below. Bureaucratic procedures involve exhausting paperwork and routine through endless official channels causing inordinate delays and frustration. Communication is reduced to a feeble walk and members while trying to adhere to rules and regulations may discount the value of arriving at prompt decisions. By encouraging conformity to rules and regulations, bureaucracies leave nothing for original or innovative behavior (Nwizu, 2011). Bureaucracy has been criticized as being too strict, rigid, static and inflexible. Often time strict adherence produces timidity, "conservatism and "technicism". These trends encourage or breeds resistance to changes. Compliance with rules and regulations may provide the cover to avoid responsibility for failures. Bureaucracy emphasizes the mechanical way of doing things through the observance of the rules and regulations, but the rules and regulations are favored over employee needs and emotions.

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This has made bureaucracy being labeled as an "organization without persons" (Nwizu, 2011). One of the means, by which an organization attains its goals, is through the objectives. Most times they are displaced as organization procedures become more formalized, individuals more specialized and means often become confused with ends. Specialist, for example, may concentrate on their goals and forget that their goals are means for reaching the broader objectives of the organization (Etzioni, 2008). Again, bureaucracy encourages the compartmentalization of activities. Specialization and division of labor are encouraged in bureaucratic structure to improve organizational efficiency. But such strict categorization of activities may often restrict people from performing a task that they are capable of performing. For example, a pipe filter can install a pump but is prohibited by work rules from making the electrical connections even if he is totally qualified to do so. Bureaucracy would also encourage a tendency to perpetuate existing jobs even when they become redundant.

This study is the assessment of bureaucratic theory in the Nigerian public sector, a study of Federal College of Education (Technical), Gombe from 2019-2023. Here the Legal-Rational authority is what is actually called the Bureaucratic theory by Max Weber. The Legal-Rational authority or the Bureaucratic authority means a big organization arranged in hierarchical order governed by rules and regulations, with officials appointed based on technical qualifications and expertise, whose activities are recorded and store in files. In other words, the Legal-Rational authority is a type of authority exercised in a big organization (usually governmental organizations) governed by 7 principles which are: Division of Labour, Hierarchical Organization, Rules and Procedures, Position of the Bureaucrat, Technical Qualifications and Expertise, Official property not to be used as personal property, Activities of Officials are recorded, Documented and Stored in Files. Division of Labour: Weber believed that for any organization especially government-owned organizations to be effective in service delivery and also achieve their objectives, jobs must be divided into various units. Each unit of the job should be assigned to individuals who have been trained or who shall be trained to handed that aspect of the job.

Almost all public and private organizations everywhere now adopt this principle. For instance, Federal College of Education (Technical), Gombe was established with the sole objective of disseminating higher knowledge to young men and women. This higher knowledge covers areas such as Vocational, Technical and Science teachers, etc. For this higher knowledge to be effectively disseminated to students, it is divided into various departments and Units, thus we have Vocational School, PES School, Business School, School of Education, Technical School, School of Science and School of undergraduate, etc. Staffers involved in achieving this higher knowledge objective are divided into academic staff who must specialize in an aspect of the job and also non-academic staff. For effective dissemination of higher knowledge, the division of labour is operational leading to the effective and efficiency dissemination of this knowledge to these Young men and women in the country. Also, a Study of Federal College of Education (Technical), Gombe, from (2019-2023) is practicing the hierarchical bureaucratic structures with its Organizational Chart of the College in line with the 7 principle of Max Weber's theory of bureaucracy. Another constraint is that there is shortage of staff in some departments and units due to embargo placed by the Federal Government in the issue of recruitment of the new employees in 2022 while the Federal Character Principle is (sometimes) not strictly adhering to in the recruitment of personnel in the Nigerian Public sector. The essence of Federal Character is to ensure that recruitment policy in Nigeria is adhered to in order to checkmate nepotism, ethnicity, religiosity, political in-fighting, corruption, inefficiency etc. This research will endeavor to provide answers to the following questions:

a. Why are the principles of bureaucratic theory in the Federal College of Education (Technical) Gombe operational?
b. To what extent are the principles of Max Weber applied?
c. What are the constraints faced by the Federal College of Education (Technical), Gombe?

PURPOSE OF THE STUDY

1. To know the extent of the operation of the principle of bureaucracy in the Federal College of Education (Technical), Gombe
2. To find out the constraint faced by the Federal College of Education (Technical), Gombe.

HYPOTHESIS

H_o^1: There is no significant relationship between the constraint faced by the Nigerian Public sector and hierarchical structure of Federal College of Education (Technical), Gombe.

METHODOLOGY

Research Design: The researcher employed a survey research design for the study. The survey is a research method which focused on a representative sample.

Population of the Study: Presently, the Federal College of Education (Technical), Gombe that has produced over fifteen thousand (15,000) NCE Teachers and number of graduates from its Degree Programme under the affiliation with the University of Maiduguri and Abubakar Tafawa Balewa, Bauchi (ATBU) over the years.

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Sample Size and Sampling Technique: For the purpose of fairness and research convenience, the researcher employed the use of random selection technique by picking the mandate of the College since its inception is to produce Technical, Vocational and Science Teachers for Primary, Junior and Senior Secondary schools in the country being a Federal Government Institution.

The Research Instrument: The questionnaire served as the instrument of data collection. And so out of the total of 500 questionnaires that were administered, only 350 were retrieved. Some were lost to mutilation and others couldn't be retrieved. The researcher deliberately skipped to analyze the sex (male and female), age, education and qualification because they are not variables to be tested and analyzed.

RESEARCH ANALYSIS AND DISCUSSIONS

Research Question 1: Is the bureaucracy theory of Max Weber effective in the smooth running of the Nigerian Public Sector of the Federal College of Education (Technical), Gombe?

Table 1: Response of the respondents

Response	Frequency	Percentage	Cumulative Frequency
Yes	350	54.44%	100.00%
Valid No	150	45.56%	45.56%
Total	**500**	**100%**	**145.56%**

Source: Field Work, (2023)

The above table shows that 54.44 % agreed that bureaucracy of Max weber is effective in the Nigerian public sector including Federal college of education (technical), Gombe while 45.56 % thinks otherwise.

Research Question 2: Does your boss consult you before decisions are taken in your office?

Table 2: Response of the Respondents

Response	Frequency	Percentage	Cumulative Frequency
Filled	350	77.22%	77.22%
Valid Unfilled	150	22.78%	100.00%
Total	**500**	**100%**	**145.56%**

Source: Field Work, (2023)

From the above table, it shows that 77.22 % of the respondents filled the section while 22.78 % of the respondent did not respond.

Test of Hypothesis

There is a great impact in the efficiency and effectiveness of operations as a result of division of labour in the Federal College of Education (Technical), Gombe.

Table 3

Response	Observed N	Expected N	Residual
Agreed	40	33.3	6.8
Strongly Agreed	50	33.3	16.8
Disagreed	26	33.3	-7.3
Strongly Disagreed	17	33.3	-16.3
Total	133		

Decision Rule

There researcher therefore reject the null hypothesis that there is a positive relationship that emphasizes clear hierarchies, formalized rules, meritocratic recruitment and expertise for efficient administration in the Nigerian public sector. As the calculated value of 19.331 is greater than the critical value of 7.82.

Therefore, the alternate hypothesis accepted that there is a negative relationship between bureaucratic characteristics and red tape (bureaucratic delays and hurdles) in the Nigerian public sector.

2. There is a great impact in the efficiency and effectiveness of operations as a result of division of labour in the Federal College of Education (Technical), Gombe.

Table 4

Response	Observed N	Expected N	Residual
Yes	73	44.3	28.7
No	33	44.3	-11.3
Undecided	27	44.3	-17.3
Total	**133**		

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Max Weber was the first to use and describe the term bureaucracy. This is also known as the bureaucratic theory of management, bureaucratic management theory or the Max Weber theory. Max Weber was a German political economist, philosopher and a social scientist who along with Emile Durheim and Karl Marx is considered to be one of the three founding pillars of sociology.

Bureaucracy is a type of formal administration with the characteristics of division of labour, rules and regulation, hierarchy of authority, impersonality of social relationships and technical competence (Reicheld and Sasser,1990), the essence of bureaucracy is to manage large organizations to achieve efficiency and be more accountable to the people (Olatunji,2023. Weber (1946) cited in Aluko and Adesopo (2004) refers to bureaucracy as the ideal and rational type of administration useful for Olalekan Ajibade and Jide Ibietan- in the Nigerian Public Sector. "Bureaucracy" is rule conducted from a table or office, that is, preparation and dispatch of written documents and electronic. Bureaucracy is borrowed into the field of public administration from sociology (Akume,2012). It was borrowed by public administration in a similar way that practices of business were borrowed from Business Administration and Economics.

Therefore, according to Max Weber; "Bureaucracy is an organizational structure that is characterized by many rules, standardized processes, procedures and requirements, number of desks, meticulous division of labour and responsibility, clear hierarchies and professional, almost impersonal interactions between employees".

He believed that bureaucracy was the most efficient way to set up an organization, administration and organizations and that bureaucracy was better than traditional structures. According to the bureaucratic Max Weber theory, such a structure was indispensable in large organizations in structurally performing all tasks by a great number of employees. In a bureaucratic organization, everyone is treated equal and the division of labour is clearly described for each employee. In addition, in a bureaucratic organization, selection and promotion only occur on the basis of technical qualifications. The term bureaucracy has been criticized by scholars, administrator, researchers, and academia. The term is used by sociologists in designating a certain type of structure, a specific organization with unequally coordinated rationality, and rejects bureaucracy as a term which equates red tape, inefficiency and other derogatory synonyms. Bureaucracy as a concept is subjected to repetitive criticisms among various scholars (Stillman, 1980; Okafor, 2005; Osawe,2015).

Notwithstanding the above, Akindele, Olaopa and Obiyan (2002) perceived that bureaucracy is an ambivalent term that can be taken to mean different things. For instance, it could be taken to mean different organizations used by contemporary governments in conducting its functions and encapsulated in the administrative system of the civil service. He added that bureaucracy could also mean a mechanistic and formal approach used in carrying out the functions of government to the point of indifference towards the effects achieved. Nwankwo, Ananti and Madubueze (2015) conceives bureaucracy as a hierarchical management that exist in organizations based on a line of authority and division of labour embedded on this arrangement. Gbenga and Ariyo (2006), in their work portrayed the concept as the apparatus which consist of the professionals, workers who are subjected to hierarchical supervision and carrying out their duties in an organized manner backed by rules and regulations from their superiors. In the light of this, bureaucrats are identified by their activities in formal and public organizations.

Bureaucracy also denotes the system of authority relationships that exist between men, offices and methods that government uses to implement its programmes. It does not cover political appointees such as Ministers and Advisers or members of the judiciary at the Federal, State and Local Government tiers of government (Eme and Onwuka,2010). Eme and Ugwu (2011) sees bureaucracy as a word in which its ordinary use conjures bad images in the mind of the people. Bureaucracy can suggest a slow moving organization, associated with government which serves the populace with a mixture of intentional obstruction, arrogance and incompetence. The term is sometimes employed as an insult, whilst bureaucrats are most time seen as figures of laughter. Bureaucracy widely defined, refers to the machinery of government created to execute the decisions and policies of government. Political office holders make policies, whilst the public bureaucracy implements it. Bureaucracy is a structure with highly routinized operating tasks that can be achieved through formalized rules, regulations and specializations of tasks grouped into functional departments, centralized authority, narrow spans of control and decision making that are in line with chain of command (Robbins and Judge, 2007). Coser and Rosenberg (1976) affirm that bureaucracy is a type of hierarchical arrangement that exists in an organization and it is design rationally to coordinate the work of employees in the pursuit of large-scale administrative tasks, administrative organization based on a hierarchical structure and governed.

CONCLUSION

The main objective of the public sector in Nigeria seeks to achieve is policy initiation, formulation and implementation for the well-being and welfare of the citizens. However, over the years, the sector has been plagued with declining service delivery and moral bankruptcy. This study within the framework of social exchange theory examined the dynamics of bureaucratic accountability, the nexus between bureaucratic accountability and public sector management in Nigeria. It is usually the public that suffers from a malfunctioning public service. Nigerian citizens look up to public servants for protection against various ills in the society and the

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provision of essential services. If the involvement of public servants in the political, economic and social life of the country is considered, we shall better appreciate the needed urgency in making the service accountable for its actions.

Hence, assessing the Max Weber's bureaucracy and the extent at which jobs are performed in the Nigerian public sector which is a replica of the Nigerian Civil Service, structured after the British colonial masters, it shows that job performance in the Nigerian public sector is a tenet of bureaucratic theory of Max Weber that structured organization both public and private hierarchically for the purpose of achieving predetermined goals and also organization should pay serious attention to employer and employees relations in order to enjoy harmonious and conducive working relationship in order to achieve her aims and objectives.

RECOMMENDATIONS

Based on the findings of this study the following recommendations were made:

1. This study argues that for Nigeria to match forward there is need for effective, efficient, patriotic and committed public servants, who should be accountable for their stewardships.
2. It also recommends that unless the Nigeria public sector is revitalized and "dead woods" therein removed, Nigeria and Nigerian will continue to experience deep-seated frustrations in the often-touted desire to move the nation forward.
3. Workers in the Nigerian system should be treated like their British counterparts and workers in the world be highly recognized and prize be given to excellent ones at the end of the year;
4. Employees be co-opted into the decision-making body of the top management to make them fell relevance so as to have a high sense of belongingness;
5. The rules and regulations of the civil service be relaxed and to allow employees some degree of freedom and to have a sense of self-evaluation, assessment of their own character and conduct;
6. The Nigerian Government and the Management of Federal College of Education (Technical), Gombe, like other developed economies in the world creates a conducive working environment for her workers by providing office equipment, furniture, and good public convenience as well as remove nepotism, ethnicity, religion but uphold technical qualification as a yardstick for recruitment in the organization.

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AN ANALYSIS OF FDI - R&D INNOVATIONS ON ECONOMICAL ACTIVITIES IN INDIA

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ABSTRACT
Presently, the economies of nations are significantly affected by their innovative activities, which indicates technological upgradation and development as the growth of human resources. To account for the effect of FDI on R&D activities in the economy, the study has used a panel data set over 2010–2022. The estimated model demonstrates strong explanatory power, with most factors promoting productive capacities in India. Those innovations are most effective in the economy after the make in India and COVID-19.

INTRODUCTION
Innovations are the key factors for productive activities and significantly encourage economic growth. Innovations can bring greater output and yield advantages for consumers, enterprises, and the economy at large. Innovation in the economic sense refers to the creation and utilization of concepts and technology that enhance products and services or increase the productivity of their manufacturing (ecb.europa.eu). However, the economy's capacity for long-term development rests on innovation. In the last two decades, studies have observed massive growth in innovation across the world. Which can cause to potential growth in production, GDP, export, technology, knowledge, employment creation, etc otherwise economic growth slowdowns in the nation (Cette et al., 2016). It has been observed from the Endogenous growth models. Therefore to maintain the higher economic activities innovations and productive activities much needed in the present generation for the future economic growth was mainly observed from the USA, China, Japan, UK, etc..

The newly developed Productive Capacities Index (PCI) shows disparities in productivity across industries, sectors, and regions, which will account the variations in socioeconomic growth. Particularly badly on PCI are fragile and structurally weak economies. It is still very difficult to make emerging nations economically resilient. It primarily relies on developing, preserving, and using productive capacity in order to promote growth. This would necessitate a change from the existing fragmented and project-based interventions to cohesive, program-based, economy-wide approaches to the removal of legally imposed development limitations. Stronger international support is required to supplement and reinforce domestic actions and initiatives. The ongoing development obstacles have been exacerbated by new external shocks and instability, including pandemics, climate change consequences, a decline in global commodity prices, and a decline in confidence in multilateralism.

The index incorporates knowledge gained from our technical assistance to the most vulnerable nations in building vital components of their trade and economic infrastructure, together with decades of comprehensive research and policy analytic work. The index is the first thorough attempt to gauge productive capabilities across all economies and create a multifaceted index that may offer diagnostics and country-specific insights on the growth of productive capacity (UNCTAD). To assist in figuring out the causes of systemic vulnerabilities and locate the factors that promote economic growth - including advancements made toward both national and international development goals - PCI plays a significant role in these initiatives. PCI also provides ratings that are particular to each nation and area.

The score highlights areas where policies are effective and those that require correction, assisting in the diagnosis of whether a country is leading or lagging behind. Under each of its eight components - human capital, natural capital, energy, ICTs, structural transformation, transportation, institutions, and the private sector - it offers a road map for upcoming policy initiatives and interventions. PCI tracks advancements and highlights barriers to the growth of productive capabilities in emerging nations is more than expectations. However, India won the R&D race from 2022 (fdiMarkets, 2023).

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IPR Policy: according to the Trade-Related Aspects of Intellectual Property Rights (TRIPS) framework. India is one of the top three nations with a significant increase in Patent Cooperation Treaty (PCT) submissions in 2018 (The Mirrority).

The government has implemented several significant measures that have strengthened India's intellectual property laws over the years (meity.gov.in, 2016). These include fee reductions such as a 10% for online filing rebate, an 80% fee concession (PIB, and the Economic Times, 2022) for startups, small entities, and educational institutions, and provisions for expedited examination for startups, MSMEs, and other categories.

Global Innovation Index

The DPIIT and IP office's concerted efforts have raised knowledge of IP rights across the board. While the number of IPR filings has increased as a result of these efforts, the number of patent applications pending at IP offices has decreased. Additionally, he stated that this will bring India one step closer to its ambitious goal of ranking among the top 25 countries in the world for innovation.

According to the Global Innovation Index (GII) 2023, India continued to rank 40th out of the world's most inventive economies. India is rated seventh in the world in terms of resident patent filing activity, according to the WIPO Report 2022. India moves up one spot in the Network Readiness Index (NRI) 2023 study, from 79th place in 2019 to 60th place in 2023. Regarding the use and effects of information and communication technology (ICT) in 134 economies worldwide, NRI is one of the top global indexes (Indian Express, 2024).

DATA AND METHODOLOGY

The study has been uses data of FDI-RD and patents over 2010 to 2022, and estimates the 5year moving average up-to 2024. Which has been used to estimate the growth rate to the base year (selected a year - 2010). Other than that study has estimated the descriptive statistics for the data of productive capacity index (PCI) covers the data of 2001-2024, which has been collected from the sources of fdiMarkets, TheMirrority, European Patent Office, and UNCTAD, etc.. the changes in PCI values has been used for the estimation of simple statistics, Pearson coefficient of correlation, and for the regression function. The study used the data for the analysis with the help of tabular and graphical methods.

The study has estimated the model using the regression function as follows:

$$Y = \alpha + \beta_1 X_1 + \beta_2 X_2 + \cdots \ldots \ldots \ldots + \beta_n X_n + \varepsilon$$

The model given in equation, 'Y' represents the Dependent variable (PCI), α is the intercept value that explains the autonomous values of the dependent variables. β is nothing but a parameter vector, which confirms the amount of slope. However, X shows independent variables, and ε concentrate on the error terms. As a nature of the panel data set, heteroscedasticity accounted. Therefore, the study has diagnosed the heteroscedasticity, autocorrelations, and multicollinearity effects by the estimation of the Newy-West model. The VIF values, which are more than 5 and 10 indicate multicollinearity and severe multicollinearity. Estimation was done with the help of SAS software.

ANALYSIS AND INTERPRETATION

The study has been used the FDI-RD investments, Patents, productive capacity index (PCI) data for the estimation and analysis. Which is as follows in bellow..

Table 1: Base year Growth rate of FDI destinations by R&D activity capital expenditure from 2010-2022 (Base year-2010, in Percentage).

Year	India	US	Canada	China	UK
2011	37.4	57.5	16.5	-9.2	5.0
2012	-0.4	72.7	38.0	-31.0	-1.9
2013	7.8	81.9	362.3	-10.8	16.3
2014	-4.5	60.7	62.9	-3.9	-10.2
2015	74.5	61.8	-21.7	-29.6	-21.4
2016	77.7	51.1	121.4	-31.8	-43.3
2017	47.1	87.8	172.5	-9.3	131.1
2018	118.7	67.1	229.9	-0.8	31.0
2019	51.8	102.8	155.3	-9.1	163.6
2020	-45.8	30.5	210.2	-70.1	10.0
2021	1.8	100.2	212.3	-60.5	32.7
2022	415.3	111.9	351.9	-46.7	-13.5
2023	271.3	108.6	322.2	-35.6	-13.8
2024	408.9	117.3	352.3	-23.9	-25.5

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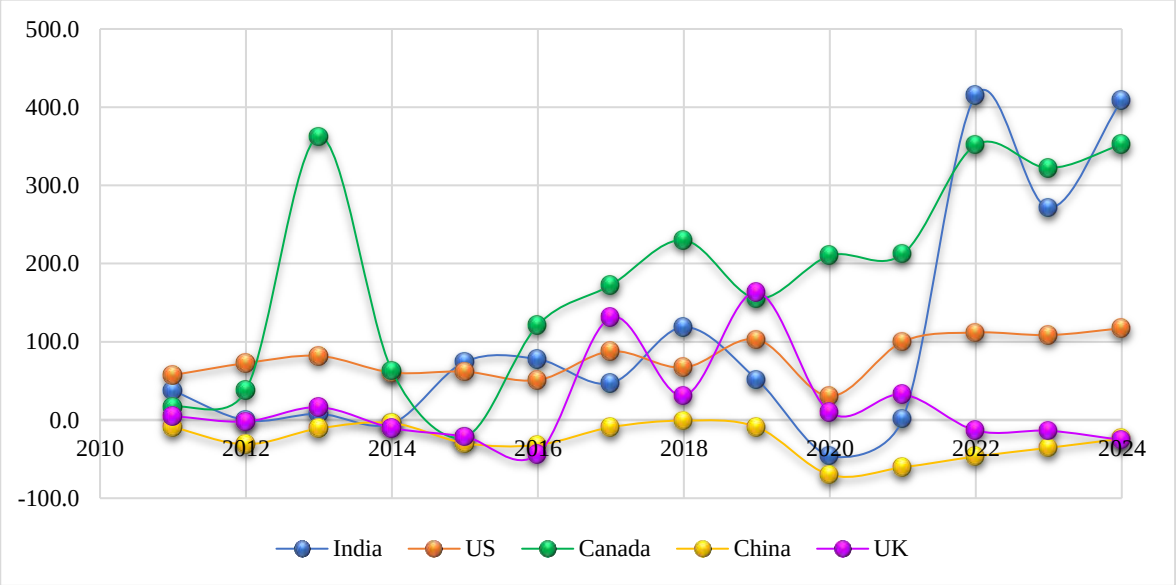
Figure 1: Base year Growth rate of FDI destinations by R&D activity capital expenditure from 2010-2024 (Base year 2010, in Percentage).



The table 1 and figure 1 shows, the top five FDI destinations by R&D activity capital expenditure from 2010 to 2022. The top 5 destination countries are: India, the US, Canada, China, and the UK. According to fDi Markets, in 2022, India recorded an estimated US$12892 billion and estimated data from moving average is also close to US$12733 billion at 2024 in FDI - R&D, is more than 400 percent from US$2548 billion in 2021 and to the 2010. 2022 is the highest level of FDI in R&D ever recorded in India, and it surpasses the United States, which has been the top FDI in R&D destination for the past decade. India has also seen its share of global R&D activity and capital expenditure grows in recent years, from 3.1 percent in 2010 to 8.1 percent in 2022. This growth is likely due to a number of factors, including India's large and growing pool of skilled workers, its cost-competitiveness, and its government's supportive policies. According to a Deloitte survey of 99 companies in 2022, India continues not only to be a destination of choice for research and development (R&D) operations and multinationals' engineering but is also expected to keep growing.

The United States has consistently been the top destination for R&D activity by capital expenditure, accounting for an average of 28.4 percent of the global total over the 13 -year period. In 2022, the US attracted an estimated US$9.8 billion in FDI in R&D, down slightly from US$9.2billion in 2021. However, the US still accounts for a significant share of the global FDI in R&D market. Which is 117.3 times higher than the 2010.

Canada, China, and the United Kingdom are also major FDI destinations for R&D activity. In 2022, Canada attracted an estimated US$ 6.7billion in FDI in R&D, China attracted an estimated US$2.4billion in FDI in R&D, and the UK attracted an estimated US$1.2billion in FDI in R&D. Canada has also been a major player, accounting for an average of 10.8 percent of the global total. Canada has been attracted 352.3 percent higher FDI-RD than 2010. China has seen its share of global R&D activity capital expenditure was grown significantly in recent years, from 5.7 percent in 2010 to 15.4 percent in 2022. But in comparison to the base year 2010, in 2022 China has received FDI on research and development works was -23.9 percent. However, the United Kingdom is the Fifth largest FDI destinations by R&D activity in capital expenditure and UK has maintaining the consistency over a period except 2016 (826 US $Billion), 2017 (3365 US$ Billion) and 2019 (3838 US$ Billion). Also, UK received a FDI in R&D activities was declining as compared to 2010 is -25.5 percent on 2024 and 13.5 percent in 2022. Overall, the table shows that the India, United States, Canada, China, and UK are the top five destinations and other five states in top ten are Spain, Ireland, Singapore, Mexico, and France are involved in this FDI destinations by R&D activity capital expenditure. These five countries account for over half of the global total.

India is becoming increasingly attractive to MNCs that are looking to invest in research and development. This is likely due to a number of factors, including India's large pool of skilled workers, its growing economy, and its government's support for R&D investment. The US remains home to some of the world's leading R&D universities and companies. It also has a well-developed innovation ecosystem. The growth in the number of FDI destinations for R&D activity is a positive sign. It suggests that MNCs are increasingly looking to invest in R&D in a variety of countries. The number of FDI destinations for R&D activity in capital expenditure will be increased over time. In 2010, there were an estimated 50 FDI destinations for

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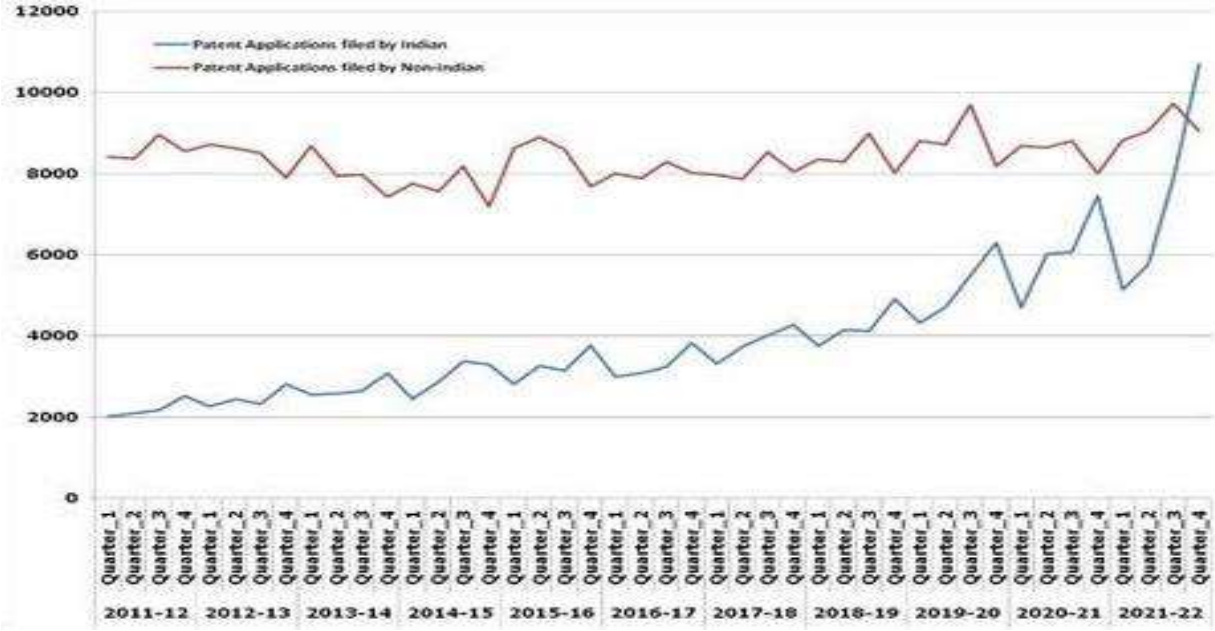
R&D activity in capital expenditure. By 2022, this number had increased to an estimated 75 FDI destinations for R&D activity in capital expenditure.

Figure 2: The quarterly filed patent applications from Indians and Non-Indians.



Source: Press Information Bureau.

In figure 2 study observed, from 2011-12 onwards (Figure 1), the patent applications of Non-Indians has been declining until 2014-15. Which is lesser than 8000, mainly in the period of 2014-15 elections due to the scariness of Govt. instability caused to decline and reached approximately 7200. As the existence new government (NDA) from the 2015-16, applications of Non-Indians has been increasing for the patents is more than the before 2014.

However, a significant milestone was reached by India in the context of the IP innovation ecosystem: in the quarter of January to March of 2022, out of the total 19796 patent applications filed, 10706 were filed by Indian applicants, compared to 9090 by non-Indian applicants. This is the first time in the last 11 years that the number of domestic patent filings at the Indian patent office has surpassed the number of international patent filings.

Moreover, the applications of Indians have been increasing over a period from 2011-12 to till date for the patents. Only due to the effects of Corona (COVID-19) the fall patent application has been observed. The COVID-19 is also a main region to rapid growth in the patent application from Indians after the end of Corona.

Table 2: Estimation of descriptive statistics

Simple Statistics						
Variable	**Variable Lables**	**Mean**	**Std Dev**	**Sum**	**Min**	**Max**
PCI	Productive Capacity Index	37.32	4.70	895.76	29.21	43.8
HC	Human Capital	31.54	4.36	756.92	23.64	37.4
NC	Natural Capital	48.20	2.21	1157	43.93	50.6
Energy	Energy	34.00	8.16	816.01	21.76	47.52
Transport	Transport	30.52	5.96	732.54	26.1	56.2
ICT	ICT	17.68	8.80	424.31	6.85	34.91
Institutions	Institutions	50.17	1.36	1204	47.8	52.6
PS	Private sector	48.50	2.99	1164	43.53	53.23
SC	Structural change	69.75	7.96	1674	52.50	76.6
FDIRD	FDI-RD	12764	20111	306339	110.42	74051

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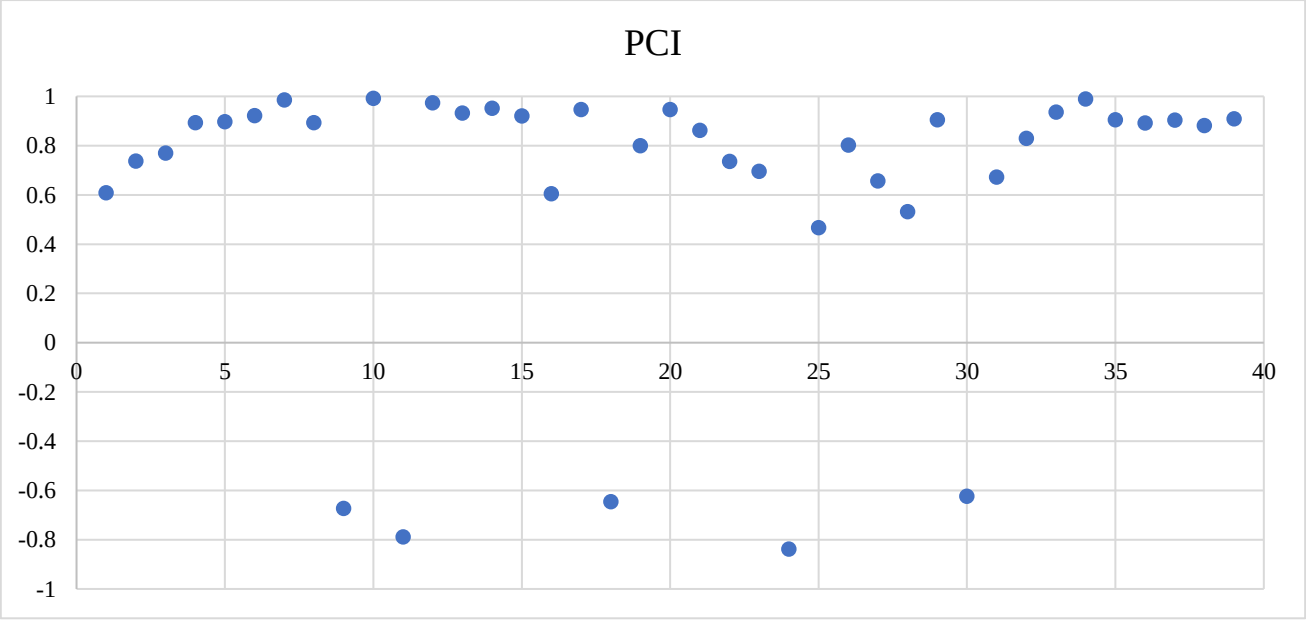
FDIRDP	FDI-RD Projects	131.25	44.36	3150	53	225
JFDIP	Jobs from FDI Projects	304540	211094	7308951	113024	885087
IC	Inventor Country	3964	3531	95143	234	10582
Inflation	Inflation	6.09	2.53	146.09	3.33	11.99
PUSD	PPP-USD	16.70	5.10	400.76	9.77	24.06
RUSD	Rupee-USD	58.49	13.76	1404	41.35	83.36
EoDB	Ease of Doing Business	105.20	32.69	2104	57.4	142

The above table 2, depicts the descriptive statistics, in which Productive Capacity Index (PCI) deviates 4.70 from the mean value of 37.32. The PCI has moderate variability with values ranging between 29.21 and 43.80, indicating consistent productivity levels across different observations. Followed by Human capital (HC), transport, private sector performance, inflation, and purchasing power parity are also shows a moderate variability. Low variability is found in natural capital (Std Dev of 2.21) and the institutions (1.36) are shown relative consistency.

With a standard deviation of 8.16, the energy variable exhibits substantial variability, suggesting a notable variation in energy supply or use. Transportation has a moderate degree of variability over a somewhat broad range, indicating varying capacities or infrastructure levels. ICT has high variability, pointing to notable variations in ICT usage or infrastructure between observations. There appear to be variations in the performance or activity of the private sector based on the modest variability of the private sector variable. The variety of structural change is quite high, suggesting varying degrees of structural or economic shift. FDI-RD exhibits exceptionally high variability, pointing to notable variations in FDI in R&D between data. The number of FDI-RD projects varies significantly, indicating varying degrees of foreign investment in R&D initiatives.

High variability is observed in energy availability, ICT adoption, structural change, employment generation from FDI projects, inventor numbers, and ease of doing business. Extremely high variability is observed in FDI-RD, FDI-RD projects, and exchange rate (Rupee-USD) changes over time. Overall, the study highlights the importance of understanding and adapting to changes economic conditions.

Figure 3: The Pearson Coefficient of correlation among PCI and other variables.



The study has estimated Pearson Correlation Coefficient to the Productive Capacity Index (PCI), has been shown in the below table 3 and figure 3 explains, there was a strongly and positive correlation with HC (0.99), Energy (0.97), ICT (0.93), PS (0.95), SC (0.92), FDI-RD (0.61), JFDIP (0.74), IC (0.92), PUSD (0.98) and RUSD (0.89) are statistically significant P<0.0001. The other variables of NC (-0.789) and EoDB (-0.719) are showing negative correlation with statistically significance. The remaining variables of Institutions, Transportation, FDIRDP, and Inflation are negative but insignificantly correlated with PCI.

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Table 3: Estimation of Pearson Correlation Coefficients to India's Productive Capacity Index (PCI).

Var	PCI	HC	NC	Energy	Trans	ICT	Insti	PS	SC	FDIRD	JFDIP	IC	Inflation	PUSD	RUSD
HC	0.99213 <.0001														
NC	-0.78916 <.0001	-0.80131 <.0001													
Energy	0.97418 <.0001	0.97122 <.0001	-0.88383 <.0001												
Trans	-0.29202 0.1662	-0.30811 0.143	0.22821 0.2835	-0.27884 0.187											
ICT	0.93268 <.0001	0.92221 <.0001	-0.91533 <.0001	0.98078 <.0001	-0.24786 0.2429										
Insti	-0.15821 0.4603	-0.17519 0.4129	-0.05703 0.7913	-0.10758 0.6168	-0.26632 0.2084	-0.0982 0.648									
PS	0.95176 <.0001	0.94341 <.0001	-0.86678 <.0001	0.96151 <.0001	-0.28096 0.1836	0.94616 <.0001	-0.10407 0.6284								
SC	0.9201 <.0001	0.92124 <.0001	-0.6001 0.0019	0.85244 <.0001	-0.29728 0.1583	0.76297 <.0001	-0.21191 0.3202	0.86392 <.0001							
FDIRD	0.60863 0.0016	0.57903 0.003	-0.79841 <.0001	0.72899 <.0001	-0.1318 0.5393	0.80483 <.0001	0.12023 0.5757	0.7234 <.0001	0.45566 0.0252						
JFDIP	0.73766 <.0001	0.72211 <.0001	-0.89127 <.0001	0.84581 <.0001	-0.19939 0.3503	0.90395 <.0001	0.0411 0.8488	0.80677 <.0001	0.56052 0.0044	0.96617 <.0001					
IC	0.92161 <.0001	0.91257 <.0001	-0.9183 <.0001	0.9764 <.0001	-0.25718 0.2251	0.99459 <.0001	-0.06369 0.7675	0.92483 <.0001	0.73408 <.0001	0.78395 <.0001	0.89142 <.0001				
Infla	-0.02293 0.9153	0.02303 0.9149	0.17343 0.4177	-0.09636 0.6542	-0.172 0.4216	-0.21378 0.3158	0.18782 0.3795	-0.02236 0.9174	0.27324 0.1964	-0.153 0.4754	-0.18965 0.3748	-0.24933 0.24			
PUSD	0.98519 <.0001	0.9743 <.0001	-0.84706 <.0001	0.99192 <.0001	-0.29516 0.1614	0.97256 <.0001	-0.11112 0.6052	0.95661 <.0001	0.86699 <.0001	0.69717 0.0002	0.81469 <.0001	0.96869 <.0001	-0.10163 0.6365		
RUSD	0.89393 <.0001	0.87369 <.0001	-0.86889 <.0001	0.94747 <.0001	-0.28675 0.1743	0.97256 <.0001	-0.05234 0.8081	0.88892 <.0001	0.69739 0.0002	0.77167 <.0001	0.86749 <.0001	0.98433 <.0001	-0.29415 0.163	0.95057 <.0001	
EoDB	-0.71893 0.0004	-0.76459 <.0001	0.90915 <.0001	-0.8292 <.0001	0.09568 0.6882	-0.85924 <.0001	-0.09512 0.69	-0.75177 0.0001	-0.34141 0.1407	-0.64984 0.0019	-0.78982 <.0001	-0.86885 <.0001	0.53514 0.015	-0.76468 <.0001	-0.80409 <.0001

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Table 4: Estimation of regression function on India's Productive Capacity Index (PCI).

The AUTOREG Procedure			
Variable	**Variable Label**	**Parameter**	**Approx**
		Estimate	**Pr > |t|**
Intercept		2.7626	0.0003
FDIRD	FDI-RD	-1.52E-06	0.0383
FDIRDP	FDI-RD Projects	0.000256	0.0011
JFDIP	Jobs in FDI Projects	-5.23E-08	0.1808
HC	Human Capital	0.009327	0.0008
NC	Natural Capital	-0.001827	0.2051
Energy	Energy	0.0112	0.0043
Transport	Transport	0.000767	0.0087
ICT	Information and Communication Technology	0.0135	0.0069
Institutions	Institutions	0.00418	0.0248
PS	Private Sector	-0.002816	0.0648
SC	Sectoral Change	-0.00488	0.0052
IC	Inventor Country	-0.00003	0.0019
Inflation	Inflation	0.003192	0.0136
PUSD	PPP-USD	0.0143	0.01
RUSD	Rupee-USD	0.000233	0.4077
EoDB	Ease of Doing Business	0.001142	0.0066
Dependent Variable		ln Productive Capacity Index (ln PCI)	
Total R-Square		0.9996	

The study has been estimated the regression function particularly a HAC or Newy-west Model from the AUTOREG Procedure using the SAS software. In the above table 4, intercept value is positive and significantly associated with the dependent variable PCI. When all other factors are held constant, there is a statistically significant (0.0008) association between a rise in human capital causes to increase 0.0093 percent in PCI. Energy availability or utilization has a positive impact on PCI, with an estimated value of 0.0112, and the effect is significantly associated (P<0.0043). The P<0.0087 result indicates a significant effect, and increases in the capacity of transport infrastructure are positively linked (0.000767) with PCI.

As higher the Information Communication Technology (ICT) infrastructure or adoption can increase 0.0135 percent in PCI, and this relationship is significant (0.0069). A 1 percent of change in institutional quality was significant at P<0.0248 and shows a positively affects 0.00418 percent in PCI. The 1 percent increase in FDI-RD projects are positively influences PCI at 0.00025 percent was significantly effective (P<0.0011).

Higher inflation rates positively affect 0.0032 percent to the PCI, and it shows a significant (P0.0136) relationship. as price of the products increases at higher demand from the public production activities increases as much as possible to maximize profit rate. Therefore, the 1 percent increase in Purchasing power parity (PPP) in USD positively affects (0.0143) PCI at the significant level of P<0.01). A better score in ease of doing business was significantly (0.0066) associated and positively affects PCI at the rate of 0.00114. The score increases as the country changes to the business-friendly nation, the investment activities boost the productions.

Sectoral change has a significant effect (P<0.0052) but negatively impact (-0.0048 percent) on PCI. Followed by FDI in R&D's shows a significant (P<0.0383) effect but study observed very small negative effects (-1.52E-06) on PCI. As a Inventor country study has observed significant effect (P<0.0019) but shows a small

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negative impact (-0.00003) on PCI. The recent innovative active activities of India are helping to the positive growth. The effect of the private sector on PCI is marginally significant under 10 percent (P0.0648) but negatively associated with the PCI (-0.00282). The impact of natural capital, Jobs in FDI Projects, and the exchange rate (Rupee-USD) on PCI is not significant statistically.

With an R-square of 0.9966, the regression model demonstrates a strong explanatory power, meaning that nearly all of the variability in PCI can be explained by the factors that are included in the study. Human capital, energy, transport, ICT, institutions, sectoral transformation, FDI-RD, FDI-RD projects, foreign patents, inflation, PPP-USD, and ease of doing business are other major factors that promote PCI. The majority of these variables exhibit notable effects. The exchange rate, jobs from FDI projects, natural capital, and private sector performance were not important predictors in this model.

CONCLUSION

The study assesses the effects of FDI-RD on economic activities, mainly production in India. Because, the present inventions are helpful to the future production of goods and services, which purely affects the nation's economic conditions. To analyze that study used a panel data set of PCI and other independent variables over 2010-2024. The study has observed an increasing trend in FDI-RD, Patents, and PCI in India, over the last five years which is increasing at an increasing rate. The estimation of the coefficient of correlation analyses the significant strong correlation between PCI and independent variables. The result of the regression estimation, study reveals a significant association between human capital, energy availability, infrastructure, ICT adoption, institutional quality, FDI-RD projects, inflation rates, and ease of doing business in the growth of business-friendly India. However, sectoral change, FDI in R&D, inventor activities, and the private sector have small negative effects on PCI. The regression model demonstrates strong explanatory power, with most factors promoting PCI.

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Conflict of Interest

There is no conflict of interest to be declared and the study is greatly thankful to NFST for funding the research work.

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PLAYING VIRTUAL MUSICAL DRUMS BY MEMS 3D GENERATOR WITH MACHINE LEARNING MODELS

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ABSTRACT

In our life, music is one of the important tools of entertainment whose ingredients are musical instruments. For instance, acoustic drum is very important when a song is being sung. In the modern world, therefore, the style of the musical instruments is changing, yet retaining the same tune for instance an electronic drum*. Based on MEMS 3D accelerometersensor data and machine learning, we have created "Virtual Musical Drums" in this work. Machine learning is integrating in all fields of AI for solving problems and the MEMS sensor is transforming a large ph* ***This study has shown that, in the specified simulation, there is a detection accuracy of 91.42%, and in the real-time scenario with 20% window overlapping, there is an accuracy of 88. 20%. The simulated drum sound seemed unreal, even if the accuracy of the system detection was adequate. Therefore, we selected the "virtual musical drums sound files" in line with the acoustic drum sound pattern and length, and we adopted the "multiple hit detection within a fixed interval, sound intensity calibration, and sound tune parallel processing." Finally, but just as importantly, we completed the "Playing Virtual Musical Drums" exercise and were able to simulate playing an acoustic drum. Another aspect of MEMS sensors and machine learning has been illustrated by this work. It illustrates how data,****. It demonstrates how data, sensor, and machine learning can be applied in a different way in offering musical entertainment with enhanced precision.*

KEYWORDS—*Virtual musical drum, MEMS, SHIMMER, support vector machines (SVM) and k-Nearest Neighbors (kNN)*

I.INTRODUCTION

To freshen the mind, music is indispensable in our lives. Musical instruments that support songs are played with a set of musical instruments such as pitch, dynamics, rhythm and presenting performance. Guitar, piano, and drums Among the most widely used musical instruments are the accordion, clarinet, saxophone, violin, trumpet, and cello.The drum is classified under the percussion instrument category and it is one of the most important musical instruments. The acoustic drum involves the use of the stick in executing the musical instrument. The electronic drum kits, often also referred @ as silicon drums, computer drums or electronic drums, are currently in use as a substitute to the acoustic drum kit in regard to demand. This highly popular new generation electronic musical instrument has an acoustic drum-like sensation. These days, machine learning and micro electromechanical systems (MEMS) sensors are undergoing a paradigm change. All facets of AI problem-solving that help to improve our quality of life see a surge in the application of machine learning. But as a result, the MEMS sensor was reduced in size from a huge small physical system they have to establish a connection between a large physical system and a small physical system. accuracy. MEMS and machine learning both are modern day technologies Human-Computer Interaction (HCI) system we've worked on creating a music-based setup named "Playing Virtual Musical Drums where the user can play drum music without touching a single instrument just by mere hand posture (Figure 1).

Fig. 1. (a). Real musical instruments (b). Virtual musical instruments playing

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Big hurdles for 3D gesture control systems include

1. Data is collected from the sensors and then stored; as the stream of data is monitored for training and recognition.
2. The program searches for predefined patterns by comparing the specific pattern with the data vector
3. On the assessment of the 3D gesture recognizer algorithm
4. The reaction time or latency assessment during record monitoring in real time, whenever a match is found in the pattern.

Thus, we have been able to solve the above mentioned major challenges while designing and implementing a system called "Playing Virtual Musical Drums" which will enable the drum lover to play the virtual drum while at the same time providing the feel of the above mentioned acoustic musical instruments. If one aims at buying a set for using in playing any musical instrument, then he or she has to spend a lot of money. Furthermore, large instruments are also difficult to transport from one place to the other. Now-a-days, Smart Phone music application is becoming limited to the user as it can be accessed only with a finger touch. Through these music application, the user don't develop the real interest from this application and cause the young generation feel boring. The musical instrument of this work is significantly different from the conventional musical instrument in several ways because by the use of advanced technology the drum player is provided with the right gesture tracking and recognition method. In the recent years, all aspects of people's lives are shifting to automation and virtual environment and music needs to adapt to it too.

II. RELATED WORKS

Joseph and his colleagues argue that Uses for 3D hand gesture and body natural posture with computer interface include musical instruments, training and simulation for video games, and movement-based disease detection. The raw data has also been analysed [2]. By Berman et al. created a GRS model with the following components: Sensor (Gesture Capture Device), Motion Capture/Tracking, Feature Extraction, and Classification Algorithm. This was accomplished by combining these two cutting-edge technologies with the Human computer accurately while learning the 3D movements [1].Consequently, he observes that the most crucial initial design factors are GRS's assessment of context utilization, a sensor's stimulus, and its platform.applying magnetic sensing technology to evaluate different movements from varied fingertips; Chen et al designed and implemented 'Finexus' system. Head-mounted displays in virtual reality is one area where this system becomes useful as well as human input like drawing in the air. He said that compared to an optical tracker, 'Finexus' system has higher average accuracy [3]. Proposed by Hoang, Truong et al (2018), this is a wristband system wherein a wireless communication module (BLE), capacitive sensors on flexible circuit board, and cheap microcontroller unit have been integrated into 3D printed wristband. To detect and locate the hand gestures of users, the wristband samples capacitance variations from several capacitive sensors [4]. The new OLE was developed and used for portable intra-hand multi-finger-motion capture wearable device by Kang Li and his team. In its nature, it is compact, power efficient and light in its composition. [5]. An efficient gestural music interface has been demonstrated in Brown et al. in relation to a Leap Motion optical sensor and a camera-based motion tracking system.. On the other hand, when looking at the interface it seems to be far more accurate since leap motion being placed on flat surface like table [6]The controller MYO was developed by Nymoen et al., which includes an inertial measurement unit (IMU) and measures muscle tension using eight electromyography (EMG) sensors, 3D accelerometer, 3D gyroscope. The primary objective of this wearable device is to design novel musical instruments,[7].Another example provided by Jeffrey et al. is for people wanting to play traditional musical instruments using virtual reality tools. The three major components in the system include: the instrument robot, webserver and user interface.This translates user hand gestures into playable instruments as a virtual environment in the user interface. After that HTTP server will deliver transformed data to the webserver [8].Caramiaux et al.'s article, "Analyzing Musical Gestures and Sound Control with Regression and Classification" shows how regression and classification analyses can be used to play virtual music through gesture controls [9]. This is "a live performance approach" – a concept created by Torre et al. that describes his latest invention - a new musical glove that is difficult technically as well as sociologically, musically,[10]. Consequently, with a particular focus on the elderly and patients who need to live independently, this has made MEMS sensor the most preferred medical sector [11]. This implies that a caregiver or a health attendant is responsible for his physical wellbeing, while he continues to live normally at home [12]. Currently, MEMS has wide applications. For instance, we have made another example of sensors where MEMS sensor and machine learning can be used to bring about innovative music playing devices in the future generations. Moreover, this article will show that data serves not only as information but also entertainment itself.

III. METHODOLOGY

This information section will discuss the step by step procedure which we follwed in order to complete "Playing Virtual Musical Drums".

A .Sensor type, number and dimensions selection

There are a number of different types of IR,pressure, gyroscope, magnetometer, accelerometer, encompass, and other micro-electromechanical systems (MEMS) sensors etc. that can be found in the market. In order to pick an appropriate sensor for our particular purposes it is important to consider the functionality as well as application areas. From the outcome analysis and observational study it's seen that playing virtual drum using MEMS accelerometer has been very successful. It's also possible to play a virtual drum by using either gyroscopes or magnetometers individually or both in this When using a single sensor, such as aamagnetometer or gyroscope, the accuracy, precision, and recall for identifying virtual drums are reduced. Accuracy percentage,

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precision, and recall are high when accelerometer, gyroscope, or gyroscopes with magnetometer are combined.The angledetection requires a gyroscope, while motion velocity demands an accelerometer. This enhances virtual drum detection better than either sensor on its own but is slightly more expensive. Similarly, when we Use a three-dimensional accelerometer to get results similar to those of a gyroscope and accelerometer combined. Thus, instead of using resultant accelerometer plus gyroscope we can solely employ the three-dimensional accelerometer. The 3D accelerometer provides a three-axis value that resembles a gyroscope and meets both criteria for a resulting accelerometer. We decided to utilize a single MEMS 3D accelerometer for virtual drumming in this experiment (Figure 2).

Fig. 2. Accelerometer and 3D coordinate systems

B. Selecting the number of samples and the frequency of sensor sampling

One of the primary goals of this study is to identify the virtual drum position and hand posture. Increased accuracy in posture recognition is achieved at the cost of increased computational expenditure and shorter sensor battery life when sampling frequency is high. The high frequency setting of the sensor in a real-time application can occasionally result in a delayed response. In this paper we have considered the use of the SHIMMER (Sensing Health with Intelligence, Modularity, Mobility and Experimental Reusability) brand sensor for the sensing activity [13]. SHIMMER's sampling frequency can be adjusted between 10 and 1000 Hz. Afterward,

C: Noise Filter of acceleration signal and calibrating of axis

The CPU in our experimental sensor has a A 12-bit digital-to- analog converter and a 16-channel integrated circuit. The sensor offers three configuration options: low-pass, high-pass, and band filter. It may be set up by Bluetooth or a conventional dock connection. The built-in SHIMMER function has been used to configure the low-pass filter. In an audio signal processing systemsignals over a specified cutoff frequency are attenuated and signals below it are passed through a low-pass filter (LPF). When recording accelerometer sensor data, low pass filter produces lower noise acceleration than band and high pass filters. For-windows platform, we have set 9 DoF calibration.which allows us to use commands to define the required x, y, and z axis. The tri-axial MEMS 3D accelerometer sensor can be calibrated and the configuration written using the formula below.

C=R-1.K-1.(u-b) In this equation:
C=3x1 calibrated signal vector
R=3x3 alignment matrix
K=3x3 sensitivity matrix u=3x1
Uncalibrated signal vector b=3x1 offset vector

D. Position of virtual drum and sensor wear

The top end of the drum stick, the wrist, just under the elbow, and the base of the stick are where you can wear the sensor. Putting the sensor on the top end of the stick works best for picking up the right drum sounds. The wrist is just as good. But, putting it under the elbow or at the stick's base doesn't work as well. Because it's more comfy and keeps the sensor safe, wearing it on the wrist is the best choice

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Fig. 3. Right side 1- 4 drums hand posture and left side 1-4 same hand posture

We have eight drum positions indicated in our system. The remaining four are on the left, and the final four are on the right.. For either sensor, they were referred to as "first drum position" (sensor in the right hand), "second drum position" (left hand sensor), "third drum position" (sensor in the right hand) and finally "fourth drum" (left sensor) In total we have two sensors for four positions and each of these sensors has four different Drum positions.

Apparently, there are two sensors with four separate positions each for a Drum that is shown below:

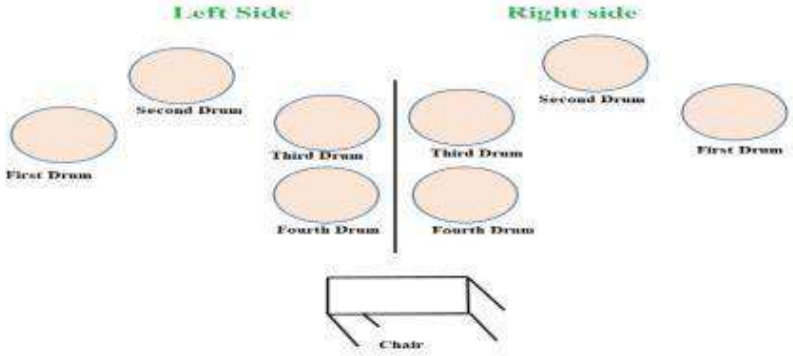

Fig. 4. Position of Virtual Drum

E. Train and test data preparation

In the above learning model, the nuber of training data sets from the subject, which provide good perlformance is optimum. is needed to achieve high detection accuracy system by any machine learning algorithm. The unexperienced subjects' data gives overfitting, leading to machine error detection and lowering overall performance. Furthermore, having more subjects than necessary does not always result into improved performance because in some cases it may even have a negative effect on the performance itself.we have chosen volunteer and their recorded data based upon We focused on capturing the natural hand posture of volunteers while playing the drums. Consequently, we disregarded certain data sets, and the remaining 1000 data sets were selected for further processing, as shown in Figure 5.However, to ensure the effectiveness of our model, we randomly split the entire dataset into two sections: one comprising 75% of the data, designated as the training dataset, and the other containing 25% of the data, designated as As can be observed in the above learning model, the number of training data sets from the subject which gives good performances is optimum.

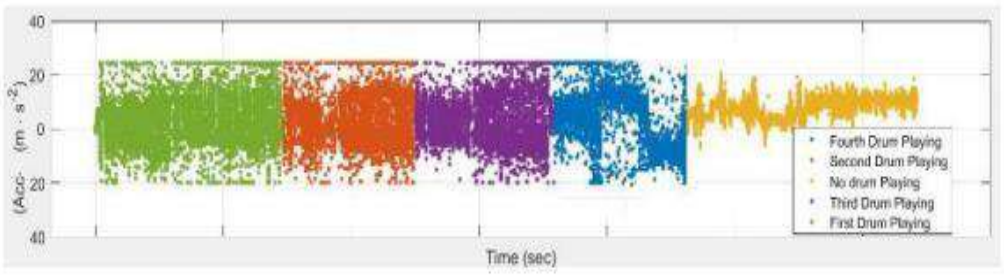

Fig. 5. Virtual drum training and testing dataset

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F:Drum musical selection
Drum music selection system Our system has eight virtual drums, set up like figure 2. We got over 500 drum audio files from "musicradar" website. First, we chose short audio files, less than one second, for drum play.

128 samples equals 1.28s of data saving time. It was done one after another. But for better sound, we changed to parallel processing (details are in the parallel processing section). Then, we picked the right audio files based on drum set and sound pattern.

IV. RESULT

SVM and KNN are used to check how well things work in a test and the outcomes are written down here. For
SVM: The mix-up grid and overall results for spotting virtual drums are seen in Tables I and II

Table I:SVM classifier's confusion matrix

True Class \ Detection	First Drum	Second Drum	Third Drum	Fourth Drum	No Drum
First Drum	38		6	1	5
Second Drum		42		2	6
Third Drum	4	2	34	3	7
Fourth Drum	1		7	39	3
No Drum	1		1	4	44
	First Drum	Second Drum	Third Drum	Fourth Drum	No Drum
Predicted Class					

Table II: a summary of the SVM results

Detection	Accuracy (%)	Precision (%)	Recall (%)
First Drum	92.28	76.00	86.36
Second Drum	96.00	84.00	95.45
Third Drum	88.00	68.00	70.83
Fourth Drum	91.60	78.00	79.59
No Drum	89.20	84.00	67.69

KNN Classifier: The confusion matrix and the summary of the virtual drum recognition using KNN classifier are displayed in Tables III and IV.

Table III:KNN Classifier's Confusion Matrix

True Class \ Detection	First Drum	Second Drum	Third Drum	Fourth Drum	No Drum
First Drum	33	1	9	3	4
Second Drum		37	1	5	7
Third Drum	7	3	29	5	6
Fourth Drum	3	3	7	32	5
No Drum	2	1	7	4	36
	First Drum	Second Drum	Third Drum	Fourth Drum	No Drum
Predicted Class					

Table IV: Summary results of KNN

Detection	Accuracy (%)	Precision (%)	Recall (%)
First Drum	87.20	66.00	73.33
Second Drum	91.60	74.00	82.22
Third Drum	80.00	58.00	54.71
Fourth Drum	86.20	64.00	65.30
No Drum	85.60	72.00	62.06

When comparing the results obtained from table2 and table 4,we are able to see that SVM has a higher accuracy, precision and recall than that of KNN. Therefore for the identification of the real-time drum,the SVM is selected and implemented
The real-time and simulated detection tests are as follows:

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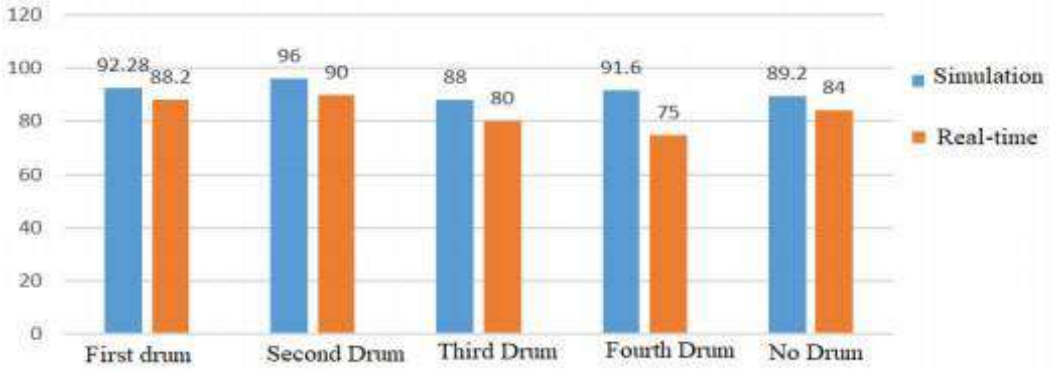
Last but not the least , we compared real-time testing with simulation. when we finished the real-time video experiment we tested its effectiveness by comparing the content of the vedio with that calculated by the computers. Through the random selection of data segments in real time, there was an improvement in the number of "no detection" cases as depicted in figure 12.



We fixed the "no finding" issue and improved the accuracy in the simulation and real-time. We used 20% windows overlapping for this. Now, we have almost achieved the simulation and real-time accuracy

V. CONCLUSION

In this work, we show a different use of data for fun in the world of music. Step by step, we solved the start-up issue through using numbers smartly and making the best choices. In the "Playing Virtual Musical Drums" task, we picked things carefully: the sensor type is an accelerometer with 3D ability; the make is SHIMMER; it checks data 100 times a second; it looks at 1.28 seconds of data, totaling 128 samples; it cuts down noise with a low pass filter; you wear it on your wrist; it tracks 4 hand shapes; it knows 8 drum spots; we got skilled people to help; we checked average values, how spread out the numbers are, and PCA; we sorted data with SVM; and we let data overlap by 20%. We ran a live test by first training and testing our data, and we also made a video of it. We spotted drum beats over time, their music patterns, and how long they played. We used tech to spot many drum hits at once, adjust the sound, and handle multiple sounds at the same time. After doing all these steps and getting 88.20% right in picking up drum sounds, we could play the virtual drum just like a real one. In Picture 14, we show a user playing this virtual drum.

Fig. 14Using MEMS 3D accelerometer sensors to play a virtual drum

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STATISTICAL ANALYSIS OF MODERN FEMALE NAMES

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ABSTRACT
This article highlights the statistical analysis of Uzbek female names that have been frequently used by Uzbek people in the last five years, furthermore, the motives and semantic characteristics of these names are shown.
KEYWORDS. *Female names, anthroponyms, modern names, similar names, first name, last name, middle name.*

Language is always in contact with people's life. Therefore, it is natural to reflect the changes and updates in the life of the people. The impact of the changes outside the language on the language is so great that it causes the renewal of the national worldview and the change of the national mentality. For example, the wide spread and assimilation of Islam in Central Asia had a great impact on the customs and traditions of naming children, as well as on all areas of the spiritual life of local peoples. The Soviet ideology, the Soviet system, and the new economic policy, which lasted for nearly seventy years starting from the first quarter of the 20th century, drastically changed the thousand-year-old way of life of the Uzbek people. As a result, Uzbeks, who lived mainly under the influence of Islamic beliefs, began to look at life with Soviet eyes. Through ideological influences, they tried to penetrate the entire mental and spiritual world of the people. Such effects lasted for a quarter of a century.

One of the greatest blessings of the Allah is a child. His coming of age, growing up, maturing and finding his place in life as a person is an inexhaustible blessing for parents. Choosing a beautiful name for a child means recognizing and appreciating this blessing given by Allah. Because a beautiful, meaningful name makes a person's character more beautiful. On the contrary, the meaning of silly and ugly names is not good for anyone. Giving a beautiful name to a child is one of the important duties of parents and family heads. When choosing a name, if you do not know the meaning of the name you want to name, you should definitely ask a dictionary of names or an expert in this field, people of science, because any sonorous, apparently pleasant-sounding names does not indicate the correct meaning.

But, unfortunately, today there are many people who pay attention to these things, that is, to the sonorousness of the name, rather than its meaning. Also, among modern names, there are many names representing religious concepts.

Recently, we witnessed interesting statistics about names [2]. On January 5, 2023, the Ministry of Justice announced some information about the end of 2023. According to it, 968 thousand 140 children were born in 2023, of which 501 thousand 577 were boys and 466 thousand 563 were girls. According to the Ministry of Justice, for the fifth year in a row Muhammadali is the most popular name for boys, and for the sixth year in a row Saliha is the most popular name for girls. Before Muhammadali, the name Azizbek was the leader among boys, but in the last four years this name did not even enter the top ten. In general, since 2020, the top ten consists only of names with Abdullah, Mustafa, Imran, Ibrahim and the root Muhammad. For comparison, there were many names like Asilbek, Umid, Azod, Shahjakhan, Sardar, Jahangir, Jawahir, Ulugbek in the 2014-2015 ratings.

Now, if we pay attention to the name of girls, which is the object of our research, the rating of girls is also interesting (Figure 1). For example, from 2013 to 2016, names such as Madina, Dilnura, Marjona, Sevinch, Malika, Farangiz, Ezoza, Umida became popular; Ezoza and Malika did not enter the top ten from 2018, and Madina from 2020. On the contrary, Mubina since 2014, Muslima/Muslimakhon since 2015, Soliha/Solihabonu since 2016, Imona/Iymona since 2017, Shukrona since 2018, Hadicha since 2020. For two years, the names Yasmina and Ifora have been used a lot (by the way, in 2013 and 2014, Jasmina was on the 1st place). This year, the names Sumayya and Sa'diya entered the top ten for the first time. And Mubina was ranked at the bottom for the first time since 2014, when it entered the top ten, and we think it will leave the ranking in 2024.

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Figure 1

2023	2022	2021	2020	2019	2018	2017	2016	2015	2014	2013
SOLIHA	SOLIHA	SOLIHA	SOLIHA	SOLIHA	SOLIHA	MADINA	MUBINA	MUBINA	JASMINA	JASMINA
MUSLIMA	MUSLIMA	MUSLIMA	MUSLIMA	MUSLIMA	MUBINA	MUBINA	MADINA	MADINA	MADINA	SEVINCH
YASMINA	IMONA	SHUKRONA	IMONA	IMONA	MADINA	SHUKRONA	DILNURA	DILNURA	MARJONA	MADINA
HADICHA	SHUKRONA	IMONA	SHUKRONA	MUBINA	MUSLIMA	SOLIHA	MUSLIMA	MARJONA	SEVINCH	MARJONA
IMONA	HADICHA	HADICHA	MUBINA	SHUKRONA	SHUKRONA	MUSLIMA	SOLIHA	FARANGIZ	FARANGIZ	UMIDA
SHUKRONA	YASMINA	MUBINA	MUSLIMAXON	MADINA	MALIKA	MALIKA	MARJONA	JASMINA	E'ZOZA	CHAROS
SUMAYYA	IFORA	MUSLIMAXON	MADINA	MUSLIMAXON	IMONA	IYMONA	SEVINCH	MUSLIMA	MUBINA	FARANGIZ
IFORA	MUBINA	SOLIHABONU	HADICHA	IYMONA	IYMONA	E'ZOZA	MALIKA	E'ZOZA	DILNURA	DILNURA
SA'DIYA	MUSLIMAXON	FOTIMA	IYMONA	SABINA	MUSLIMAXON	PARIZODA	FARANGIZ	SEVINCH	DURDONA	E'ZOZA
MUBINA	FOTIMA	FARZONA	SOLIHABONU	MALIKA	E'ZOZA	IMONA	E'ZOZA	MALIKA	UMIDA	ZARINA

Of course, every parent tries to give their child a beautiful and meaningful name. If we analyze the modern names mentioned above, the essence of why these anthroponyms are used today will be revealed.

If we analyze the anthroponym Soliha, which is used most often in the Uzbek language today, Soliha is derived from the Arabic language and means pure, neat or pious, godly, white-hearted, kind, intelligent, faithful Muslim girl [5]. Forms: Soliha, Solihabonu, Solihabegim. In Uzbe people, when a child is born, intentions such as “may she be a righteous child” and “may she be a faithful girl” be expressed. In the explanatory dictionary of the Uzbek language, the word “solih”, which is the root of this name, is explained as follows: “arabic. –cheerful, good, open hearted; good; useful; right; potential, valid [9]. It is known that Solih as an anthroponym has existed in historical anthroponymy for several centuries, mainly as a name for men. However, according to the statistics of the Ministry of Justice, the number of girls named Soliha has been increasing year by year in the last 10 years. Judging from the meaning of the word, this name is given to girls with the help of an affix “-a” and means “to be a good-natured, good, open-minded, righteous child”. This beautiful name, both meaningful and melodious, attracts the attention of parents who have a daughter and is given to girls with good intentions.

Another popular name for girls is Muslima/Muslimakhon. Muslima means – a Muslim, pious woman, virtuous, believing girl who obeys God. Forms: Muslimakhon, Muslimaoy, Muslimabonu [3]. The word “muslim”, which is the root of this name, is explained as “muslim – arabic. a Muslim who has accepted Islam” [8]. Also, it was noted that “Muslim” is rarely used in the first meaning, i.e. Muslim, and in the second meaning, it is precisely its meaning as a noun, that is, as a male name. If we look at modern anthroponymics, this name has become more active with the help of an affix “-a” for expessing girls. Compared to men, we can notice that it has decreased. The name Muslima is loved by parents who have a daughter and is given to their children with good intentions. According to the information on the “ismlar.com/uz” website, which has become a useful tool for learning the meaning of names, the names Muhammad, Mustafa, Imran, Ali, Omar, Madina, Mubina, Muslima, Imona, Maftuna have the most the searched names for their meanings. So, these names are more interesting to our people. The names Muhammad, Ali, and Umar were among the most common names even before independence, but Madina, Mubina, Muslima, and Imona became active during the years of independence [11].

Another name that has become active in recent years is the anthroponym Yasmina. According to the data of the Ministry of Justice at the end of 2023, this name took the third place. If we look for the essence of the anthroponym, then this name goes back to the name of the flower “Yasmin”, which means the flower of paradise, the name of the flower growing in paradise, fragrant, strong, beautiful flower. Forms: Yasminakhan, Yasmin, Yasminabonu, Yasminaoy, Jasmin [4]. In the explanatory dictionary of the Uzbek language, this word is explained only as the name of a flower, and only the example “Persian – yosuman” is given [10]. We did not find this anthroponym in the dictionary of Uzbek names by E. Begmatov. It is known that this anthroponym in the form of Jasmina has been given to many girls in recent years. This option was not observed in anthroponymic dictionaries either. It can be seen from this that this anthroponym has entered the ranks of modern names and has become more active in Uzbek anthroponymics in the last 10 years. Even, according to statistics, in 2023/2014, it took first place among the female names. One thing surprises us, neither in the dictionary of Uzbek names nor in the Uzbek annotated dictionary did we find the word “jasmin” in the Uzbek language either

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as a flower name or an anthroponym, but our people use this antonym for their daughters. and it is self-evident that the religious motive was the reason for many references to this anthroponym along with the names mentioned above. The content of "Paradise flower" attracted the attention of many parents.

The anthroponym Hadicha, built on the basis of a similar religious motive, is also active in the anthroponymics of today. There are many cases where the anthroponym of Hadicha is written with a hard X sound. But it should actually be written with a guttural H, so that it is orthographically correct. In the dictionary of Uzbek names, it is interpreted in the style of Hadicha, meaning "premature". It is explained that the name of the first wife of Muhammad (peace be upon him) was Hadicha (approx. 555 - 556 - 620 - 621), the mother of Fatima [1]. It is true that in the past this name was given to girls who were born prematurely and had some kind of defect, but today this name is a tradition due to religious motives, that is, it was the name of the wife of Muhammad (peace be upon him).

The anthroponym Imona/ I(y)mona is also leading in the top ten famous names. We all know that the dictionary meaning of the word is "faith". There is a problem with the spelling of the anthroponym, and in the new explanatory dictionary, this word is given in the form of "i(y)mon", that is, in Arabic, trust in God, religious faith [7]. If we analyze the spelling of the word through the spelling dictionary of the Uzbek language, we can see that the word is given side by side in two different versions, in the form of "iymon and imon" [6]. When we looked at the dictionary of names, we saw that it was recorded as a male name in the form of "Imon". It is known that this anthroponym is attributed to girls with the help of the index "-a" and has been used as a name for girls in recent times. So, Imona means trust, belief, worship in Arabic and is one of the main conditions of Islam, which means trust and belief in Allah, Islam and Muhammad. It can be seen that this name is given to girls with the meaning "let she be a girl of faith".

The analysis of modern names shows that the leading religious motive can be felt in the names of both boys and girls. This, of course, shows that the interest of our people in religious knowledge has increased, and the number of people with strong religious knowledge is increasing among our people.

So, a certain period has its own material and spiritual needs. These needs impose their demands on all aspects of society's life. The age also affects the naming habits of the child and forms a reserve of names specific to the period. However, this is not a process completely independent of human influence and conscious intervention. The analysis of modern names specific to each period automatically creates the need to make changes to the dictionary of names. The advanced intelligentsia of the society should be vigilant in such national issues, feel involved in the sometimes inconsistent and sometimes inappropriate processes.

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THE USE OF SOME ONOMASTIC UNITS AS A NICKNAME

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ABSTRACT

This article explores the multifaceted world of nicknames in the Uzbek language, analyzing their origins, classifications, and cultural significance. It delves into the process of how words transform into nicknames based on various lexical-semantic groups, including anthroponyms (personal names), zoonyms (animal names), and other categories. The article provides numerous examples of nicknames and their associated meanings, highlighting how they reflect cultural values, social dynamics, and individual characteristics. It emphasizes the role of nicknames in informal communication and their impact on daily life.

KEYWORDS: *nicknames, uzbek language, anthroponymsm, zoonymsm, lexical-semantic groups, informal communication, cultural significance, social dynamics, individual characteristics, folk etymology.*

People prefer to give names to everything in order to move comfortably in society. Sometimes we remember these names because they are funny but surprisingly memorable, clear, and similar. We use these names for our family members, relatives and friends and call them short nicknames. There are formal and informal names of members of society that have developed in their own way. Nicknames play an important role in informal communication, which plays an essential role in a person's daily life.

Nicknames can be based on different names such as animals, birds, insects, fish, plants, food, things, people, places. It is determined what lexical-semantic group the word belongs to before it becomes a nickname.

Nicknames formed on the basis of anthroponyms - nicknames formed on the basis of personal names:
Gagarin. He was a driver and was driving too fast. Therefore, people joked that “he will go to the moon while driving”: [*Ābdullā gāgārin*] – *Abdulla gagarin* (Shavat district).

Lin. Because of his small eyes, he is likened to Koreans, and they add the word *lin* to his name, referring to his Korean family: [*Šammï lin*] – *Shamurad lin* (Urgench city).

Noγajtmas – Nugaymas. His grandfather was originally from Karakalpakstan, and his name was Nugaymas (they gave him this name in order to keep him healthy). This name was changed and became a nickname for his child in this form: [*Häsän noγajtmas*] – *Hasan nugaytmas* (Yangibazar district).

Allazär – Allanazar. Grandfather’s name became a nickname and underwent a phonetic change: [*Joldaš allazär*] – *Yuldosh allanazar* (Shavat district).

Särsan – Serson. His father’s origin goes back to another nation. That’s why the name is special. Those who could not pronounce the name well called *Särsan*. Later it became a nickname for his children: *Ämät särsan – Ahmad sarson* (Bagat district).

In addition to these, nicknames such as *Sägdiānā, Äpändï, Gitler, Gütmän, Mičurin, Nekrāz, Xűri:š, Pu:skin, Piŋkās, Tāŋŋem, Tarzan, Ʒuŋsaŋ, Bajʒan, Ʒänʒälbek, Šān-li, Tűrka:n // Tűrkanxa: tïn* can be counted as examples [6].

Nicknames formed on the basis of zoonyms - nicknames related to fauna or formed on the basis of animal names. A common type of nickname is the form used in relation to animals. It can be said that such a nickname was a custom of ancient herding peoples [3].

Äždär – The dragon. Stubborn, angry, rude and belligerent: [*Janïbek äždär*] – *Janibek ajdar* (Urgench city).

Bűlbűl – The sparow. When five or six people gather, they call him *bulbul* (sparrow) because he annoys everyone by talking a lot, not allowing anyone to speak: [*Joldäš bűlbűl] – Yuldosh bulbul* (Hazorasp district).

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Börï – The wolf. A beast belonging to the canine family; lobo; literally means evil, bloodthirsty, cruel person [2]. The word *Bori* (wolf) is a nickname for children born with teeth (*börï Joldaš – bori Yuldosh*, *Jarmät börï – Yormat bori*, Hazorasp district); this nickname is due to the fact that he is very mean and quarrelsome (*Dävran börï – Davron bori*, Khanka district); it can also be put down because they have a habit of walking on the street in the evenings (*Häjtvaj, Kamïl, Ätïš börï – Khajiboy, Komil, Alisher bori*, Yangibazar district).

Döŋŋïz – The wild boar. Figuratively, an uneducated, ignorant or unscrupulous person. In Khorezm dialects, the word *döŋŋïz* is used as a nickname for people who lead a rough life, living like animals, lacking cultural diet (*Ilxam döŋŋïz – Ilhom tongiz*, Yangiarik district), education, and knowledge (*Alïm döŋŋïz – Olim tongiz*, Kushkupir district).

Häkäk – The magpie. Imitation of the hakka (magpie) bird's sound "hack-hack", because of its constant chattering, some people were given this nickname in imitation of the Hakka bird. (*Toxta häkäk – To'xtajon hakak*, Kushkupir district), it is typical for women to become a nickname with this meaning. It can also be seen that the word *hakka* (magpie) is used as a nickname for people who destroy everything (*Jaqïp häkäk – Yoqib hakak*, Yangibazar district).

Ökïz – The ox. It is the nickname of the famous classical singer Rozmat Jumaniyazov, because he had a strong voice, it had both a bass and a high voice, and he was given the nickname *ökïz* (ox) because of the wide range of his voice. In fact, this nickname was originally given based on his overweight (*Rozmät ökïz – Rozmat hokiz*, Urgench city), his previous nickname *ɣajbu* (*goybu*) was not used later.

Kűrrä – The colt. A word that came from the Tajik language. Colt [2] is a child of horse, camel and donkey [1]. The origin of this word (kur) in the composition of personal names in ancient and middle Iranian languages is related to the fact that it was originally used for animals and human children [4]. This word is used as a nickname for people who cannot be trained through words (*Atažan kűrrä – Atajan kurra*, Bagat district), who "work like donkeys" very well at weddings (*Ata kűrrä – Atakhan kurra*, Urgench district), who always follow their mother (*Satïm kűrrä – Satim kurra*, Kushkupir district).

Bűlbűl – The sparrow. People who talk a lot and annoy everyone (*Joldäš bűlbűl – Yuldash bulbul*, Hazorasp district), talk a lot at gatherings without taking anyone's turn (*Ergäš bűlbűl – Ergash bulbul*, Hazorasp district), people who have a pleasant voice and sing at weddings and please everyone (*Azi:m bulbul – Azim bulbul*, Shavat district).

Qānʒïq – a dog is kept at home, and because the dog is a purebred, they quickly demand their children. In order to find new buyers, after giving birth to a dog, they always boast "bïzänï qanʒïq tuɣdï 4-5nï": [*Kamïl qānʒïq*] – *Kamil qanjiq* (Kushkupir district).

Qarɣa – The carrion crow. A good person, but likes a crow because eats both edible and non-edible things: [*Rošan qarɣa*] – *Ravshan qarga* (Khanka district).

Köppäk – The guard dog breed. People who quarrel with their relatives and neighbors and talk a lot behind their backs have been compared a lot. (*Ämät köppäk – Ahmadjan koppak*, Khanka district). Based on the word *koppak (dog)*, which became a clan name formed in connection with totems, there is also the nickname *köpäk*, which appears in several anthroponyms. This nickname does not have a negative meaning, but refers to loyalty and consistency: *Jűsïp köpäk* (*Yusufbay koppak*, Khanka district).

Känä – The tick. An impudent character of such people is like an insect called a tick (*Šämmï känä – Shomurod kana*, Urgench city), It is applied to people who, when they start something, stick to it like a tick, and will not stop until it is finished (*Äbdïllā känä – Abdulla kana*, Shavat district).

Examples of nicknames formed on the basis of animal names are *lāqqā* (wels catfish: *Xušnït lāqqā – Khushnud laqqa*, Bagat district; *Rozmät lāqqā – Rozmamat laqqa*, Urgench city), *läjläk* // *lällï* (storks which has lonf legs: *Rozïm läjläk – Rozmamat laylak*, Kushkupir district, *lällï– laylak Ruslon*, Bagat district). It is reasonable to call such nicknames metaphorical nicknames or zoonymic nicknames in linguistics. Because here the qualities characteristic of animals are adapted to people with negative characteristics [5].

Nicknames formed on the basis of phytonyms:
Kärväk – He has been engaged in horticulture for many years, works in a two-hectare garden in his village, "knows the language" of apple trees. When he goes to wedding ceremonies, he always mentions that the apples from his orchard are the tastiest apples in the village: [*Satïm kärväk*] – *Satimboy karvak*, Hazorasp district).

Űzïmčï – a specialist, gardener, who is engaged in the work of planting vines and growing grapes [2], they start work in the spring, and when the fruits of the vine ripen in the autumn, they pay for them at a high price and get their own income: *Rïjm űzïmčï*

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(*Reyimboy uzumchi*, Bagat district). *Uzum (grape)* is a purely Turkic word, a lexical unit that has been actively used since ancient times. M.Koshgari used as *üzüm* (*al üzüm sïqïd* – he squeezed a grape), and in the works of A.Navoi, it was used in the form of *uzum (grape)*. When justifying the etymology of the word *uzum (grape)*, it can be connected with the ancient Turkic word *uzu*, which means top [4].

Naš (pear). There is a plot of land, which he turned into a garden. Only pears are grown in this garden: *Rozim naš:* [*Rozim naš*] – *Rozmamat nosh* (Kushkupir district).

Pïstä. From farmers who heard from somewhere that pistachio sales are very good. He was the first to plant pistachios on a large field in his field: [*Ǯābbār pïstä*] – *Jabbor pista* (Shavat district).

Ma:ş – The mung bean. It is a Persian word, an annual leguminous crop belonging to the legume family [2]. The word *Mosh* (mung bean) was used as a nickname for a small person, and it did not disappear over time and was passed down to generations: [*Toqqï ma:ş, Sadïlla ma:ş*] – *Tokhtagul mosh*, *Sa'dulla mosh* (Bagat district).

Pïjatčï – actually an onion planter. He makes a living by planting onions on a lot of land in the village and selling them in the market. Currently, the phrase an onion planter has come to the form of pïjatčï: [*Ātāvāj pïjatčï*] – *Otavoy piyazchi* (Shavat district).

Nö:uš – the green onion. He lives in the village of Goybu, Urganch District, and has a greenhouse in his yard. He grows and sells greens and green onions there: [*Paqqï nöuš*] – *Fakhriddin nush* (Urganch city).

Burč – The pepper. Their faces are red. They neither benefit nor harm anyone. They are lazy people. They do what they want, they don't care what women say. Their women are pitiful and have no rights, compared to pepper: [*Atanäzär, Furqät burč*] – *Atanazar*, *Furqat burch* (Yangibazar district).

Studying the linguistic features of other types of lexical units formed on the basis of nouns is important in showing the rich ways of the Uzbek vocabulary, clarifying the meaning relations of various linguistic phenomena between proper nouns and appellatives.

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THE EVOLUTION OF THE DERIVATIVE MARKET IN INDIA AND ITS GROWING APPEAL TO RETAIL INVESTORS

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ABSTRACT
The Indian derivatives market has seen significant growth since its inception, becoming one of the largest in the world. Historically, derivatives were primarily used by institutional investors for risk management, but in recent years, retail investors have become increasingly active participants. This paper explores the structure of the derivative market in India, its evolution, regulatory environment, and the growing participation of retail investors. It also examines the risks and opportunities presented by derivatives for retail investors, and discusses the implications for financial literacy, market stability, and policy.
KEYWORDS: *Derivative Market, Retail Investors, Financial Literacy, Risk Management, SEBI, Options, Futures, Indian Stock Market*

1. INTRODUCTION

The Indian financial market has experienced exponential growth, and the introduction of derivatives has played a critical role in deepening and broadening the market. Derivatives such as futures and options provide a mechanism for hedging risk, enhancing liquidity, and promoting price discovery. This paper focuses on the evolution of the derivatives market in India and its implications for retail investors, who are increasingly becoming key participants.

1.1 Definition of Derivatives

Derivatives are financial contracts whose value is derived from an underlying asset, index, or rate. In the Indian market, derivatives primarily trade on equities, interest rates, currencies, and commodities. The two most commonly traded derivatives in India are futures and options.

1.2 Objective

This paper aims to:

- Explore the growth and structure of the derivative market in India.
- Analyze the increasing participation of retail investors.
- Highlight the risks and challenges faced by retail investors.
- Discuss the role of financial literacy in safeguarding retail participation.

2. EVOLUTION OF THE DERIVATIVE MARKET IN INDIA

2.1 Early Days

The Indian derivative market officially began with the introduction of index futures in June 2000 at the National Stock Exchange (NSE). This was followed by the launch of index options and stock futures in 2001 and stock options in 2002. Derivatives trading is regulated by the Securities and Exchange Board of India (SEBI), which has played a key role in shaping the market.

2.2 Growth of the Market

India has emerged as one of the largest derivative markets globally. According to data from the World Federation of Exchanges (WFE), the NSE consistently ranks as one of the top exchanges in terms of the number of derivative contracts traded. The growth of the Indian derivative market is attributed to several factors:

- Technological advancements in trading infrastructure.
- Increasing participation from domestic and international investors.
- A well-regulated and transparent trading environment.

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2.3 Regulatory Framework

The SEBI has been instrumental in promoting the growth of derivatives trading while maintaining strict regulations to ensure market integrity. Key regulatory reforms include the introduction of margin requirements, circuit breakers, and robust risk management mechanisms.

3. RETAIL INVESTORS AND DERIVATIVES

3.1 Rise in Retail Participation

Traditionally, derivatives were the domain of institutional investors such as mutual funds, insurance companies, and foreign institutional investors (FIIs). However, in the past decade, retail investors have increasingly participated in derivative trading. Several factors have contributed to this trend:

- Advances in technology have made trading platforms more accessible.
- Discount brokerages have lowered the cost of trading, making it affordable for retail participants.
- Awareness campaigns and education programs by SEBI and market participants have increased the understanding of derivatives.

3.2 Derivatives as a Speculative Tool

For retail investors, derivatives are often seen as a tool for speculation, rather than hedging. The low margin requirements allow retail investors to control large positions with a relatively small capital outlay, amplifying both potential gains and losses. This has led to concerns about the adequacy of risk management practices among retail participants.

3.3 Popular Derivative Products Among Retail Investors

Retail investors in India predominantly trade in:

- **Equity futures**: Contracts that obligate the buyer to purchase, and the seller to sell, a specific amount of stock at a predetermined price in the future.
- **Options**: Contracts that give the buyer the right, but not the obligation, to buy (call option) or sell (put option) an asset at a specified price before or at expiration.

4. RISKS AND CHALLENGES FOR RETAIL INVESTORS

4.1 Lack of Financial Literacy

One of the key challenges facing retail investors is the lack of financial literacy. While derivatives offer significant opportunities for gains, they are complex instruments that carry substantial risk. Many retail investors may not fully understand the implications of margin calls, leverage, and volatility, which can lead to significant financial losses.

4.2 Over-Leverage

The use of leverage in derivative trading allows retail investors to take positions much larger than their capital, leading to amplified losses in volatile markets. This can result in retail investors facing margin calls, where they are required to deposit additional funds to maintain their positions.

4.3 Behavioral Biases

Retail investors are often driven by behavioral biases such as overconfidence, herd mentality, and the tendency to chase short-term gains. These biases can lead to poor decision-making in derivative markets, where timing and strategy are critical.

5. OPPORTUNITIES FOR RETAIL INVESTORS

5.1 Hedging and Portfolio Diversification

While many retail investors engage in derivatives for speculation, derivatives can also serve as effective tools for hedging risks and diversifying portfolios. For instance, investors can use options to hedge against downside risks in their stock portfolios, providing a safety net during market corrections.

5.2 Educational Programs and Tools

The increasing availability of online educational programs, webinars, and trading simulations can help retail investors better understand the intricacies of derivatives. Stock exchanges, financial institutions, and brokerage firms are playing an important role in educating investors on risk management and trading strategies.

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5.3 Regulatory Safeguards

SEBI has taken several steps to protect retail investors in the derivative market. Measures such as mandatory margin requirements, position limits, and restrictions on naked option selling are designed to prevent retail investors from taking excessive risks.

6. CONCLUSION

The growth of the derivative market in India has opened up new avenues for retail investors. While derivatives offer the potential for high returns, they also carry significant risks, particularly for inexperienced investors. Ensuring that retail investors have access to financial education and robust risk management tools is essential for the sustainability of their participation in this market. Regulatory bodies like SEBI must continue to strike a balance between fostering innovation and ensuring market integrity, while also protecting retail participants from undue risks.

As the Indian derivative market continues to evolve, retail investors will need to adopt more sophisticated approaches to trading, focusing on risk management and financial literacy. The future growth of retail participation in the derivative market will depend on how effectively these challenges are addressed.

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A THEORETICAL FRAMEWORK FOR UNDERSTANDING CONSUMER BEHAVIOR IN VIRTUAL REALITY SHOPPING EXPERIENCES

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ABSTRACT
This paper presents a theoretical framework for understanding the influence of Virtual Reality (VR) shopping experiences on consumer behavior. By synthesizing concepts from immersion, presence, flow theory, and consumer decision-making models, the framework highlights critical factors such as interactivity, sensory engagement, and perceived realism that affect consumer engagement, satisfaction, and purchase intentions within VR environments. Additionally, the paper addresses potential barriers to VR adoption, including technological accessibility and consumer readiness. The study proposes directions for future empirical research to validate and refine this model, providing insights for enhancing consumer experiences in VR retail settings.
KEYWORDS: *Virtual Reality (VR), Consumer Behavior, Immersion, Interactivity, Purchase Intentions*

INTRODUCTION

The retail industry is undergoing a significant transformation, driven by advancements in technology that are reshaping how consumers interact with products and brands. Among these technological innovations, Virtual Reality (VR) stands out for its potential to create immersive shopping experiences that go beyond the capabilities of traditional online and in-store shopping. VR allows consumers to interact with products in a simulated environment, offering a sense of presence and engagement that can influence their decision-making processes.

Despite its potential, the adoption of VR in retail remains relatively nascent, with varying degrees of consumer acceptance and technological integration. Understanding the factors that drive consumer behavior in VR shopping environments is crucial for retailers seeking to leverage this technology effectively. This paper proposes a theoretical framework to explain how VR influences consumer behavior, identifying key elements such as immersion, interactivity, and sensory engagement. By exploring these factors, the study aims to provide a comprehensive understanding of the consumer experience in VR shopping, offering insights for both researchers and practitioners.

OBJECTIVES OF THE STUDY

The primary objectives of this paper are:

1. To develop a theoretical framework that explains how VR shopping experiences influence consumer behavior.
2. To identify and analyze the key factors such as immersion, presence, interactivity, sensory engagement, and perceived realism that affect consumer engagement, satisfaction, and purchase intentions in VR environments.

REVIEW OF LITERATURE

Virtual Reality and Consumer Behavior

Virtual Reality has been increasingly recognized as a transformative tool in the retail sector, offering immersive environments that can alter consumer perceptions and behaviors. Research by Steuer (1992) on telepresence emphasizes the importance of immersion and presence in VR environments, where a high degree of sensory engagement can significantly enhance the consumer experience. Studies by Daugherty, Li, and Biocca (2008) have demonstrated that VR's ability to simulate real-world shopping environments leads to higher levels of consumer engagement and satisfaction compared to traditional online shopping.

Immersion, Presence, and Flow in VR

The concepts of immersion and presence are central to understanding consumer behavior in VR environments. Immersion refers to the depth of sensory engagement, while presence is the psychological state of feeling "inside" the VR environment (Slater & Wilbur, 1997). Flow theory, introduced by Csikszentmihalyi (1990), also plays a critical role, describing a state of deep engagement and

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enjoyment that can enhance the overall shopping experience. Research has shown that when consumers experience flow in VR, they are more likely to exhibit positive attitudes towards the products and increase their purchase intentions (Hoffman & Novak, 1996).

Interactivity and Sensory Engagement

Interactivity in VR is another crucial factor influencing consumer behavior. It allows consumers to control their environment and interact with products in a way that is not possible in traditional online shopping (Sundar et al., 2015). Sensory engagement, which involves stimulating multiple senses such as sight, sound, and touch, enhances the perceived realism of the VR environment, leading to greater consumer satisfaction and trust (Schwartz & Saad, 2014).

1. Theoretical Framework

1.1. Introduction to the Theoretical Framework

- Begin by establishing the need for a theoretical framework to understand the influence of Virtual Reality (VR) shopping experiences on consumer behavior. Highlight the rapid growth of VR technology in retail and the lack of comprehensive models to explain how these immersive experiences affect consumers' perceptions, emotions, and actions.

1.2. Foundational Theories

- **Immersion and Presence Theory:** Introduce the concepts of immersion and presence as foundational elements. Immersion refers to the extent to which VR can simulate a real-world environment, while presence is the psychological feeling of being "inside" that environment. These concepts are critical for understanding how deeply consumers engage with VR experiences.
- **Flow Theory:** Incorporate Csikszentmihalyi's Flow Theory, which describes a state of deep focus and enjoyment in an activity. In VR shopping, achieving a flow state can lead to increased consumer satisfaction and higher likelihood of making a purchase.
- **Consumer Decision-Making Models:** Integrate traditional consumer decision-making models, such as the Theory of Planned Behavior (TPB) or the Consumer Decision Journey, to contextualize how VR shopping environments influence various stages of the decision-making process (e.g., awareness, consideration, purchase).

1.3. Key Components of the Framework

- **Interactivity:** Define interactivity as the degree to which consumers can interact with and manipulate the VR environment. High interactivity can lead to greater engagement and more positive consumer experiences.
- **Sensory Engagement:** Discuss the role of sensory engagement, including visual, auditory, and haptic feedback, in creating a more realistic and compelling shopping experience. The more senses that are engaged, the more immersive the experience.
- **Perceived Realism:** Introduce perceived realism as a factor that affects how consumers evaluate the authenticity and trustworthiness of products in a VR setting. Higher perceived realism can enhance product evaluation and increase purchase intentions.

1.4. Consumer Responses

- **Engagement:** Explain how the components of VR (immersion, presence, interactivity, sensory engagement) contribute to consumer engagement. High engagement in VR environments can lead to stronger emotional connections with the brand and products.
- **Satisfaction:** Detail how positive VR experiences can lead to higher consumer satisfaction. Satisfaction is influenced by the seamlessness of the experience, the quality of the VR environment, and how well it meets consumer expectations.
- **Purchase Intentions:** Discuss how the culmination of engagement and satisfaction influences consumers' intentions to purchase. VR environments that successfully engage and satisfy consumers are more likely to convert these intentions into actual purchases.

1.5. Moderating Variables

- **Technological Accessibility:** Identify technological accessibility as a moderating factor that can either enhance or limit the effectiveness of VR experiences. This includes the availability of VR hardware, ease of use, and the consumer's comfort level with the technology.

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- **Consumer Readiness:** Highlight consumer readiness, which encompasses familiarity with VR technology, willingness to adopt new technologies, and the perceived value of the VR shopping experience. Consumers who are more tech-savvy and open to new experiences are likely to have more positive responses to VR shopping.

2. Identifying and Analyzing Key Factors Affecting Consumer Behavior in VR Environments

2.1. Immersion

Definition: Immersion refers to the extent to which a VR environment can replicate a real-world experience, enveloping the user's senses and creating a convincing simulation.

Impact on Consumer Behavior

- **Consumer Engagement:** High levels of immersion can captivate consumers, leading them to become deeply involved in the VR shopping experience. This increased engagement is likely to enhance the emotional connection to the brand and the products.
- **Satisfaction:** The more immersive the environment, the more likely consumers are to perceive the experience as enjoyable and fulfilling, contributing to overall satisfaction.
- **Purchase Intentions:** When consumers feel fully immersed, they may perceive the products as more tangible and real, which can positively influence their intent to purchase.

Analysis: Immersion can be measured by evaluating how much of the user's sensory input is controlled by the VR environment. VR systems that offer full 360-degree visual experiences, coupled with spatial audio and haptic feedback, tend to provide higher immersion, leading to stronger consumer responses.

2.2. Presence

Definition: Presence is the psychological state where a user feels physically "present" in the virtual environment, as opposed to just observing it.

Impact on Consumer Behavior:

- **Consumer Engagement:** Presence enhances the sense of being part of the VR environment, making the experience more engaging and realistic. This heightened sense of presence can lead to deeper involvement with the shopping experience.
- **Satisfaction:** A strong sense of presence can increase consumer satisfaction by making the virtual experience feel more lifelike and authentic.
- **Purchase Intentions:** Presence contributes to a stronger belief in the reality of the products being viewed, which can influence consumers to make purchasing decisions as if they were in a physical store.

Analysis: Presence can be evaluated through subjective measures such as user self-reports, where consumers describe how "real" or "involved" they felt during the experience. Higher presence typically correlates with positive consumer outcomes like increased engagement and purchase intentions.

2.3. Interactivity

Definition: Interactivity refers to the degree to which consumers can interact with and manipulate elements within the VR environment, such as examining products from different angles, changing colors, or trying on items virtually.

Impact on Consumer Behavior

- **Consumer Engagement:** High interactivity encourages active participation, making consumers feel more involved in the shopping process. This active involvement can sustain attention and deepen the emotional investment in the experience.
- **Satisfaction:** Interactive features allow consumers to explore products in detail, leading to a more satisfying experience as they can make more informed decisions.
- **Purchase Intentions:** Interactivity enhances perceived control and personalization, which can lead to stronger purchase intentions as consumers feel more confident and committed to their choices.

Analysis: The effectiveness of interactivity can be assessed by tracking how consumers interact with products in the VR environment—such as the number of interactions, time spent on each interaction, and the diversity of actions performed. High interactivity usually leads to greater satisfaction and a higher likelihood of purchase.

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2.4. Sensory Engagement

Definition: Sensory engagement involves stimulating multiple senses (sight, sound, touch) to create a richer and more immersive VR experience.

Impact on Consumer Behavior

- **Consumer Engagement:** Engaging multiple senses simultaneously can heighten consumer involvement in the VR experience, making it more compelling and memorable.
- **Satisfaction:** A multisensory experience is more likely to meet or exceed consumer expectations, leading to greater satisfaction with the shopping process.
- **Purchase Intentions:** When consumers experience products through multiple sensory channels, they may develop a stronger attachment to the products, thereby increasing their intent to purchase.

Analysis: Sensory engagement can be measured by the extent to which the VR system integrates visual, auditory, and haptic feedback. The richness and coherence of these sensory inputs directly affect how engaging and satisfying the experience is perceived to be.

2.5. Perceived Realism

Definition: Perceived realism is the degree to which the VR environment and its components are seen as accurate and lifelike representations of the real world.

Impact on Consumer Behavior:

- **Consumer Engagement:** Higher perceived realism can make the VR experience more believable and relatable, encouraging deeper engagement with the virtual environment.
- **Satisfaction:** When consumers perceive the VR environment as realistic, they are more likely to feel that the experience met their expectations, leading to greater satisfaction.
- **Purchase Intentions:** Realism in product representation can increase consumer trust in the products, thereby boosting purchase intentions as consumers feel more assured about their choices.

Analysis: Perceived realism can be gauged through consumer feedback, where users rate the authenticity of the VR experience. Technologies that closely replicate real-world appearances, movements, and sounds tend to score higher on perceived realism and positively influence consumer behavior.

CONCLUSION

The theoretical framework proposed in this paper provides a comprehensive approach to understanding the impact of VR on consumer behavior in shopping contexts. By identifying and analyzing these key factors—immersion, presence, interactivity, sensory engagement, and perceived realism—this framework provides a comprehensive understanding of how VR shopping experiences influence consumer engagement, satisfaction, and purchase intentions. Each factor plays a critical role in shaping consumer behavior within VR environments, and their interplay can significantly affect the overall effectiveness of VR as a retail tool. Future research should empirically test these factors in various VR shopping scenarios to further refine the theoretical framework and validate the relationships between these factors and consumer outcomes. Understanding these dynamics will help retailers design VR shopping experiences that are not only innovative but also effective in driving consumer engagement and sales.

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A STUDY ON IMPACT OF HOME ENVIRONMENT ON LEARNING STYLES OF THE HIGH SCHOOL STUDENTS IN VELLORE DISTRICT

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ABSTRACT

Home environment refers to all sorts of moral and ethical values along with emotional, social and intellectual climate set up by the family members to contribute to the wholesome development of an individual. Learning style is a concept that can be important in this movement, not only in informing teaching practices but also in bringing to the surface issues that help faculty and administrators think more deeply about their roles and the organizational culture in which they carry out their responsibilities. 300 High school students have been selected as the sample using random sampling technique for the present investigation. The tools viz., Home Environment Inventory constructed and validated by Ceema Nair, J., and I. Jesudoss, S.J., (2014) and Learning Style Inventory (LSI) constructed and validated by Sean Whiteley (2004), has been used in the present investigation. Further the study is delimited to the high school students and the descriptive, differential analysis and correlation analysis has been carried out using the SPSS which gives the findings for the present investigation as the majority of the high school student shows high level of home environment and average level of learning style.

KEYWORDS: *Home environment, Learning style and high school students.*

INTRODUCTION

Home environment is the social setting in which the child interacts with the members of the family. The young child's tendency to explore, acquire skills and solve problems also depends on the kind of challenges the home environment provides. Family is the primary environment of a child and from there he draws his raw materials for nourishment and developing good character, healthy living and excellent educational performance (Sharma, n.d.). The social, psychological and physical development of a child depends upon home environment. The constituents of home environments are physical facilities, nature of relationship among members, religion and traditions, occupation of parents and economic condition of the family.

Learning style has been the focus of considerable study, and a number of colleges and universities have made it an important part of their work. The many approaches to learning style can be examined at four levels: (1) personality, (2) information processing, (3) social interaction, and (4) instructional methods. One researcher, however, speculates that several models in fact describe correlates of two fundamental orientations in learning: "splitters," who tend to analyze information logically and break it down into smaller parts, and "lumpers," who tend to watch for patterns and relationships between the parts (Kirby 1979).

For the present study the reviews given below helps the investigator in providing the possible research design and methodological procedures to be used in the present investigation.

NEED AND SIGNIFICANT OF THE STUDY

The present study has been specifically intended to study the impact of home environment on learning styles – a study with reference to high school students in vellore district with respect to Personal variables and Institutional related variables. The High school students are selected for this study.

All round development of an individual should be the aim of education. Compared to the previous generations, people today have realised the importance of education. A society and nation can progress only if its citizens are well-prepared to meet challenges. To be well prepared means to have an asset that no one can ever take away from us. Education is that asset which will see us through many tribulations in life. The years spent in high school is one of the most significant stages in any person's life. During this

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adolescent period, students are at their most vulnerable self. A lot of physical and psychological changes take place which may lead to confusions, frustrations and feelings of insecurity.

Home is the place where a person gains his basic education. A child learns by observing and imitating others at home. During the adolescent stage also, the impact of home environment is of considerable value. An adolescent growing up in a peaceful home environment with well-educated parents, siblings and educational resources find it easy to achieve academically. At the same time, children from an unhealthy home environment have to work extra hard to achieve academically. So, the influence of home environment is of utmost importance. As a person has to be a part of society, a lot of practical knowledge can be gained from mingling with others. A person with interpersonal intelligence finds it easy to understand and interact with others. Such interaction with outsiders unconsciously makes adolescents imbibe values and knowledge.

If the students adopt proper Learning Styles it will enhance their Academic Achievement. This study would guide the students to adopt proper learning style for the development of their character. The Academic Achievement of the students will improve only when they have proper Learning Styles. Hence the in-investigator things that the present study possess the high need and importance.

OBJECTIVES

The following were the objectives formulated by the investigator for the present study

1. To study the high school students' level of home environment.
2. To study the high school students' level of learning styles.
3. To study if there is any significant difference in (a) home environment and (b) learning style between
   a. The high school boys and girls.
   b. The high school students studying in the schools located in the urban area and in the rural area.
   c. The high school students residing in the urban area and in the rural area.
   d. The high school students studying in the English medium and Tamil medium.

HYPOTHESES

The following the hypotheses formed from the formulated objectives for the present investigation.
The following were the hypotheses framed from the formulated objectives

1. The high school students show a conducive home environment.
2. The high school students show a high level of learning styles.
3. There is no significant difference in (a) home environment and (b) learning style between
   a. The high school boys and girls.
   b. The high school students studying in the schools located in the urban area and in the rural area.
   c. The high school students residing in the urban area and in the rural area.
   d. The high school students studying in the English medium and Tamil medium.

METHOD OF THE STUDY

Normative survey method has been employed in the present study.

TOOLS USED

(a) Home environment inventory

Home environment inventory constructed and validated by Ceema Nair, J., and I. Jesudoss, S.J., (2014).

(b) Learning Style Inventory

Learning style inventory constructed and validated by Sean Whiteley (2004).

SAMPLE OF THE STUDY

Random Sampling technique has been used in the present study to select the sample of 200 high school students from the total population of 1000 high school students.

STATISTICAL TECHNIQUES USED

The mean and standard deviation for the entire sample and its sub-sample were computed. The test of significance("t"test) was used in order to find out the significance of the difference between the means if the demographic variable used in the objectives. The collected data were computed with the SPSS 11.5 and the result was furnished accordingly in the table.1, table.2 and correlation analysis results were furnished in table.3.

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TABLE-1

S.No	SAMPLES	SUB-SAMPLES	N	MEAN	STANDARD DEVIATION	't' VALUE	SIGNIFICANCE AT 0.05 LEVEL
1	Sex	Male students	108	57.9259	7.78893	1.08	Not Significant
		Female students	192	56.7240	11.30083		
2	School locality	Rural area	139	56.9424	10.91188	0.33	Not Significant
		Urban area	161	57.3416	9.53291		
3	Residence	Rural area	115	57.1043	10.89131	0.06	Not Significant
		Urban area	185	57.1892	9.74132		
4	Medium of study	Tamil medium	96	57.1979	12.34301	0.04	Not Significant
		English medium	204	57.1373	9.01836		

TABLE-2

S.No	SAMPLES	SUB-SAMPLES	N	MEAN	STANDARD DEVIATION	't' VALUE	SIGNIFICANCE AT 0.05 LEVEL
1	Sex	Male students	108	83.1852	9.33704	3.33	Significant
		Female students	192	87.0729	10.26022		
2	School locality	Rural area	161	85.7019	10.49157	0.05	Not Significant
		Urban area	139	85.6403	9.65642		
3	Residence	Rural area	185	84.8324	9.75844	1.80	Not Significant
		Urban area	115	87.0261	10.52021		
4	Medium of study	Tamil medium	204	84.3529	10.18416	3.46	Significant
		English medium	96	88.4792	9.35496		

TABLE-3

VARIABLES	N	MEAN	S.D	'r' VALUE	SIGNIFICANCE AT 0.05 LEVEL
HOME ENVIRONMENT	300	57.1567	10.1796	0.07	Not Significant
LEARNING STYLES	300	85.6733	10.0965		

FINDINGS

The following are the important findings of the present investigation.

1. The high school students show a high level of home environment.
2. The high school students show an average level of learning styles.
3. There is no significant difference in home environment between the high school boys and girls.
4. There is no significant difference in home environment between the high schoolstudents studying in the schools located in the rural area and urban area.
5. There is no significant difference in home environment between the high schoolstudents residing in the rural area and urban area.
6. There is no significant difference in home environment between the high schoolstudents studying in the Tamil medium and English medium.
7. There is a significant difference in learning styles between the high school boys and girls.
8. There is no significant difference in learning styles between the high schoolstudents studying in the schools located in the rural area and urban area.
9. There is no significant difference in learning styles between the high schoolstudents residing in the rural area and urban area.
10. There is a significant difference in learning styles between the high schoolstudents studying in the Tamil medium and English medium.
11. There is no significant relationship between home environment and learning styles of the high school students.

CONCLUSION

The present investigation revealed that the high school students studying in the Vellore district, Tamilnadu, India, were found to have a high level of home environment and average level of learning styles which in turn gives a very high level of achievement for

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students. So, it can be revealed from the investigation that the high school students should develop the home environment and learning styles in a constructive way. This should be done by the high school students.

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HIGHER EDUCATION IN HOOGHLY DISTRICT, WEST BENGAL: AN OVERVIEW

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ABSTRACT

Higher education plays an important role in the social, political, economic and scientific developmentof any nation. India has one of the largest education system especially higher educations in the world. Higher education in West Bengal has witnessed a tremendous increase in institutions in recent years. The society's expectations from higher education have not remained the same always; it's kept changing with different social corners, economic conditions, and political situations. The Hooghly district has had a great legacy of higher education in the state of west Bengal and the country as well. The Present study is directed to investigate the existing status of higher education in Hooghly district in terms of institutions, quality, access, diversification of subjects, etc.

KEYWORDS: *Higher Education, Higher Education Institutions, Hooghly, Diversification.*

1. INTRODUCTION

Hooghly is one of the districts in the state of West Bengal**,** India. Hooghly can alternatively be spelt Hoogli or Hugli. The Hooghly district is named after the Hooghly River.So far history goes, the name "Hooghly" is derived probably from the 'HOGLA', a tall reed, which grows in plenty on the riverbanks and in the boggy low lands below them. The district headquarter is located at Chinsurahtown; it is within the Burdwan Division of the State of West Bengal. There are four sub-divisions in this district, namely; Chinsurah-Sadar, Shirampore, Chandannagore, and Arambagh. The district is bordered by Bardhaman district to the north, Howrah districtto the south, Hooghly River to the east and Bankura district lies to the north-west, with Medinipur District to the south-west. There are approximately above ninety (90) higher education institutions in Hooghly district, among themtwenty eight (28) general degree colleges, twelve (12) technical institutes, one (1) Medical college, one (1) University and so many others higher education institutions are situated in this district. Hooghly district had a literacy rate of 81.80% as per the provisional figures of the last census of India i.e. 2011. Chinsurah sub-division had a literacy rate of 79.17%, Arambagh sub-division 79.05%, Chandannagore sub-division 83.01%, and Shirampore sub-division 86.13%.

Hooghly District Map

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Table 1: A comprehensive picture of Hooghly District

HOOGHLY DISTRICT								
Sl. No.	**Sub-Division**	**No. of Blocks**	**No. of Municipality**	**Total Population (2011)**	**Area (Sq. Km.)**	**Population%**		**No. of degree colleges & University(s)**
						Rural	**Urban**	
1.	**Chinsurah**	05	02	16,57,518	1148.15	68.63	31.37	**07**
2.	**Serampore**	04	06	14,69,849	422.45	26.88	73.12	**08**
3.	**Chandannagar**	03	03 + *01 (*Municipal Corporation)	11,27,176	508.08	58.52	41.48	**08**
4.	**Arambagh**	06	01	12,64,602	1058.87	94.77	5.23	**06**
Total		**18**	**12**	**55,19,145**	**3137.55**	**62.20**	**37.8**	**29**

Source: Hooghly District, Govt. of West Bengal.

Table 2: Number of University(s) in Hooghly District & West Bengal

Sl. No.	University type	Hooghly	West Bengal
1.	Central University	0	1
2.	State University	1	37
3.	Deemed University	0	2
4.	Private University	0	10

Source: UGC consolidated list of all Universities.

2. OBJECTIVES OF THE STUDY

- To know the present status of higher education in the district of Hooghly.
- To analyse and compare among the higher education institutions in Hooghly district.

3. METHODOLOGY OF THE STUDY

The study is qualitative in nature. The study has been involved in documentary analysis. Documents have been collected from various research journal-articles, books, and various websites related to Hooghly district. In this article analytical approach was employed for data analysis and interpretation.

4. DELIMITATIONS OF THE STUDY

The study has been delimited to find out the overall state and status of higher education in Hooghly district.

5. HIGHER EDUCATION INSTITUTIONS IN HOOGHLY DISTRICT

At present, there are around ninety (90) higher education institutions in Hooghly district. Twenty eight (28) general degreescolleges and one (1) University are there in this district, among them three (3) are government colleges and twenty four (24) are government aided and one (1) is private grant-in-aid minority college (Serampore College) and the University is Rani Rashmoni Green University, which is situated in Tarakeswar. Twelve (12) technical institutes, one (1) Medical college (Prafulla Chandra Sen Government Medical College and Hospital, Arambagh), are situated in this district. Among the technical institutes there are eight (8) engineering colleges, Four(4) polytechnic colleges. Four (4) pharmacy colleges are also situated in this district. There are a lots of teacher training colleges are performing to train our student-teachers in primary and secondary level by eminent teacher educators among them twenty four (24) B.Ed. colleges and six (6) D.Ed. colleges. One (1) Law College (George School Law) and seventeen (17) nursing colleges are in this district among them six (6) are B.Sc. nursing colleges, ten (10) GNM and one (1) ANM nursing college. A total of seven (7) girl's higher education institutions are there in the district of Hooghly, among them four (4) are general degree colleges; one (1) B.Ed. (Institute of Education for Women, Chandannagar), one (1) government Physical Education College for women, Hooghly and one (1) polytechnic college (Women's Polytechnic College, Chandannagar).
Numbers of higher education institutions in the district of Hooghly, West Bengal are as follows:

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Table: 3 Number of Higher Education Institutions in Hooghly District

Institutions	No. of Inst.	Govt. /Govt. Aided/Private			Inst. type		Affiliating University/Board	
		Govt.	Govt./State Aided	Private	Co-Ed.	Girls	BU	CU
General Degree College	27	03	24	00	23	04	20	07
	01	Private Grant-in-Aid Minority College			01	0	0	01
University	01	0	State Aided	0	01	0	UGC	
Physical Education College	01	01	0	0	0	01	BU	
Medical College	01	01	0	0	01	0	WBUHS	
Engineering College	08	01	0	07	08	0	MAKAUT	
Polytechnic College	04	03	0	01	03	01	WBSCTE	
Pharmacy College	04	0	0	04	04	0	MAKAUT	
Law College	01	0	0	01	01	0	CU	
B.Ed. College	24	02	04 (public-private)	18	23	01	BSAEU	
D.Ed. College	06	01	02 (public-private)	03	06	0	WBBPE	
Nursing College	17	02	0	15	-		WBNC	
Total:	**95**	14	32	49	71	07	-	

Source: Dept. of Higher Education, Govt. of West Bengal.

*CU: Calcutta University, *BU: Burdwan University, *RRGU: Rani Rashmoni Green University, *WBUHS: West Bengal University of Health Sciences *MAKAUT: MaulanaAbulKalam Azad University of Technology,*WBSCTE: West Bengal State Council of Technical Education, * BSAEU: Baba SahebAmbedkar EducationUniversity, *West Bengal Board of Primary Education,*WBNC: West Bengal Nursing Council.

6. BRIEF DESCRIPTIONS OF GENERAL DEGREE COLLEGES AND THE UNIVERSITY(S) IN HOOGHLY DISTRICT

Hooghly district has twenty eight (28) general degree colleges and one (1) University spread across the four Sub-Divisions. Most of the colleges conduct UG courses in various subjects, among them six (6) colleges conduct UG courses along with PG courses. The Only University in this district i.e. Rani Rashmoni Green University which was established in 2020 offers PG courses in six (6) subjects. A brief description of twenty eight (28) general degree colleges and the University is given below:

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Table: 4 Descriptions of general degree Colleges and the University(s) in Hooghly district.

Sl. No	Name of the Inst.	Year of Estd.	Affiliation board/Univ	Inst. type	Location	Course offered (Hons.)/ Departments
1.	Rani Rashmoni Green University	2020	UGC	State Aided, Co-Ed.	Tarakeswar Chandannagar Sub-Division	**PG Courses** **M.A in** Bengali, English. **M.Sc. in** EnvironmentalSc., Chemistry, Comp. Sc., Nutrition & Public Health.
2.	AKPC Mahavidyalaya,	1959	BU	Govt. Aided, Co-Ed.	Bengai Arambagh Sub-Division	**Science** Chemistry, Physics, Mathematics,Botany, Zoology, Environmental Sc., Nutrition. **Arts and Commerce** Bengali,English,Sanskrit,History,Geography,Pol. Sc., Philosophy,Education, Physical Education, Economics, Mass Communication &Journalism**,** Sociology**,** Santali,Music, Accountancy**.**
3.	Arambagh Girls' College	1995	BU	Govt. Aided, Girls College	Arambagh Arambagh Sub-Division	**Arts** Bengali**,** English, Sanskrit**,** History,Geography**,** Political Science**,** Philosophy**,** Sociology, Education.
4.	BalagarhBijoy Krishna Mahavidyalaya	1985	BU	Govt. Aided, Co-Ed.	Jirat Chinsurah Sub-Division	**Science** Physics,Mathematics,Computer Science (Only General Stream) **Arts and Commerce** Bengali,English,History,Geography,Political Science,Philosophy,Commerce.
5.	Bejoy Narayan Mahavidyalaya	1950	BU	Govt. Aided, Co-Ed.	Itachuna Chinsurah Sub-Division	**Science** Botany, Zoology, Mathematics, Physics, Chemistry, Nutrition, Economics, Statistics. **Arts** Bengali,English,History,Sanskrit,Political Science,Philosophy,Santhali.
6.	Bidhan Chandra College	1957	CU	Govt. Aided, Co-Ed.	Rishra Serampore Sub-Division	**Science** Electronics, Computer Science, Mathematics, Physics, Economics, Geography. **Arts** Bengali,English,History,Sanskrit,Political Science,Philosophy,Education, Hindi. **Commerce** Accounting & Finance
7.	Chandernagore Government College	1862	BU	Govt., Co-Ed.	Chandannagar Chandannagar Sub-Division	**Science** Chemistry, Physics, Mathematics, Computer Science, Botany, Zoology, Environmental Science, Economics. **Arts & Commerce** Bengali, English, Sanskrit, French, History, Geography, Political Science, Philosophy,

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						Education, Sociology, Commerce (Accountancy). **PG Courses (2 years)** **M.A in**Bengali, Geography, French.
8.	Hooghly Mohsin College	1836	BU	Govt., Co-Ed.	Chinsurah Chinsurah Sub-Division	**Science** Chemistry, Physics, Mathematics, Botany, Zoology, Physiology, Geology, Economics. **Arts & Commerce** Bengali, English, Sanskrit, Hindi, Urdu, History, Political Science, Philosophy, Commerce(Accountancy), Economics. **PG Courses (2 years)** **M.Sc. in** Botany, Zoology, Geology, Physiology, **M.A in** English, Pol. Sc., Urdu. **M.Com.** **Law Section**
9.	Hooghly Women's College	1949	BU	Govt. Aided, Women's College	Pipulpati, Hooghly Chinsurah Sub-Division	**Science** Chemistry, Physics, Mathematics, Zoology, Botany (General course) Economics, Microbiology, Nutrition, Geography. **Arts** Bengali,English,History,Sanskrit,Political Science,Philosophy,Education, Music, Geography.
10.	KabiSukantaMahavidyalaya	1986	BU	Govt. Aided, Co-Ed.	Bhadreswar Chandannagar Sub-Division	**Arts** Bengali,English, Mathematics, Sanskrit, History, Geography, Journalism & Mass Communication, Political Science, Economics, Education, Sociology, Philosophy, Urdu. **Commerce** Accountancy
11.	KabikankanMukundaramMahavidyalaya	2007	BU	Govt. Aided, Co-Ed.	Keshabpur Arambagh Sub-Division	**Arts** Bengali,English,History,Geography, Sanskrit,Political Science,Philosophy,Education, Physical Education, Environmental Studies.
12.	KhalisaniMahavidyalaya	1970	BU	Govt. Aided, Co-Ed.	Khalisani Chandannagar Sub-Division	**Science** Chemistry, Physics, Mathematics, Botany, Zoology. **Arts and Commerce** Bengali,English, Sanskrit, History,Geography,Political Science,Philosophy, Economics, Education,Commerce
13.	MahitoshNandy Mahavidyalaya	2007	CU	Govt. Aided, Co-Ed.	Jangipara Srirampore Sub-Division	**Arts** Arabic, Bengali,English,Sanskrit,History,Education, Geography, Political Science,Philosophy.

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14	NabagramHiralal Paul College	1957	CU	Govt. Aided, Co-Ed.	Konnagar Srirampore Sub-Division	**Science** Chemistry, Physics, Mathematics, Economics. **Arts & Humanities** Bengali, English, Psychology, Sanskrit, History, Pol. Sc., Philosophy, Hindi, Sociology, Education. **Commerce** Accountancy **B. Voc.** Retail Management, Hospitality & Tourism. **PG Courses (2 years)** **M.A in** Bengali
15.	NetajiMahavidyalaya	1948	BU	Govt. Aided, Co-Ed.	Kalipur, Arambagh Arambagh Sub-Division	**Science** Chemistry, Physics, Mathematics, Computer Science & Application, Botany, Zoology, Plant Protection, Environmental Science, and Economics. **Arts and Commerce** Bengali, English, Sanskrit, Santali, History, Geography, Political Science, Philosophy, Music, Physical Education, Education, Commerce, and Business Administration. **PG Courses (2 years)** **M.A in** Bengali.
16.	PolbaMahavidyalaya	2005	BU	Govt. Aided, Co-Ed.	Polba Chinsurah Sub-Division	**Arts** Bengali, English, History, Sanskrit, Philosophy, Political Science, Education, Geography, Economic (General) **Science** Geography (Hons.), B.Sc (Gen) - Mathematics, Chemistry, Physics, Zoology, Botany.
17.	RabindraMahavidyalaya	1971	BU	Govt. Aided, Co-Ed.	Champadanga Chandannagar Sub-Division	**Science** Chemistry, Physics, Botany**,** Zoology**,** Microbiology**,** Statistics**,** Mathematics, Geography, Economics. **Arts and Commerce** Bengali**,** English**,** Sanskrit**,** History**,** Geography**,** Political Science**,** Philosophy**,** Education**,** Economics**,** Physical Education**,** Defence Studies **and** Commerce.
18.	Raja Peary Mohan College	1887	CU	Govt. Aided, Co-Ed.	Uttarpara Srirampore Sub-Division	**Science** Chemistry, Physics, Mathematics, Computer Science & Application, Botany, Zoology, Physiology, and Economics.**Arts & Commerce** Bengali, English, Sanskrit, History, Political Science, Philosophy, Education, and Commerce.
19.	Raja Rammohan Roy Mahavidyalaya	1964	BU	Govt. Aided, Co-Ed.	Radhanagar Arambagh Sub-Division	**Science** Physics, Chemistry, Mathematics, Computer Science, Botany, Zoology. **Arts & Commerce** Bengali, English, Education, Sanskrit, History, Pol. Sc., Philosophy, Geography, Economics, Physical Education. **PG Courses (2 years)** **M.A in** Bengali

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20.	Sarat Centenary College	1978	BU	Govt. Aided, Co-Ed.	Dhaniakhali Chinsurah Sub-Division	**Science** Chemistry, Physics, Mathematics, Botany, Zoology. **Arts & Commerce** Bengali, English, Sanskrit, History, Geography, Political Science, Philosophy, Commerce (Accountancy Honours), Santhali(General), Education (General), Physical Education (General).
21.	Serampore College	1818	Senate of Serampore College (University) & CU Religious affiliation: Baptist	Private Grant-in-Aid Minority Co-Ed. College	Srirampore Srirampore Sub-Division	**Science** Chemistry, Physics, Mathematics, Botany, Zoology, Physiology, and Economics. **Arts & Commerce** Bengali, English, Communicative English, Sanskrit, History, Geography, Political Science, Philosophy, Education, and Commerce (Finance & Accounting). **PG Courses (2 years)** **M.Sc. in** Zoology, Botany, Physiology. 1. **Diploma Courses:**Journalism & Mass Communication, Social Work (DSW),Youth Development, English for Effective Communication, Applied Sociology. **Certificate Course in:** Medicinal Plants: Traditional Knowledge and Sustainable Approaches.
22.	Serampore Girls' College	1981	CU	Govt. Aided, Girls College.	Srirampore Srirampore Sub-Division	**Science** Computer Science, Physics, Electronics, Mathematics, Geography, Economics, Botany, Chemistry, Zoology. **Arts** Bengali, English, Sanskrit, History, Geography, Political science, Philosophy, Education, Urdu, Hindi, Sociology, Physical Education, Music.
23.	Government General Degree College, Singur.	2013	BU	Govt., Co-Ed.	Singur Chandannagar Sub-Division	**Science** Physics,Chemistry, MathematicsComputer Science, Anthropology,Botany, Zoology. **Arts** Bengali, English, History, Philosophy, Sanskrit, Political Science, Psychology, Sociology, Santhali.
24.	Sreegopal Banerjee College	1958	BU	Govt. Aided, Co-Ed.	Bagati, Mogra Chinsurah Sub-Division	**Science** Chemistry, Physics, Mathematics, Botany, Zoology, Plant Protection. **Arts & Commerce** Bengali, English, Sanskrit, History, Political Science, Philosophy, Economics, Physical Education, Accountancy, Business Studies.
25.	Sri RamkrishnaSaradaVidyamahapith	1959	BU	Govt. Aided, Co-Ed	Kamarpukur Arambagh	**Science** Chemistry, Physics, Mathematics, Computer Science & Application, Nutrition, and Economics.

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					Sub-Division	**Arts** Bengali, English, Sanskrit, History, Geography, Political Science, Philosophy, Physical Education, and Education.
26.	Swami Niswambalananda Girls' College	1978	CU	Govt. Aided, Girls College.	Bhadrakali, Uttarpara Srirampore Sub-Division	**Science** Economics, Geography, Mathematics. **Arts and Commerce** Bengali, English, Education, Sanskrit, History, Hindi, Political Science, Philosophy,Commerce.
27.	Tarakeswar Degree College	1986	BU	Govt. Aided, Co-Ed.	Tarakeswar Chandannagar Sub-Division	**Science** Physics**,** Mathematics**,** Computer Science**,** Chemistry, Botany, Zoology. **Arts and Commerce** Bengali, English, History, Sanskrit, Geography, Philosophy, Political Science, Music, Sociology, Education, Physical Education, Business Administration, Accountancy, Economics, Auditing.
28.	VidyasagarMahavidyalaya	1998	CU	Govt. Aided, Co-Ed.	Masat Srirampore Sub-Division	**Arts and Commerce** Bengali, English, History, Political Science, Education, Sanskrit,Commerce.
29.	Vivekananda Mahavidyalaya	1966	BU	Govt. Aided, Co-Ed.	Haripal Chandannagar Sub-Division	**Science** Mathematics**,** Physics& Electronics**,** Computer Science**,** Nutrition**,** Chemistry**,** Botany, Zoology. **Arts and Commerce** Bengali**,** English**,** Sanskrit**,** Santali**,** History**,** Geography**,** Political Science**,** Philosophy**,** Education**,** Commerce. **BCA**

Source: Websites of specific Institutions.

From the above description it is clear that the twenty eight (28) general degree colleges and one (1) university is located in the district of Hooghly, among them twenty (20) colleges are affiliated by the University of Burdwan and eight (8) colleges are affiliated by the University of Calcutta. There are six (6) colleges in Arambagh Sub-Division, seven (7) colleges are located in Chinsurah Sub-Division, seven (7) colleges along with one (1) University are in Chandannagar Sub-Division, and eight (8) colleges are located in Serampore Sub-Division. In this district, there are four (4) general degree girls's colleges, among them Arambagh sub-Division has one (1)girl's college, Chinsurah Sub-Division has one (1)girl's college and Serampore Sub-Division has two (2) girl's Colleges and no girls college is found in Chandannagar Sub-Division, but a women's B.Ed. college is found in Chandannagar Sub-Division. The historic and third oldest college (Serampore College, Estd.:1818) in India after CMS College and Presidency College is located in this district.Government Centre of Legal Education was founded on 29th November, 2021 at Hooghly Mohsin's College Campus. The only Government Law College in West Bengal was erstwhile known as Law Section, Hooghly Mohsin College. The College is till date situated in the campus of the famous Hooghly Mohsin College, Chinsurah, Hooghly.

7. CONCLUSION

Disparity in higher education is observed among different Sub-Divisions of Hooghly district. General degree colleges are now under-enrolled; the number of students is starting to decrease in general degree colleges after the Covid-19 Pandemic in Hooghly district.Arambagh Sub-Division is ahead of the Serampore and Chandannagar Sub-Division in terms of area and population but it is relatively behind in terms of number of higher education institutions. There is variation among various colleges in terms of offered courses. Very few colleges conduct PG courses on few subjects. There are around fifty (50) universities in West Bengal, but only one (1) university is located in Hooghly District. The entire country is being transformed into a digitally empowered society and knowledge economy; education will be a crucial part to this shift, technology itself will be crucial to improving educational outcomes procedures and results. It needs to be emphasized that this sector is plagued by various problems – viz. quality and number of teachers, infrastructure etc. While increasing private sector participation in higher education promotes educational opportunities, it

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has been the same time concern for the quality of higher education sector and raises question about equity. West Bengal should try to develop its own form of integration between higher education sectors andbusiness world.

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COMPARISON OF AEROBIC AND ANAEROBIC CAPACITY IN COLLEGE AND UNIVERSITY LEVEL HANDBALL PLAYERS

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ABSTRACT
The study aimed to compare the aerobic and anaerobic capacity of college-level and university-level male handball players. To do this, sixty players aged 18 to 25 were randomly selected from various departments and colleges affiliated with Bharathiar University in Coimbatore, Tamil Nadu. The players were divided into two equal groups: thirty college-level players and thirty university-level players. The data collected from the players were analyzed using an independent t-test to check for significant differences in their capacities. The results showed a significant improvement in both aerobic and anaerobic capacity between the two groups.
KEYWORDS: *handball, aerobic and anaerobic*

INTRODUCTION

Handball, also known as team handball or Olympic handball, is a sport where two teams of seven players each (six outfield players and one goalkeeper) work together to pass a ball and try to throw it into the other team's goal. A typical match has two halves, each lasting 30 minutes, and the team with the most goals wins.

The term "aerobic" means "with oxygen." It refers to how our bodies use oxygen to produce energy for activities. When we exercise, our bodies need energy, which comes from burning the food we eat. Oxygen is essential for this process. The concept of fitness, particularly aerobic fitness, was popularized by Kenneth Cooper, who played a big role in the fitness movement. Many doctors believe that aerobic exercises are good for the heart and lungs and provide other health benefits.

On the other hand, anaerobic exercise is important for athletes in non-endurance sports and for bodybuilders who want to build strength and muscle. When muscles are trained without oxygen, they develop differently, making them better for short, intense activities. In contrast, aerobic exercises include lower-intensity activities like walking, running, swimming, and cycling, which require a lot of oxygen for longer periods of exercise.

CRITERION MEASURES

The following tests were used to measure the selected variables.

1. Queens college step test was used to measure the aerobic capacity (cardio respiratory Endurance) and score was recorded in minutes
2. Maragariya-kalamen test was used to measure the anaerobic Capacity (speed) and score was recorded in seconds.

METHODS

To achieve the purpose of the study,60 handball men players will be selected as subjects from departments and affiliated colleges of Bharathiar University, Coimbatore, Tamilnadu. The subjects age ranged between 18 and 25 years. The selected men handball players will be assessed by aerobic and anaerobic capacity. The selected 60 handball men subjects will be divided into two equal groups, Group – I named as College level men handball players and Group-II named as University level men handball players.

STATISTICAL ANALYSIS

The descriptive calculation and ‘t’ test were computed. The level of significance will set at 0.05 level of confident.

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TABLE 1
COMPUTATION OF 't' RATIO BETWEEN COLLEGE AND UNIVERSITY LEVEL MEN HANDBALL PLAYERS ON AEROBIC CAPACITY

Variable	Group	N	Mean	Standard deviation	Standard Error Mean	t-ratio
Aerobic	College	30	44.03	2.09	0.38	**11***
	University	30	49.43	1.68	0.30	

*Significant at 0.05 level of confidence (1.69) 1 and 29

Table 1 shows the mean value of aerobic for college and university level men handball players were 44.03 and 49.43 respectively. The obtained "t" ratio value of 11 was higher than the required table value of 1.69 for degrees of freedom, 1 and 29 significant at 0.05 level of confidence. The study also reveals that the university level handball players had more aerobic capacity then college level handball players.

The mean value of college and university level handball players on aerobic were graphically represented in figure.

FIGURE I
Graphical Representation on Mean Values of College and University Level Men Handball Players on Aerobic Capacity

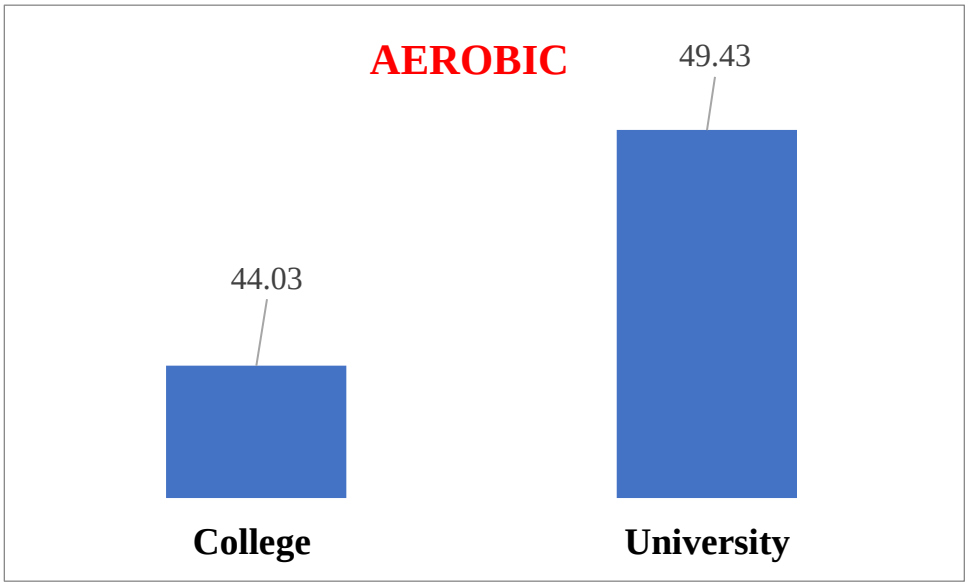

TABLE 2
COMPUTATION OF 't' RATIO BETWEEN COLLEGE AND UNIVERSITY LEVEL MEN HANDBALL PLAYERS ON ANAEROBIC CAPACITY

Variable	Group	N	Mean	Standard deviation	Standard Error Mean	t-ratio
Anaerobic	College	30	368.42	34.71	6.33	**6.96***
	University	30	450.30	54.23	9.90	

*Significant at 0.05 level of confidence (1.69) 1 and 29

Table 2 shows the mean value of anaerobic for college and university level men handball players were 368.42 and 450.30 respectively. The obtained "t" ratio value of 6.96 was higher than the required table value of 1.69 for degrees of freedom, 1 and 29 significant at 0.05 level of confidence. The study also reveals that the university level handball players had more anaerobic capacity then college level handball players.

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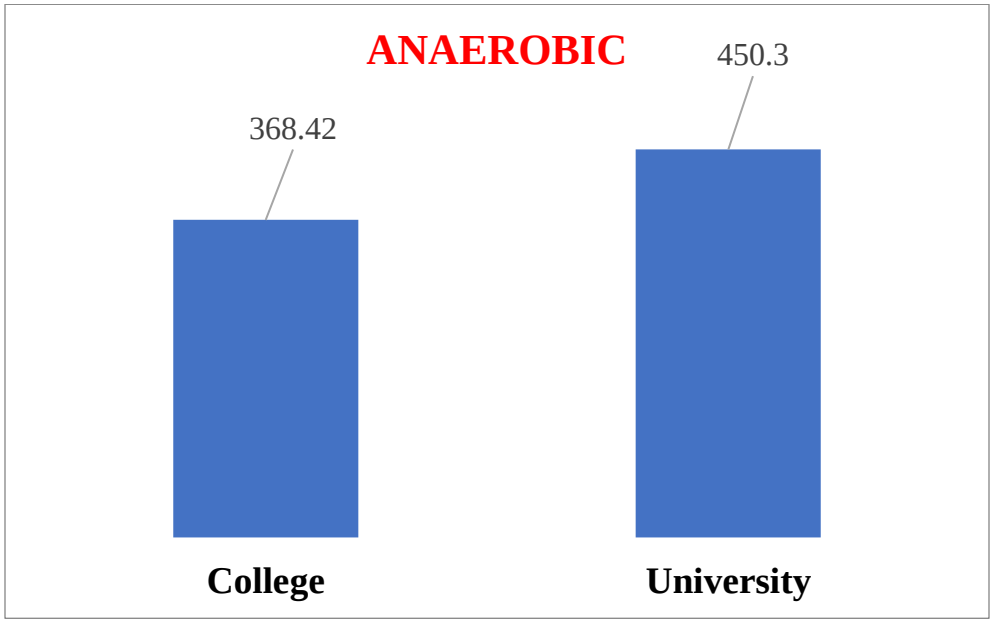
The mean value of college level and university level men handball players on anaerobic capacity were graphically represented in figure II.

FIGURE II
Graphical Representation on Mean Values of College and University Level Men Handball Players on Anaerobic Capacity



DISCUSSION ON FINDINGS

The findings of this study show clear differences in both aerobic and anaerobic capacity between college and university-level male handball players.

First, the results indicate that university-level players have a higher aerobic capacity than their college-level peers. Aerobic capacity is important for endurance during games, allowing players to maintain their performance over longer periods. This suggests that university-level players may have more training experience or higher intensity practices, which can improve their endurance.

Additionally, the study found significant differences in anaerobic capacity as well. University players also scored better in anaerobic tests, which are crucial for short bursts of energy, such as sprinting or quick movements during a match. This means that university players may be better at handling intense moments in the game.

Overall, these results suggest that as players progress from college to university levels, they likely receive more advanced training and competition, leading to improved physical performance. This emphasizes the importance of developing both aerobic and anaerobic capacities in handball training programs to help athletes reach their full potential.

CONCLUSIONS

Based on the results and discussion made into the previous chapter, the Following conclusions have been made:

1. It was concluded that there was a significant difference among college level and university level men handball players on aerobic capacity.
2. It was concluded that there was a significant difference among college level and university level men handball players on anaerobic capacity.
3. It was concluded that university level handball players had better aerobic capacity than college level handball players.
4. It was concluded that university level handball players had better anaerobic capacity than college level handball players.

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CNN MODEL FOR TRAFFIC SIGN RECOGNITION

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ABSTRACT

The traffic sign recognition framework (TSRS) is an important component of intelligent transportation systems (ITS). Accurately identifying traffic signs can improve driving safety. This research provides a traffic sign recognition approach based on profound learning. It primarily focuses on the location and order of roundabout signs. First, a photograph undergoes pre-processing to highlight important facts. Hough Transform is used to distinguish and find regions. Finally, the unique street traffic signs are analyzed for further understanding. This paper proposes a photo handling-based traffic sign discovery and distinguishing proof technique that is combined with convolutional brain organization (CNN) to sort traffic signs. CNN is useful for recognizing many PC vision tasks due to its high recognition rate. TensorFlow is used to implement CNN. We have a recognition accuracy of over 98.2% for the roundabout image in the German informative collections.

KEYWORDS——*traffic sign recognition, traffic sign detection, deep learning, convolutional neural network*

I.INTRODUCTION

Traffic sign recognition is important for intelligent driving frameworks like assisted and programmed driving. Manual component procedures and profound learning techniques are the two categories under which street sign acknowledgment approaches fall. For example, explicit variety acknowledgment [10] and other element acknowledgment schemes required manual marking and component extraction, which greatly slowed down the pace of framework activity. Not only was manual marking more work, but it was also more difficult to guarantee accuracy rates. The most common techniques for learning fake elements are SVM and arbitrary backwoods, although this method can be easily understood for images with blurry inclusion boundaries [1].

Traffic signs contain consistent properties that can be used for position and arrangement, including diversity and shape, which can help drivers get street data. Rush hour gridlock signs are similar across countries, with basic colors (red, blue, yellow) and fixed shapes (circles, triangles, square shapes). However, the appearance of traffic signs is often influenced by external factors such as weather patterns. Traffic sign recognition is a challenging and crucial topic in rush hour jam design exams. In [3] and [4], various traffic-sign ID advancements were developed. In paper [5], a CNN with a learning strategy is advanced. Profound CNN is trained on large amounts of data, and viable territorial convolutional neural networks (RCNNs) are discovered using typical traffic preparation methods.

In paper [6], a multi-goal highlight mix network texture is developed to focus on useful elements from small-sized objects. The traffic sign recognition system is also partitioned into spatial succession order and relapse assignments to acquire more data and improve recognition execution. To better comprehend CNN identification and traffic sign recognition. This article uses Hough Transform to recognize and pre-process street traffic signs, enhancing their accuracy and usefulness.

This article covers traffic sign identification in three sections: pre-handling, location, and order. Figure 1 depicts the traffic sign recognition framework procedure. Pre-handling improves the static variety picture and changes the variety space. During the identification stage, street signs are classified based on their shape and variety data. Roundabout traffic signs are then detected using the Hough Transform [7]. During this stage, an image of the region of interest is generated, together with the location of traffic signs. During the recognition and characterization stage, the extracted and sectioned traffic sign region is used as input. A convolutional neural network [8] in deep learning is then used to distinguish and group the recognized data.

CNN has recently gained attention as a topic of study, and many academics are working in this area [6], [7], [8]. CNN has since consistently evolved into PC vision's most typical picture categorization model. Three fundamental components are often included in a complete CNN: the convolutional layer, the pooling layer, and the fully associated layer. The convolutional layer is an important component of CNN. A two-dimensional inclusion map is produced when the convolution piece convolves the relevant region of the image with a preset step size [9]. The image develops from low-dimensional to high-layered, and then it obtains high-dimensional

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picture highlights. Adding convolutional layers can, in contrast to conventional AI algorithms, eliminate highlights at different levels in the picture and has interpretation invariance to the information picture.

Additionally, the limits of the common are the convolution section in the convolution layer, which significantly reduces the size of the boundaries. In the convolution interaction, the pooling layer can reduce the aspect of the picture, retain the important data, and quicken the organization's preparation. Techniques for normal pools include arbitrary, normal, and biggest pools. The primary goals of pooling, regardless of the approach employed, are to reduce the spatial element aspect, reduce the framework load, and quicken the network preparation speed. At least one fully linked layer usually exists at the end of the brain's organization.Its task is to connect to a single-layered include map, group the image using the high-layered include data that has been separated, use the final fully associated layer as the yield layer, and then the network produces the arrangement result. Moreover, the order initiation capacity may vary across the picture's component data into the (0, 1) span, reducing the amount of PC execution used during the preparatory interaction.

In the identification step, the primary goal is to eliminate the regions of interest from the image and prepare the scene for the layout stage. This work will investigate the finding of traffic signs based on the two data of signs: the variety and shape data. Since each traffic sign has a defined shape and tone, there are two massive data sets related to traffic signs. The goal of area of interest extraction in light of varied data is to extract H and S portions of the image. changed to an HSV variety space. Tone is important because it provides more consistency in the way that illumination circumstances fluctuate and a range of immersion in the shadows or elements behind the scenes. The partition table with according to HSV space.

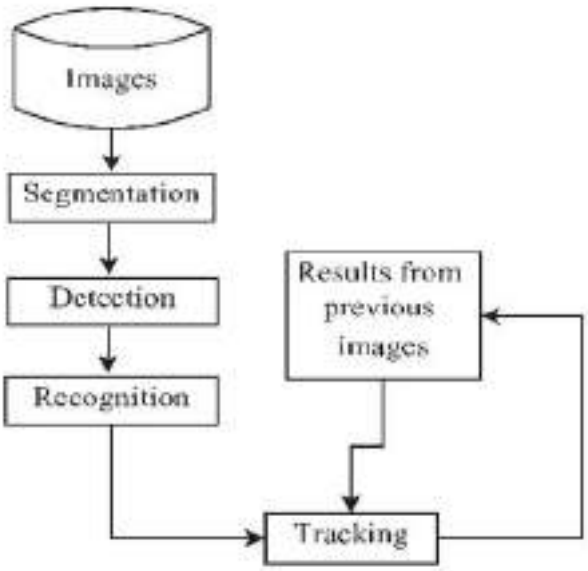

Fig.1. Block diagram of Traffic Sign Recognition

After division, there will be some turbulence in the picture.
This work uses math's morphological activity to eliminate unnecessary impedance data during image division. visual morphology can improve visual information by preserving its essential condition and eliminating unnecessary design elements. After HSV space division, the image employs open activity due to minor impedance differences. As previously said, open activity can effectively eradicate these little things. with dividing the picture, erosion occurs with the development of handling.
As shown in the figure below.

II. LITERATURE REVIEW

In this section, Ciresan, D. C., Meier, U., Masci, J., Gambardella, L. M., & Schmidhuber, J. (2012). Multi-column deep neural network for traffic sign classification. Neural Networks, 32, 333-338. Introduced a multi-column deep neural network achieving high accuracy on the German Traffic Sign Recognition Benchmark (GTSRB)[1].

Sermanet, P., & LeCun, Y. (2011). Traffic sign recognition with multi-scale Convolutional Networks. IJCNN 2011, 2809-2813.Developed a multi-scale CNN that recognizes traffic signs in varying sizes and resolutions [2]. Stallkamp, J., Schlipsing, M., Salmen, J., & Igel, C. (2011). The German Traffic Sign Recognition Benchmark: A multi-class classification competition. IJCNN 2011, 1453-1460. Established a benchmark dataset for traffic sign recognition, spurring research in this area[3].

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III. METHODOLOGY

To capture images of traffic signs, use a high-quality camera. There may be some noise in the captured image.

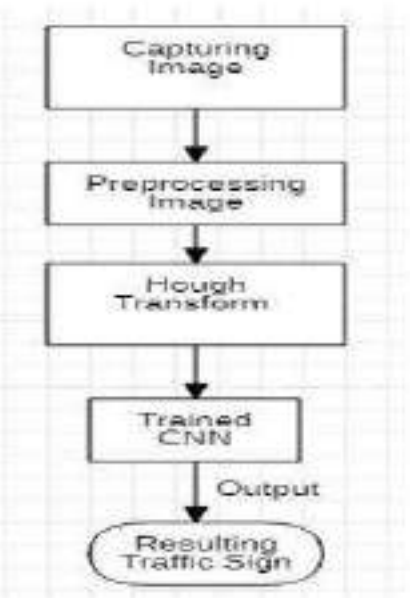

Fig.2. Content Diagram of Traffic Sign Recognition

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To remove noise and disruptions, images should be preprocessed using many filters. Finally, Hough Transform is utilized to determine roundabout sign positions. Hough Transform uses global image elements to correlate edge pixels with structural territorial bounds. Hough change refers to the relationship between a picture and its surrounding surroundings. Using Hough, a difficult-to-resolve global location issue can be transformed into an easy-to-resolve local location issue, resulting in a clearer and more understandable result. It has the advantage of having minimal influence from disturbance and intermittent bends.

ER/UML Diagram
The ER/UML diagrams provide a clear picture of how the work is going on.

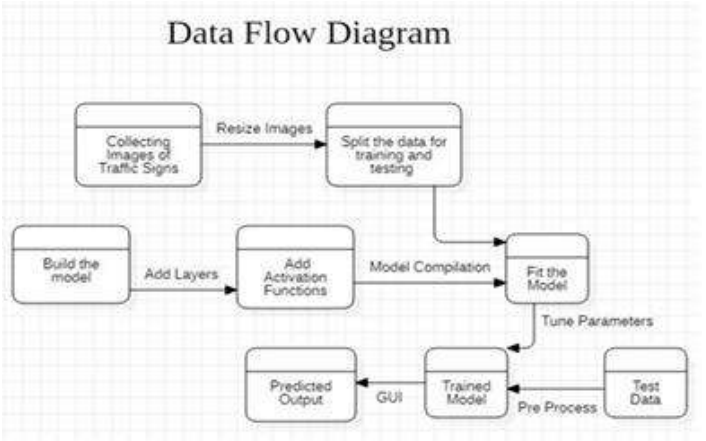

Fig.3. Data Flow Diagram of Traffic Sign Recognition

In addition to using CNN to define the distinct indications, a lightweight CNN classifier is also envisaged for this research. Two pooling layers, two full association layers, and two convolutional layers make up the lightweight CNN. This paragraph sets the convolution layer's section size to 5x5, the convolution part's amount to 32, and the step size to 1. The primary convolution layer has sixteen stored away layer hubs, whereas the secondary convolution layer has thirty-two. Highlight charts come in two sizes: 32x32 and 16x16. The pooling layer's piece size is 2x2, the full association layer's secret hubs are 512 and 128; and the final result layer has 43 stowed-away hubs. The initial value of the learning rate can be set at a higher value to improve preparation time or a lower value to speed up the combination process. The text's learning rate has an underlying value of 0.0001. Dropout (regularization) management is the covert layer of the entire association that prevents the peculiarity of overfitting in the organization. To avoid over-fitting, information on some hubs is randomly removed during the preparation phase. To eliminate some eigenvalues, Dropout set the hub information to 0. Figure 7 illustrates the CNN process of extracting elements and arranging them.

Model Design

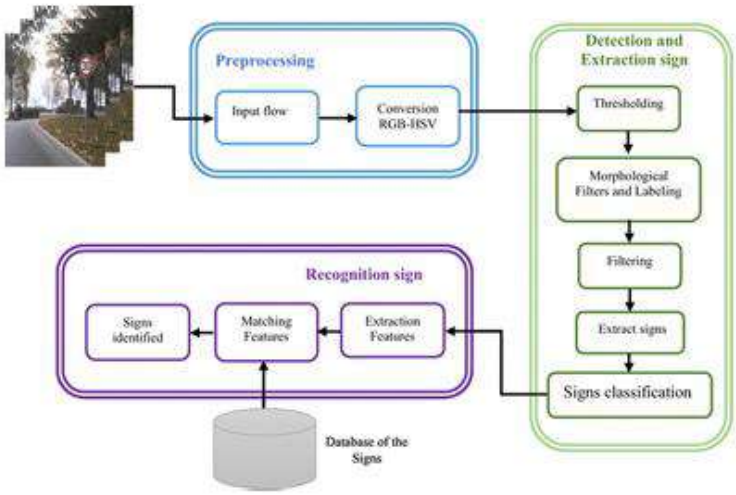

Fig.4. Flow Chart of Traffic Sign Recognition

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In this paper, the neural network is trained on the training set to ensure recognition accuracy on the validation set. The validation set's results are used to continue training on the training set. Finally, the network's accuracy on the test set is evaluated.

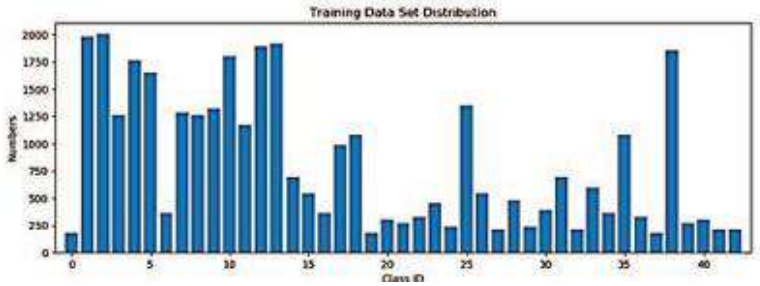

Fig.5. Dataset Distribution

Figure 1 depicts the 43 classes GTSRB that have been appropriated. Class amount is the vertical coordinate, and there are 43 classes in the level direction. It is evident that the picture dataset is disproportionately used. In order to address this, this paper employs information improvement strategies to expand the dataset. While it is relatively easy to accurately order certain classes (with more information), the order impact for other classifications (with less information) is incorrect. Both the organization's capacity for speculating and the numerous shooting points' capacity for order are advanced.

IV. DISCUSSION AND RESULTS

The calculation enhancement makes use of imgaug, an AI package for image processing. Various upgrade tactics exist, such as grayscale, revolution, and obscure, among others. As a result, this study uses imagaug to expand the GTSRB data and divide it into small chunks for network preparation, which not only increases the organization's capacity for speculation but also lowers the PC's registering heap.

One commonly used picture expansion technique to boost network speculating capacity is information increase. Accordingly, in order to increase the size of datasets and improve viability, this research uses information upgrade [5], [8] to carry out half picture hiding on the preparation set, arbitrary editing and filling of specified pixels, and half picture variety transformation.

Our approach to network development involves implementing Dropout innovation. By randomly deactivating neurons with a particular probability P during the forward growth period, this strategy reduces boundary size and improves the model's capacity for speculation. The graphs before and after are shown in Fig. 3.

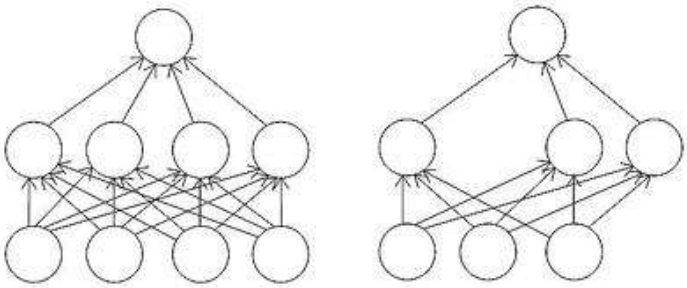

Fig.6. Before and after using Dropout

In the image above, the right picture uses Dropout while the left picture does not. It is clear that the complexity of the organization. Reduced structure after using Dropout is helpful in helping the business prepare for increased productivity and speculative capacity.

This article focuses on ELU work rather than traditional ReLU. This capacity combines the benefits of ReLU and Soft-Max capacities. The capacity's articulation and figure are as follows:

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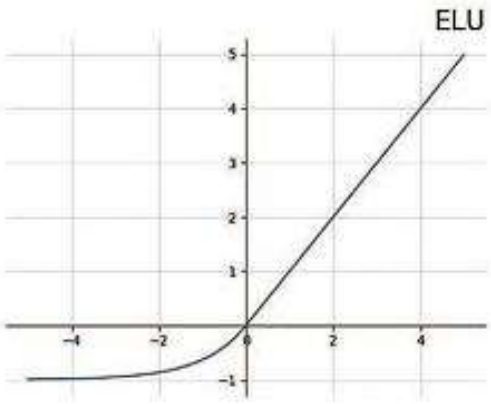

Fig. 7. ELU function.

Where is a nonzero constant? When t > 0, the output equals the input, resulting in linear growth of the function.
The ReLU function can help reduce the gradient vanishing problem. The left side exhibits soft saturation and is more adaptable to changes in the input image, unlike the ReLU function.

As shown in Fig. 7, here is -1.
Implementation of Key Functions

- Predict ()
- train_test_split ()
- length ()
- DWT ()
- Fit ()
- to_categorical ()
- Sequential ()
- Compile ()
- Predict_classes ()
- subplot ()
- plot ()

VI. CONCLUSION

This article proposes a technique for recognizing traffic signs via deep learning, with a focus on roundabouts. Using image preprocessing, traffic sign position, recognition, and arrangement, this technique can recognize and distinguish traffic signs, according to the International Research Journal of Engineering and Technology (IRJET). The test results indicate that this method is 98.2% accurate.

This study introduces a lightweight convolutional network for traffic sign recognition and grouping. The organization recognizes traffic signs using simple convolution and pooling jobs, ensures calculation productivity, and checks against GTSRB information. This organization's handling time is faster than existing calculations, and it has a clear design with key areas of strength. Future research will focus on recognizing traffic signs under extreme weather conditions and analyzing larger datasets. We intend to use this model to identify traffic signs.

Essentially, the goal of this project is to improve the evaluation process by making it more effective, equitable, and perceptive. Through the reduction of grading duties for teachers and the provision of insightful student feedback, our application facilitates more tailored and efficient learning experiences, which in turn leads to better learning outcomes.

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GROWTH TRENDS AND INSTABILITY IN EXPORT OF AGRICULTURAL CROPS FROM INDIA: AN ECONOMIC ANALYSIS

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ABSTRACT

India is the largest producer and exporter of cereal products in the world. The present paper analyse the growth trends and instability in export of agricultural crops from India with the objectives to examine growth trends and instability in export of agricultural commodities from India and to identify the major destination of India for exporting of agricultural commodities from India. To fulfill the objectives secondary data from 2010-11 to 2023-24 has been utilized for analysis using the statistical tools like Compound Annual Growth Rates, Coefficient of Variation and Cuddy Della Valle's Instability Index. The study revealed that during the period the export of some commodities in terms of quantity like maize and other cereals show a negative growth rate. In terms of value other cereals also showed negative growth. The export growth rates of foodgrain such as basmati rice, non-basmati rice, wheat and millets are positive in case of quantity. The quantity of export of agricultural cash crops such as coffee, sugar and groundnut has shown positive growth rate while tea, cashew and cotton have shown a negative growth rate. Other cereals have shown the highest instability index value indicating the highest instability and variability among others in both cases quantity and value term. In term of value, cotton has shown the high level of instability index value indicating the highest instability and variability among others. India's key markets for cereals crops are Saudi Arab, Benin, Vietnam, Nepal, United Arab Emirates, Russia and Bangladesh, while cash crops are mainly exported to the United Arab Emirates, Italy, Sudan, Indonesia and Bangladesh.

KEYWORDS: *Agriculture, foodgrain, cash crop, export, growth, instability*

1. INTRODUCTION

India's agricultural sector has long been a cornerstone of its economy, with exports of agricultural commodities playing a pivotal role in global trade. Over the past decade, India's agricultural exports have seen significant growth, driven by a combination of factors including favorable government policies, advancements in farming technologies and increased global demand for key commodities such as rice, spices, cotton and oilseeds. The country diverse climate and vast agricultural resources enable the production of a wide variety of crops, making it a leading exporter of key commodities such as rice, wheat, spices, cotton, tea, coffee and sugar. This surge in exports has not only enhanced the sectors contribution to the national GDP but has also helped improve the livelihoods of millions of farmers and rural communities. However, the growth trajectory is influenced by various internal and external factors such as fluctuating global prices, climate variability, trade barriers and evolving international standards. Understanding the dynamics of India's agriculture exports, including the drivers of growth performance metrics and the associated challenges is critical for formulating sustainable strategies. This paper seeks to examine the key trends and growth of agricultural commodities, instability and variability in export from India.

India is the largest producer and exporter of cereal products in the world. In 2023-24, India's cereal exports reached Rs. 90,961.67 crore (or 10,984.27 million USD). Rice, including both basmati and non-basmati types made up 95% of these exports in terms of value. India is the top producer of millets accounting for 38.40% of the world's production, the second largest producer of rice (25.27% of global production), wheat (13.33% of global production) and the fifth largest producer of maize (2.9% of global production). Important cereals grown in India include wheat, rice, sorghum, millet (bajra), barley and maize. According to the Ministry of Agriculture Third Advanced Estimate for 2023-24, India's production of rice was 136.7 Million tones, wheat was 112.92 million tones, and millet (bajra) was 10.66 million tones. The total cereal production in India for 2023-24 was 304.36 million tonnes (APEDA). Jha et al (2019) identified key challenges in the horticulture sector, highlighting the need to boost productivity through research and development, increase the share of value-added products, diversify export destinations, and improve infrastructure such as cold storage and rural roads. The authors stressed the importance of strengthening public sector research while addressing the limitations faced by smallholder farmers, who make up a substantial portion of the producers. Ramesh el al (2017) in their study, it was observed that the quantity of horticultural produce imported in to India increased significantly during the post-National Horticulture mission (NHM) period, rising from 0.67% to 4.23%. However, in terms of value imports experienced a decline, dropping from 0.51% to -3.34%. Despite being a major producer of horticultural crops, the growth in import volumes did not

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correspond with an increase in value, indicating a contrasting trend. This rise in imports can be attributed to the growing population and heightened awareness of the nutritional benefits associated with these crops. (Shanthanagaraju and Shanmugam (2023) in their study it was observed that there were positive growth trends in horticulture export with significant potential for further sectoral expansion. The authors stressed that the key role of the government in developing infrastructure, promoting research, and incentivizing farmers to capitalize on this potential for sustained growth in horticultural exports.

1.1 Objectives of the study

- To examine growth trends and instability in export of agricultural crops from India.
- To identify the major destination of India for exporting of agricultural commodities from India.

2. DATA RESOURCES AND METHODOLOGY

The study relies based on secondary data and the required data is collected from Agricultural and Processed Food Products Export Development Authority APEDA. Data collected to analyzing export performance of export of agriculture crops from India. The study used time series data on the quantity and value of exports of agricultural crops from India, for a period of 2010-11 to 2023-24. In order to achieve the objectives of the study, following statistical measures such as percentages, compound annual growth rates (CAGR), standard deviation (SD), coefficient of variation (CV) and Cuddy Della Valle's Instability Index (CDVI) has been applied to show the trends and instability and variability in export of agricultural crops from India.

2.1 Compound Annual Growth Rate

The compound growth rate has been carried out to identify the growth rate in the export of agricultural commodities of India during the period 2010-11 to 2023-24.The compound annual growth rates (CAGR) has been computed by using the formula;

$$Y = AB^t$$

Where Y = dependent variable, t = time

By taking logarithms of both sides of the equations it takes the form: Log Y = Log A + t Log B.

If we put Log A = a and Log B = b, then equation becomes

Log Y = a + bt, which is linear function with independent variable t and dependent variable Log Y. The compound growth rate calculate as (antilog b – 1) × 100 and represent uniform rate of change from year to year.

2.2 Instability Analysis

Instability in export of agricultural commodity from India has been estimated by using Coefficient of Variation and Cuddy-Della Valle Index. Although Coefficient of Variation (C.V) is the simplest measure of instability, it over-estimates the level of instability in time series data which are characterized by long-term trends. CV is calculated as follows:

$$\mathbf{CV= \frac{Sandard\ Deviation}{Mean} X100}$$

Cuddy-Della Valle Index (%) with an objective to know that, up towhat extent risk is occurred in the selected variables. The Cuddy Della Valle Index de-trends shows the exact direction of the instability. Therefore, it is a better measure to capture instability in export of agricultural commodity from India. The Cuddy-Della Valle Index is calculated as follows:

$$\textbf{Cuddy-Della Valle Index} = \frac{\textbf{Sandard Deviation}}{\textbf{Mean}} \text{ X } \mathbf{100} \text{ X } \sqrt{\mathbf{1 - R^2}}$$

Where, C.V. was the Coefficient of Variation in per cent, and $\mathbf{R^2}$ was the coefficient of determination from a time trend regression adjusted for its degrees of freedom.

A low value of this index indicates low instability in the selected variables. The ranges of CDVI are given as follows;

- Low instability = 0 to 15 (%)
- Medium instability = 15 to 30 (%)
- High instability = 30 and above (%)

3. RESULTS AND DISCUSSION

3.1 Growth trends and instability in the export of foodgrain and pulses crop from India in terms of quantity and value

The growth trends and instability in export of foodgrain and pulses in terms of quantity has been presented in Table 1. The export growth rates of foodgrain such as basmati rice, non-basmati rice, wheat and millets are positive with a value of 4.07%, 21.50%, 18.84%, and 24.62%, respectively. The growth rate in export for pulses has been found be positive. However, the export growth is not uniform and is fluctuating over the years. For example, maize and other cereals show a negative growth rate with -5.15% and -26.05%, respectively. The quantity exported of foodgrain such as basmati rice, non-basmati rice, wheat and millets during the year 2010-11 was 2370.66, 100.69, 0.39 and 3.54 thousand tonnes which increased to 5242.05, 11116.53, 188.29 and 146.29 thousand tonnes in 2023-24 respectively, while quantity exported of maize and other cereals during the year 2010-11 was 3010.42 and 10.00

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thousand tonnes which decreased to 1442.67 and 9.47 thousand tonnes in 2023-24. The quantity export growth for the pulses found to be positive with a value 8.44 percent per annum. The coefficient of variation of basmati rice, non-basmati rice, maize, wheat, millets, other cereals and pulses in terms of quantity is 17.61, 56.69, 63.64, 116.69, 56.34, 173.03 and 58.48 percent respectively. Other cereals have shown the highest CV value indicating the highest variability and basmati rice has shown lowest CV vale indicating lowest variability among others. The value of instability index of basmati rice, non-basmati rice, maize, wheat, millets, other cereals and pulses in terms of quantity found to be 9.26%, 44.93%, 64.04%, 116.41%, 44.58%, 144.34 and 43.71%, respectively. Other cereals has shown the highest instability index value indicating the highest instability and variability among others while basmati rice has shown the lowest instability value indicating low level of instability and variability among others.

Table 1: Growth trends and instability in export of foodgrain and pulses crop from India in terms of quantity (in'000'MT)

Year	Basmati Rice	Non Basmati Rice	Maize	Wheat	Millet	Other Cereals	Pulses
2010-11	2370.66	100.69	3010.42	0.39	3.54	10.00	209.01
2011-12	3178.17	3997.72	3855.72	740.75	5.81	45.24	174.63
2012-13	3459.90	6687.99	4788.33	6514.81	16.32	268.38	202.75
2013-14	3757.27	7133.18	3954.24	5562.37	216.42	441.28	345.28
2014-15	3702.26	8274.05	2825.61	2924.07	257.39	430.81	222.26
2015-16	4045.82	6464.57	697.95	666.67	188.99	80.99	256.05
2016-17	3985.20	6770.80	566.35	265.61	166.94	1.49	136.97
2017-18	4056.76	8648.49	705.51	322.79	156.27	1.34	180.19
2018-19	4414.58	7599.67	1051.86	226.22	219.40	5.75	289.62
2019-20	4454.66	5040.71	370.07	217.35	129.01	2.40	235.70
2020-21	4630.46	13095.13	2879.20	2088.49	146.99	2.93	296.17
2021-22	3948.16	17262.24	3690.47	7239.37	158.51	3.05	410.38
2022-23	4558.97	17786.09	3453.68	4693.26	169.05	3.80	775.02
2023-24	5242.05	11116.53	1442.67	188.29	146.29	9.47	626.65
Average	3986.07	8569.85	2378.01	2260.75	141.50	93.35	311.48
SD %	701.98	4858.42	1513.43	2638.15	79.71	161.54	182.16
CV %	17.61	56.69	63.64	116.69	56.34	173.03	58.48
CDVI %	9.26	44.93	64.04	116.41	44.58	144.34	43.71
CAGR %	4.07	21.50	-5.15	18.84	24.62	-26.05	8.44

Source: *APEDA, https://agriexchange.apeda.gov.in*

Growth trend and instability in export of foodgrain and pulses in term of value shown in Table 2, the growth rate of export in terms of the value of basmati rice, non-basmati rice, maize, wheat, millets and pulses are positive with values 7.69%, 24.71%, 0.19%, 23.18%, 28.80% and 12.17%, respectively. However, it has been showing a negative growth rate with a value -15.18% in case of other cereals. Here coefficient of variation for basmati rice, non-basmati rice, maize, wheat, millets, other cereals and pulses are 34.36%, 62.33%, 65.36%, 121.38%, 54.37%, 164.67% and 71.00% respectively. The export value of foodgrain and pulses has significant increase during 2010-11 to 2023-24. The value of instability index of basmati rice, non-basmati rice, maize, wheat, millets and pulses in terms of value is 19.25%, 46.15%, 68.03%, 119.17%, 37.75%, 157.57% and 37.17%, respectively. In term of value other cereals has shown the highest instability index value indicating the highest instability and variability among others while other basmati rice shown the lowest instability value indicating low level of instability and inconsistency of export of fresh fruits and vegetables among others.

Table 2: Growth trends and instability in export of foodgrain and pulses crop from India in terms of value (Rs. In crore)

Year	Basmati Rice	Non Basmati Rice	Maize	Wheat	Millet	Other Cereals	Pulses
2010-11	11354.63	231.29	3359.46	0.70	8.55	12.6	870.04
2011-12	15449.6	8659.13	5157.51	1023.27	18.23	64.27	1067.93
2012-13	19409.39	14448.81	7096.34	10529	39.6	440	1285
2013-14	29299.96	17749.96	5983.66	9261.61	448.21	708.7	1747.63
2014-15	27597.89	20428.54	4037.51	4991.84	540.53	683.49	1219.08
2015-16	22718.6	15483.39	1162.01	1061.77	418.83	121.65	1658.09
2016-17	21512.91	16929.88	1030.13	447.85	390.89	4.75	1278.79
2017-18	26870.17	22967.82	1228.46	624.37	370.07	3.63	1473.26
2018-19	32804.3	21185.28	1872.51	424.95	542.5	11.74	1822.58

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2019-20	31025.88	14364.66	1019.3	439.14	425.69	12.45	1533.74
2020-21	29849.89	35476.61	4675.78	4037.6	435.8	15.15	2116.69
2021-22	26416.54	45652.35	7615.42	15840.34	469.36	17.44	2834.29
2022-23	38524.11	51088.72	8987.13	11826.9	608.11	27.4	5397.86
2023-24	48389.18	37804.48	3660.1	470.83	587.73	49.35	5689.4
Average	27230.22	23033.64	4063.24	4355.73	378.86	155.19	2142.46
SD %	9355.50	14356.75	2655.90	5308.90	205.99	255.55	1521.04
CV %	34.36	62.33	65.36	121.88	54.37	164.67	71.00
CDVI %	19.25	46.15	68.03	119.17	37.75	157.57	37.17
CAGR %	7.69	24.71	0.19	23.18	28.80	-15.18	12.17

Source: *APEDA, https://agriexchange.apeda.gov.in*

Fig: 1. Growth rate in the export of foodgrain and pulses crops from India in terms of quantity and value

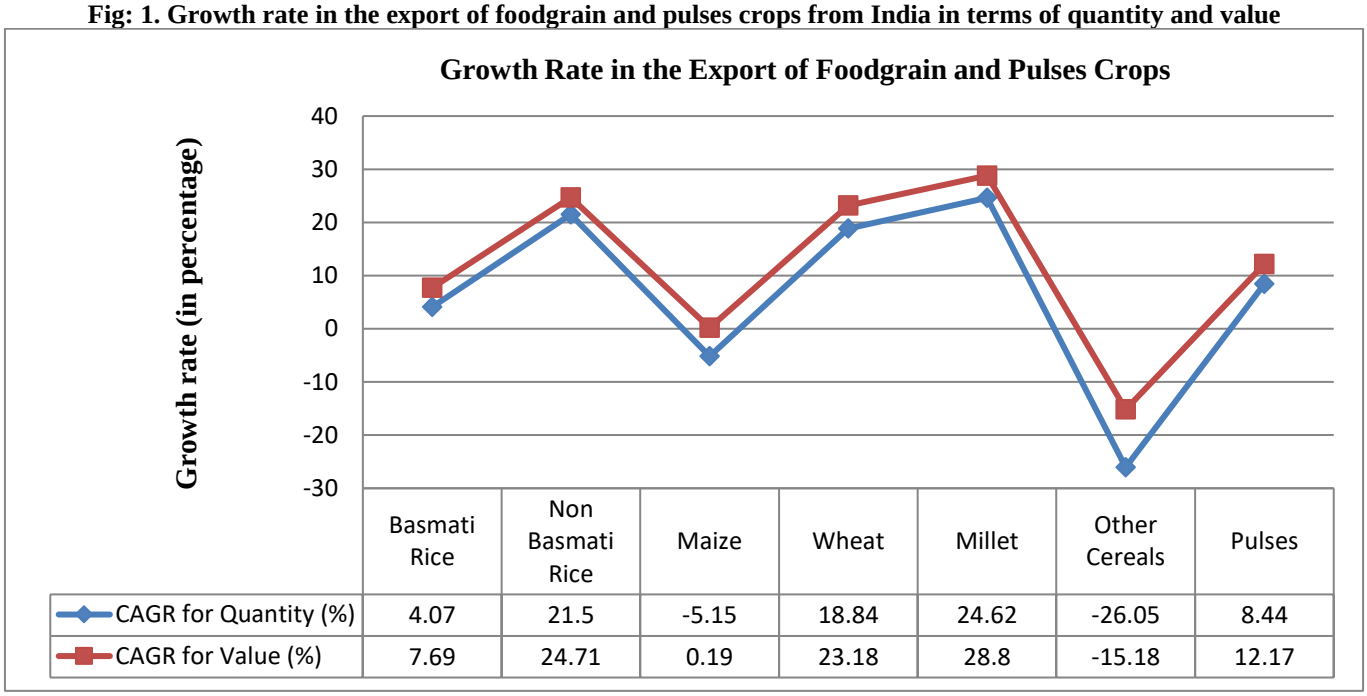
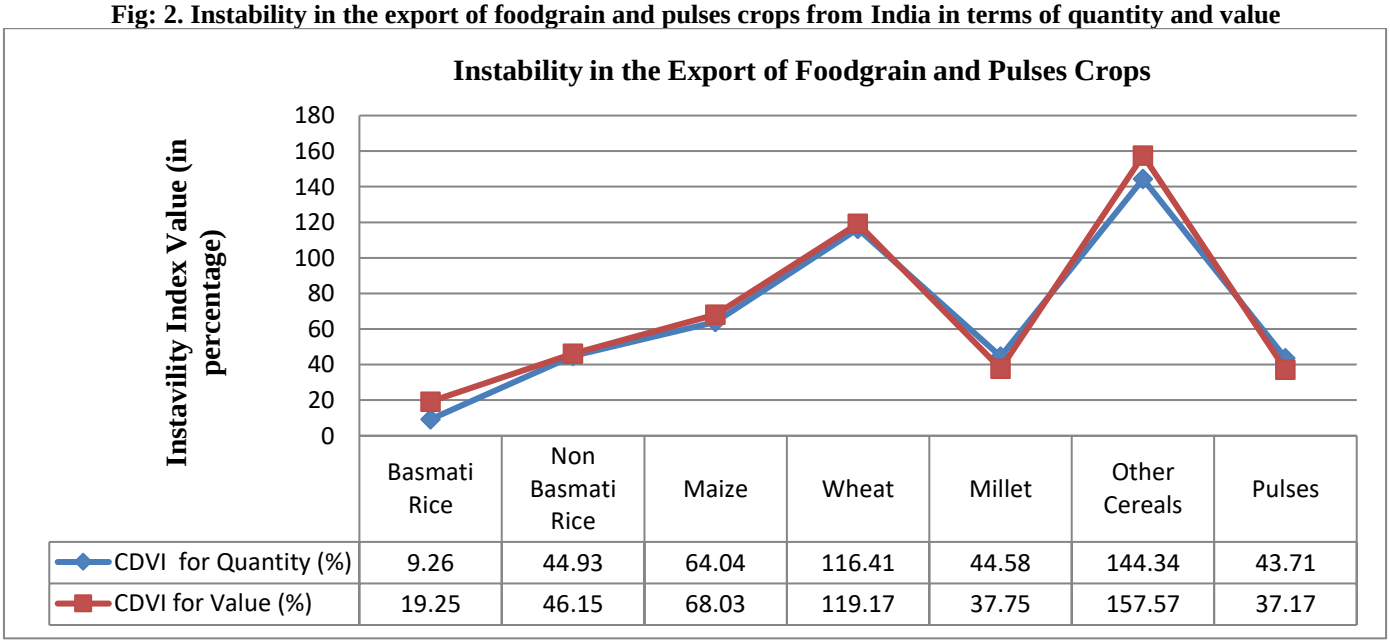


Fig: 2. Instability in the export of foodgrain and pulses crops from India in terms of quantity and value



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3.2 Growth trend and instability in exports of agricultural cash crops from India in terms of quantity and value

Table 3 indicates that the quantity of export of agricultural cash crops such as coffee, sugar and groundnuts has shown positive growth rate with 1.81%, 12.30% and 0.81% respectively. However, tea, cashew and cotton have shown a negative growth rate of -0.51%, -4.47% and -9.97% respectively. The quantity exported of cashew during the year 2010-11 was 92.36 thousand tonnes which decreased to 65.80 thousand tonnes in 2023-24 while quantity exported of tea, coffee, sugar and groundnuts during the year 2010-11 was 238.15, 231.00, 1733.87 and 433.76 thousand tonnes which increased to 260.71, 297.91, 4360.62 and 680.69 thousand tonnes in 2023-24. The quantity exported of cotton during the year 2013-14 was 1947.70 thousand tonnes which decreases to 573.10 thousand tonnes in 2023-24. The value for the coefficient of variation of tea, coffee, sugar, cashew, groundnut and cotton are 8.96%, 12.47%, 70.88%, 23.32, 19.05 and 70.92%, respectively. The value of instability index of tea, coffee, sugar, cashew, groundnut and cotton in terms of quantity is 9.06%, 10.32%, 46.99%, 13.84%, 19.51% and 53.10%, respectively. Cotton have shown the high level of instability index value indicating the highest instability and variability among others while tea have shown the lowest instability value indicating low level of instability and inconsistency of export of processed fresh fruits and vegetables among others.

Table 3: Growth trends and instability in export of agricultural cash crops from India in terms of quantity (in'000'MT)

Year	Tea	Coffee	Sugar	Cashew	Groundnut	Cotton
2010-11	238.15	231.00	1733.87	92.36	433.76	NA
2011-12	271.98	276.52	2749.33	107.81	832.62	NA
2012-13	268.80	254.02	2793.67	104.09	535.64	NA
2013-14	249.91	253.14	2476.88	120.74	509.75	1947.70
2014-15	215.21	220.48	1952.70	134.57	708.38	1142.53
2015-16	246.85	254.05	3824.01	103.13	536.82	1346.50
2016-17	244.46	288.16	2545.06	92.18	725.11	1000.02
2017-18	272.89	317.83	1758.04	90.06	503.16	1097.44
2018-19	270.27	282.87	3986.74	78.17	488.23	1143.11
2019-20	254.77	257.02	5760.07	84.33	664.44	658.98
2020-21	212.66	245.21	7518.19	70.09	638.55	1214.20
2021-22	208.56	333.10	10459.12	75.45	514.18	1258.63
2022-23	241.05	316.09	11754.69	59.58	669.11	318.49
2023-24	260.71	297.91	4360.62	65.80	680.69	573.10
Average	246.88	273.39	4548.07	91.31	602.89	835.76
SD %	22.11	34.08	3223.66	21.30	114.85	592.69
CV %	8.96	12.47	70.88	23.32	19.05	70.92
CDVI %	9.06	10.32	46.99	13.84	19.51	53.10
CAGR %	-0.51	1.81	12.30	-4.47	0.81	-9.97

Source: *APEDA, https://agriexchange.apeda.gov.in*

Growth trend and instability in export of agricultural cash crops in term of value shown in table shown in Table 4, the export growth rates of agricultural cash crops such as tea, coffee, sugar and groundnut are positive with a value of 4.37%, 6.81%, 14.43%, and 5.07%, respectively. However, it has been showing a negative growth rate with a value -2.53% and -4.92% in case of cashew and cotton respectively. Therefore, sugar has earned maximum foreign exchange value from among the category of export of agriculture cash crops. The exported value of cashew and cotton during the year 2010-11 was Rs. 2818.87 and 13162.4 crore which decreased to Rs. 2808.8 and 9249.75 crore in 2023-24, while the exported value of tea, coffee, sugar, and groundnut during the year 2010-11 was Rs. 3354.34, 3009.91, 5472.99 and 2178.41 crore which increased to Rs. 6843.13, 10644.8, 23390.5 and 7135.12 crore in 2023-24. The value of instability index of tea, coffee, sugar, cashew, groundnut and cotton in terms of value is 7.56%, 16.72%, 50.97%, 24.57%, 23.69% and 32.79%, respectively. Sugar has shown the high level of instability index value indicating the highest instability and variability among others. Tea has shown the low level of instability index value indicating the lowest instability among other processed fruits and vegetables.

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Table 4: Growth trends and instability in export of agricultural cash crops from India in terms of value (Rs. in crore)

Year	Tea	Coffee	Sugar	Cashew	Groundnut	Cotton
2010-11	3354.34	3009.91	5472.79	2818.87	2178.41	13162.4
2011-12	4078.46	4534.62	8766.4	4390.16	5246.45	21624.2
2012-13	4718.79	4711.07	8575.98	4067.21	4065.36	20276.5
2013-14	4873.34	4789.28	7176.15	5095.49	3187.66	22337.8
2014-15	4166.14	4960.38	5321.9	5565.77	4675.24	11642.6
2015-16	4718.56	5102.23	9767.92	5024.77	4038.57	12815.9
2016-17	4925.7	5651.33	8668.86	5303.37	5453.18	10948.3
2017-18	5396.39	6245.55	5228.73	5945.35	3384.42	12155.8
2018-19	5828.1	5721.98	9518.26	4579.17	3295.54	14627.6
2019-20	5850.67	5236.76	13969.8	4018.13	5096.39	7542.91
2020-21	5602.81	5339.52	20669.7	3112.22	5381.45	13968.3
2021-22	5593.85	7613.66	34348.5	3377.4	4697.1	21007
2022-23	6582.14	9190.81	46309.4	2868.72	6735.1	6218.35
2023-24	6843.13	10644.8	23390.5	2808.8	7135.12	9249.75
Average	5180.89	5910.85	14798.92	4212.53	4612.14	14112.69
SD %	967.05	1992.84	12330.20	1085.39	1376.74	5273.64
CV %	18.67	33.71	83.32	25.77	29.85	37.37
CDVI %	7.56	16.72	50.97	24.57	23.69	32.79
CAGR %	4.37	6.81	14.43	-2.53	5.07	-4.92

Source: *APEDA, https://agriexchange.apeda.gov.in*

Fig: 3. Growth rate in the export of agricultural cash crops from India in terms of quantity and value

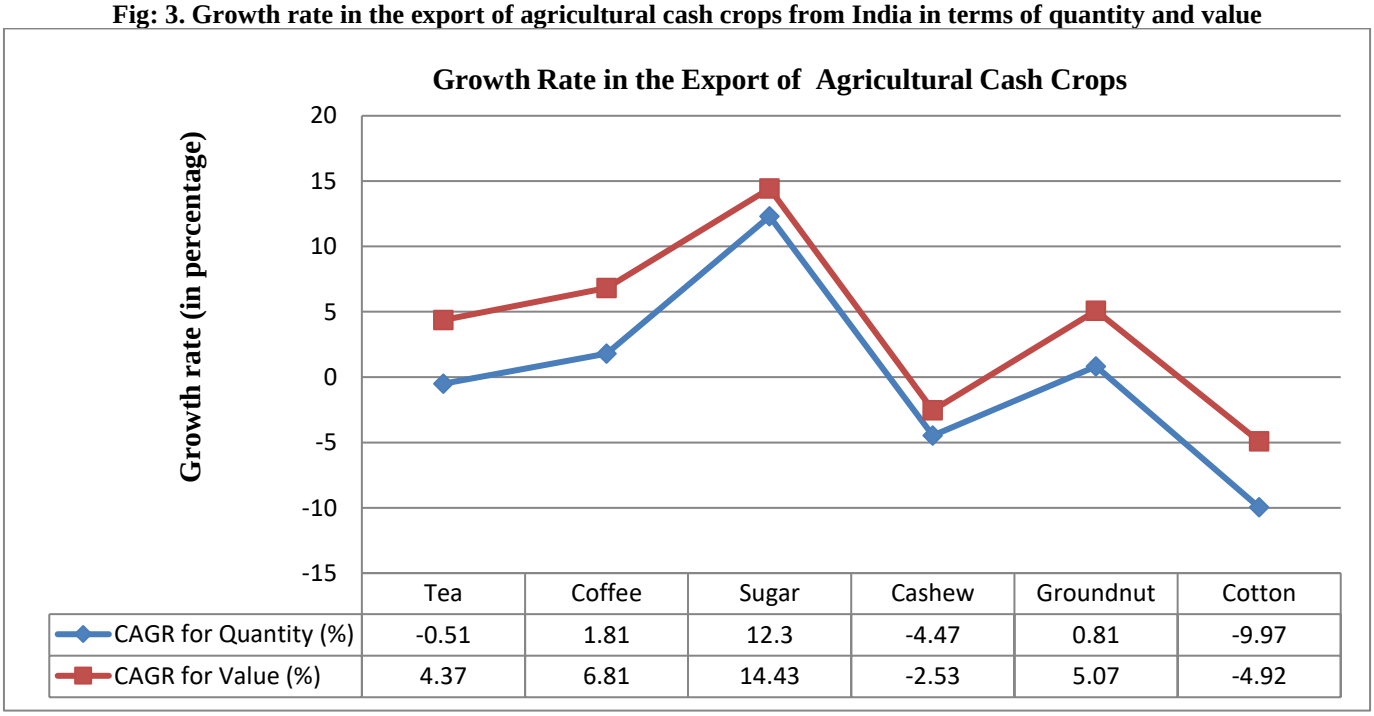

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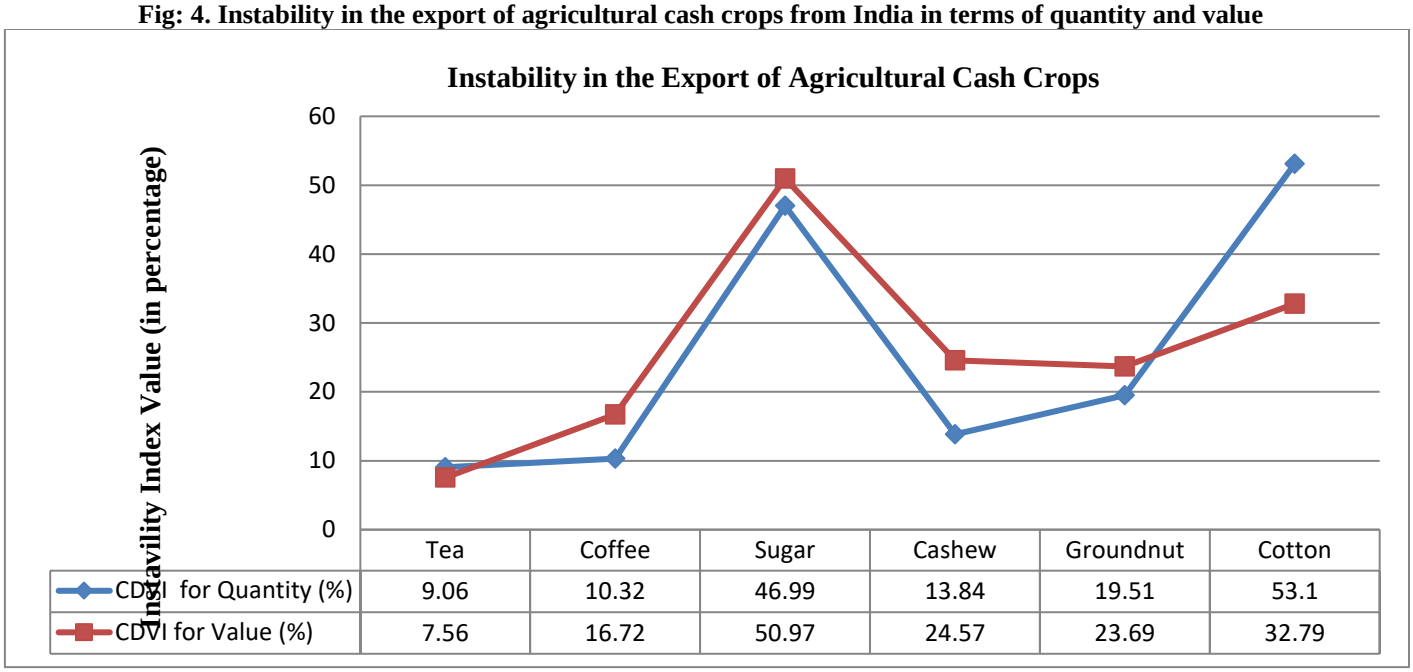
Fig: 4. Instability in the export of agricultural cash crops from India in terms of quantity and value



3.2. Major countries and share percentage of exports of foodgrain and pulses and agricultural cash crops from India, 2023-24

The Major countries where India exported maximum foodgrain and pulses and agricultural cash crops are presented in Table 5 and 6. One of the major trading partners for exports of basmati rice, non basmati rice, maize, wheat, millets, other cereals and pulses are Saudi Arab, Benin, Vietnam, Nepal, United Arab Emirates, Russia and Bangladesh respectively. The maximum share of exports of agriculture cash crops like tea, coffee, sugar, cashew, groundnut and cotton go to the United Arab Emirates, Italy, Sudan, United Arab Emirates, Indonesia and Bangladesh respectively in 2023-24.

Table 5: Major countries and share (%) of exports of foodgrain and pulses crops from India, 2023-24

Countries	Country 1	Country 2	Country 3	Country 4	Country 5
Basmati Rice	Saudi Arab (21.47%)	Iraq (15.19%)	Iran (11.63%)	Yemen Republic (5.86%)	U A E (5.72%)
Non Basmati Rice	Benin (11.21%)	Guinea (8.18%)	Togo (6.10%)	Vietnam Soc Rep (5.80%)	Cote D Ivoire (5.41%)
Maize	Vietnam Soc Rep (44.20%)	Nepal (23.61%)	Bangladesh Pr (16.44%)	Malaysia (2.25%)	Thailand (2.48%)
Wheat	Nepal (99.24%)	UAE (0.36%)	Iraq (0.20%)	Mongolia (0.14%)	Korea Rp (0.03%)
Millet	UAE (0.17%)	Saudi Arab (0.09%)	Nepal (0.09%)	USA (0.06%)	Senegal (0.05%)
Other Cereals	Russia (23.24%)	UAE (16.56%)	Bangladesh Pr (14.51%)	USA (5.61%)	Malaysia (5.35%)
Pulses	Bangladesh Pr (22.84%)	China P Rp (12.99%)	UAE (11.55%)	USA (9.21%)	Sri Lanka Dsr (4.76%)

Source: *APEDA, https://agriexchange.apeda.gov.in*

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Table 6: Major countries and share (%) of exports of agricultural cash crops from India, 2023-24

Countries	Country 1	Country 2	Country 3	Country 4	Country 5
Tea	UAE (15.90%)	Iraq (10.71%)	USA (9.40%)	Russia (9.34%)	UK (5.38%)
Coffee	Italy (16.19%)	Germany (9.86%)	Russia (5.90%)	Belgium (5.73%)	UAE (5.48%)
Sugar	Sudan (18.35%)	Sri Lanka Dsr (8.80%)	Libya (8.24%)	Somalia (7.09%)	Djibouti (6.99%)
Cashew	UAE (28.34%)	Japan (12.93%)	Netherland (9.38%)	Spain (8.95%)	Saudi Arab (8.66%)
Groundnut	Indonesia (31.20%)	Vietnam Soc Rep (19.96%)	Philippines (8.20%)	Malaysia (7.78%)	Thailand (6.12%)
Cotton	Bangladesh Pr (56.76%)	China P Rp (19.95%)	Vietnam Soc Rep (12.29%)	Taiwan (2.69%)	Indonesia (1.95%)

Source: *APEDA, https://agriexchange.apeda.gov.in*

4. CONCLUSIONS

However India is world's largest producer of agricultural crops but the export volumes instead shown fluctuating trend over the years. During the period 2010-11 to 2023-24 the export of some commodities in terms of quantity like maize and other cereals show a negative growth rate and in terms of value other cereals also showed negative growth. During the study period the quantity of export of agricultural cash crops such as coffee, sugar and groundnut has shown positive growth rate while tea, cashew and cotton have shown a negative growth rate. The value of instability index of basmati rice, non-basmati rice, maize, wheat, millets, other cereals and pulses in terms of quantity found to be 9.26%, 44.93%, 64.04%, 116.41%, 44.58%, 144.34 and 43.71%, respectively. Other cereals has shown the highest instability index value indicating the highest instability and variability among others while basmati rice has shown the lowest instability value indicating low level of instability and variability among others. The value of instability index of tea, coffee, sugar, cashew, groundnut and cotton in terms of quantity is 9.06%, 10.32%, 46.99%, 13.84%, 19.51% and 53.10%, respectively. Cotton have shown the high level of instability index value indicating the highest instability and variability among others while tea have shown the lowest instability value indicating low level of instability and inconsistency of export of processed fresh fruits and vegetables among others. India's key markets for cereals crops are Saudi Arab, Benin, Vietnam, Nepal, United Arab Emirates, Russia and Bangladesh, while for cash crops are mainly exported to the United Arab Emirates, Italy, Sudan, Indonesia and Bangladesh. However, fluctuations and instability in the export of agricultural commodities from India are driven by various factors, including unpredictable weather conditions volatile global markets, changing government policies and infrastructure challenges. These fluctuations affect farmers' incomes and create uncertainty in trades' partnerships. To mitigate these challenges, India needs to invest in modern agricultural practices, enhance storage and transportation infrastructure and adopt consistent export policies. Strengthening market linkages and exploring value-added products can also stabilize exports, ensuring better economic resilience for the agricultural sector in global trade.

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PROMOTION PRACTICES OF PHILIPPINE DRUG ENFORCEMENT AGENCY -REGION 10: BASIS FOR ENHANCEMENT MEASURES

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ABSTRACT

Employee promotion, particularly within police organizations, is vital for recognizing dedication, fostering motivation, and ensuring a skilled leadership pipeline. Despite the recognized importance of these practices, there is a noted gap in research on promotion practices across different jurisdictions. This study addresses this gap by assessing the promotion practices of drug enforcement officers in the Philippine Drug Enforcement Agency (PDEA) Region 10, especially in light of persistent issues similar to those identified in the Philippine National Police. The research, which involved 86 officers, utilized an adopted questionnaire and inferential statistical analysis to examine the factors influencing perceptions of promotion practices. The findings revealed that transparency procedures and rules for promotion are moderately implemented, suggesting areas where clarity and accessibility need enhancement. The implementation of competency-based promotion was widely regarded as highly effective, indicating successful integration of these strategies, while seniority-based promotion was moderately accomplished, implying a balanced influence of seniority, competency, and performance in career progression. Furthermore, age, years of service, and rank are significant predictors, suggesting that perceptions of promotion practices are shaped by career stage, tenure, and hierarchical positioning within PDEA 10. Policy recommendations were recommended to enhance the transparency, guidelines, processes and effectiveness of promotion practices within the agency.

KEYWORDS: *Competency-based promotion, Employee Promotion, Philippine Drug Enforcement Agency, Seniority-based promotion*

INTRODUCTION

Employee promotion involves systematically advancing employees to higher positions or roles with greater responsibilities, authority, and often increased compensation (Li & Wang, 2020). Thus, it is essential as it rewards employee dedication, performance, and potential, fostering a sense of recognition and motivation. As Akhtar and Khan (2021) noted, effective promotion practices contribute to employee morale, job satisfaction, and overall engagement while aiding in talent retention and succession planning, thus ensuring a skilled and motivated workforce to meet organizational goals.

Specific to policemen, Drew and Saunders (2020) argued that a well-structured employee promotional system is critical for police organizations as it fosters motivation, recognizes leadership potential, ensures fairness in advancement, and supports succession planning. By acknowledging officers' dedication and performance, promoting merit-based advancement, and maintaining transparent processes, the system enhances morale, identifies future leaders, reduces bias, and guarantees a pipeline of skilled officers, ultimately contributing to a more effective and trustworthy police force.

However, while there has been research on various aspects of police organizations, including employee promotions, the extent and depth of this research vary (Boag-Munroe et al., 2017). Some studies have explored fairness, transparency, bias, and effectiveness in police promotion processes. However, Jacobs, Cushenbery, and Grabare (2019) argued that there is a need to explore that gap in specific organizational practices and variations across different jurisdictions. The need to conduct further investigation regarding the same topic could not be overstated. As Varona (2010) noted, the Philippine National Police still has many of the problems of the old Philippine Constabulary, especially in ranking and promotions.

Literature Review

Promotion practices in the Philippines are a complex interplay of cultural, organizational, and economic factors. Filipino scholars have extensively examined these practices, shedding light on their nuances. According to Alampay (2010), the "hiya" culture, rooted in shame and pride, heavily influences promotion dynamics. This cultural aspect often leads employees to downplay their achievements to maintain humility, making self-promotion less common.

Santos and Lucas (2017) highlight the significance of personal relationships, known as "pakikisama," in Filipino workplaces. Promotion decisions can be influenced by one's network and ability to navigate organizational politics. Promotion decisions in Filipino workplaces often extend beyond the realm of mere individual performance and qualifications. Santos and Lucas underscore how the quality of an employee's interpersonal relationships, their ability to collaborate, and their skill in navigating organizational politics play a pivotal role in determining their suitability for promotion. An employee's network, which consists of both personal and professional connections, can significantly impact their visibility and reputation within the organization.

Additionally, Nepomuceno (2006) emphasizes the impact of economic factors, as family obligations often pressure employees to seek promotions for financial stability. This aligns with the "breadwinner" role deeply ingrained in Filipino culture. Nepomuceno's insight reveals that the decision to pursue higher positions is often influenced by more than just personal ambition or career satisfaction. The economic pressures stemming from familial obligations drive employees to seek promotions as a means of ensuring financial stability and fulfilling their role as providers for their families.

Similarly, Garcia (2015) points out that the concept of "utang na loob," or debt of gratitude, plays a crucial role in promotion decisions. Employees who have received favors or support from superiors may feel obligated to reciprocate, potentially impacting their advancement prospects. Employees who have been recipients of assistance, favors, or mentorship from their superiors might feel a strong sense of indebtedness. This can create a moral and emotional obligation to reciprocate the goodwill they've received, which could influence their behavior, decisions, and even career aspirations. The potential impact of "utang na loob" on promotion decisions is rooted in the Filipino value of preserving harmonious interpersonal relationships, where reciprocity and gratitude are fundamental.

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Furthermore, Pertierra (2013) highlights the influence of the "kapwa" concept, emphasizing the interconnectedness of individuals. This relational perspective can lead to promotions being viewed not only as personal achievements but also as communal successes, reflecting the collective identity of Filipinos. In the context of promotions, the "kapwa" perspective provides a distinctive framework for understanding career advancement. Unlike individualistic cultures where promotions are often seen as personal accomplishments, the relational lens of "kapwa" encourages Filipinos to view their career successes as interconnected with the well-being of their colleagues, families, and communities. This communal perspective aligns with the collectivist nature of Filipino culture, where accomplishments are celebrated collectively and often come with communal expectations.

Looking into the organizational aspect, Lanzona (2011) notes that hierarchical structures are deeply ingrained in Filipino workplaces, which can lead to limited upward mobility. Promotion opportunities might be restricted by the scarcity of higher-level positions and the preference for external recruitment, hindering the advancement of existing employees. One of the key insights offered by Lanzona is the potential limitation of upward mobility within organizations due to the scarcity of higher-level positions. Hierarchical structures often involve a pyramid-like arrangement, where only a few individuals occupy top-tier roles while the majorities hold positions lower down the hierarchy. This scarcity of top-level positions can create a bottleneck effect, where numerous qualified employees aspire for a limited number of promotional slots

However, Reyes (2008) argues that this trend is slowly changing, with more organizations recognizing the value of internal talent development and promoting based on merit. This shift aligns with global best practices and demonstrates the evolution of promotion practices in the Philippines. The recognition of the value of internal talent development signifies a departure from the traditional preference for external recruitment to fill higher-level positions. As organizations become more aware of the advantages of cultivating their existing workforce, they are investing in training, skill enhancement, and career development programs. This approach not only enhances the skills and capabilities of employees but also positions them for higher responsibilities within the company

Moreover, Aguilar (2016) delves into the concept of "smooth interpersonal relations," emphasizing the avoidance of conflict and maintaining harmony. This aspect impacts promotions, as employees might prioritize maintaining good relationships over assertively pursuing advancement opportunities. The cultural value of harmonious relationships can create a dynamic where employees prioritize maintaining positive interactions over assertively pursuing advancement opportunities. The desire to avoid conflict and uphold a congenial atmosphere might lead employees to adopt a more reserved approach when expressing their career aspirations or showcasing their achievements. This can result in a subtle form of self-restraint, as individuals may be hesitant to stand out or engage in behaviors that could potentially disrupt the equilibrium of their relationships.

Additionally, Castillo and Canlas (2018) emphasize the role of "personalismo," which emphasizes personal connections and rapport. This practice often results in promotions based on familiarity and trust rather than solely on merit. "Personalismo" can lead to decisions that are influenced by familiarity and interpersonal relationships rather than being solely based on qualifications and achievements. Employees who have established strong personal connections with decision-makers may be more likely to be considered for advancement, even if their merit might not be as apparent. This practice is rooted in the cultural value of maintaining close ties with colleagues and superiors, and it reflects the broader Filipino inclination toward building and nurturing relationships.

Theoretical/Conceptual Framework/Paradigm of the Study

This study is anchored on the Expectancy Theory developed by Vroom (1964). The theory suggests that individuals are motivated to act in a certain way based on the belief that their actions will lead to desired outcomes. In the context of drug enforcement officers, this theory could help analyze how their perception of the connection between their efforts (performance) and the likelihood of receiving a promotion (outcome) influences their motivation to excel in their roles.

According to Zhang and Jia (2019), transparency of procedures and guidelines in employee promotion is essential in Expectancy Theory because it directly impacts an individual's belief in the effort-performance-reward relationship. Expectancy Theory posits that individuals are motivated to put in effort when they believe that their efforts will lead to improved performance.

On the other hand, Chen and Zhang (2019) explained that the application of seniority-based promotion is somewhat relevant to expectancy theory but challenges the theory's core principles. While it still offers rewards based on tenure, it may weaken the expectation that effort leads to performance due to a lack of direct correlation between skills and promotions.

Thus, this study draws its foundation from Vroom's Expectancy Theory (1964), which asserts that individuals' motivation is driven by their belief that their actions will yield desired outcomes. As emphasized by Zhang and Jia (2019), the transparency of promotion guidelines strengthens the perceived connection between effort, performance, and rewards, aligning with the theory's principles.

Based on the discussion on the theoretical underpinning of the study, this investigation looked into the promotion practices of drug enforcement officers in the Philippine Drug Enforcement Agency (PDEA). The study's examination of promotion practices within the Philippine Drug Enforcement Agency (PDEA) 10 holds significant potential for rectifying disparities, enhancing fairness, and promoting equal opportunities among drug enforcement officers. However, to comprehensively gauge its impact, it is important to consider existing gaps within the global context. Specifically, the study scrutinized whether the PDEA's promotion protocols align with internationally recognized standards for law enforcement agencies. Esteemed bodies like INTERPOL and UNODC provide directives to ensure transparency, human rights adherence, and professionalism in law enforcement operations. Evaluating the degree of alignment is pivotal, as any deviations might erode the agency's credibility and impede international cooperation efforts. To operationalize this, the study used the schema presented on the next page as a paradigm for inquiry.

The research study adopted an input-process-output (IPO) research conceptual framework to comprehensively investigate and address the promotion practices of drug enforcement officers within the PDEA-10. The study's input phase encompasses the collection of profiles of the respondents, the drug enforcement officers, detailing their demographic attributes, including age, sex, marital status, years of service, and rank. This contextual information lays the foundation for understanding the diverse group engaged in assessing the promotion practices. In addition, the study will also consider the respondents' evaluation of key dimensions of promotion practices as key inputs. These dimensions include the transparency of procedures and guidelines, the application of competency-based promotion, the application of seniority-based promotion, and the overall fairness of the process.

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Moving into the process phase, a meticulous analysis of the descriptive data provided by the respondents. This analysis aims to discern patterns, trends, and potential significant differences in the assessments across the four dimensions. Employing appropriate statistical methods, such as t-tests or ANOVA, the research explores potential variations in respondents' assessments based on different demographic categories.

The culmination of the study's efforts lies in the policy recommendations generated as part of the output. Informed by the data analysis and insights drawn from the respondents' assessments, these recommendations propose actionable strategies to enhance the promotion practices within PDEA-10.

Significance of the Study

This study will be beneficial to the following:

PDEA Administrators. Through a detailed analysis of factors such as transparency, competency-based and seniority-based promotions, and overall fairness, administrators gain a nuanced understanding of the current state of promotion mechanisms within the agency. This insight enables them to identify areas that require enhancement and address potential shortcomings. In addition, the study's policy recommendations serve as a tailored roadmap for administrators to improve promotion practices within PDEA.

PDEA Officers. The study's insights into the transparency of promotion procedures and guidelines will provide PDEA officers with a clearer understanding of the criteria and processes involved in promotions. This transparency not only demystifies the promotion process but also empowers officers to make informed decisions about their career paths, fostering a sense of ownership and agency.

Criminology Faculty. The study provides a real-world case study that faculty can incorporate into their curriculum. The examination of promotion practices in a law enforcement agency offers a practical context for discussing topics related to organizational dynamics, ethics, fairness, and professionalism. Faculty can use these findings to facilitate critical debates and exercises that encourage students to think analytically about the complexities of promotion mechanisms within law enforcement agencies.

Criminology Students. By understanding how promotions are determined and what factors are considered, criminology students can gain a deeper appreciation for the complexity of career advancement in the field of law enforcement. In addition, the study's analysis of transparency, competency-based, and seniority-based promotions provides criminology students with a comprehensive view of the challenges and nuances associated with promotion practices.

Future Researchers. The study's insights offer a valuable foundation for comparative research. Future researchers can use the detailed examination of promotion practices, including factors like transparency, competency-based, and seniority-based promotions, as a benchmark to compare and contrast with other law enforcement agencies or similar organizations.

Objectives of the Study

This study is conducted to assess the promotion practices of drug enforcement officers in the PDEA-10. The research will allow a rare opportunity to objectively assess its promotion practices to identify and rectify any inconsistencies or discriminatory practices, promoting fairness and equal opportunities for all officers. Additionally, assessment enhances transparency, accountability, and trust within the drug enforcement force and the community, reinforcing the credibility of the organization's leadership decisions. The study results will be valuable in designing policies to refine the organization's talent management strategies, recognize leadership potential, and maintain a skilled and motivated workforce capable of effectively serving the community's needs.

METHODOLOGY

Research Design

This study used a cross-sectional research design. A cross-sectional research design is a method used in various fields such as social sciences, psychology, and public health to gather data from a group of participants at a specific moment. Gouveia et al. (2022) explained that, unlike studies that follow participants over time, cross-sectional studies provide a snapshot view of a population's characteristics, attitudes, or behaviors all at once. Researchers select a representative sample from the population and collect data through surveys, questionnaires, or interviews. This data is then analyzed to identify correlations, differences, and patterns between different variables based on identified groups, such as the profiles of the respondents.

A cross-sectional research design is appropriate for the study assessing the promotion practices of drug enforcement officers in the Philippine Drug Enforcement Agency (PDEA) and identifying potential differences in assessment based on respondents' profiles. This design allows for the collection of data from various officers at a single point in time, providing a snapshot of their perceptions and allowing researchers to explore potential associations between promotion practices and demographic factors. This is particularly suitable when investigating factors such as age, sex, marital status, years of service, and rank, as these are static characteristics that can be captured in a single data collection instance.

Implementing the study using a cross-sectional design involves several steps. First, the researchers would select a representative sample of drug enforcement officers from PDEA-10, ensuring that different age groups, sexes, marital statuses, years of service, and ranks are adequately represented within the sample. The researchers would then design a survey questionnaire to assess the personnel's perceptions of promotion practices, incorporating questions that pertain to various aspects of promotion, such as criteria, transparency, and fairness.

To explore potential differences in assessment based on demographic factors, the researchers would group the respondents according to their profiles (e.g., age, sex, marital status, years of service, rank). Statistical analyses, such as analysis of variance (ANOVA) or chi-square tests, would be employed to determine if there are significant differences in how the different groups perceive the promotion practices. These analyses would provide insights into whether certain demographic factors are associated with varying perceptions of promotion practices within PDEA-10.

In a study by Perez et al. (2018), a cross-sectional design was similarly employed to examine the job satisfaction of law enforcement officers in the Philippines. The researchers collected data from a diverse group of officers at a specific point in time, allowing them to assess job satisfaction levels and identify potential factors influencing satisfaction.

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Another example by Gomez and Tuguinay (2020) utilized a cross-sectional design to investigate the relationship between job stress and performance among police officers. The researchers collected data from officers with varying ranks, demographics, and years of service, enabling them to analyze how these factors might impact job stress and performance.

Furthermore, a study by Cruz et al. (2017) used a cross-sectional design to explore the job-related stressors and coping strategies of police officers in the Philippines. The researchers gathered data from officers of different ranks, highlighting the utility of a cross-sectional approach in examining varying experiences and perceptions within a law enforcement organization. Thus, this design allows for the assessment of officers' perceptions at a single point in time and facilitates the exploration of potential differences based on demographic factors. By following established procedures and statistical analyses, researchers can gain insights into how these factors might influence officers' assessments of promotion practices within the agency.

Research Method

For a study aimed at assessing the promotion practices of drug enforcement officers in the PDEA-10 and identifying potential differences in their assessments based on demographic profiles, a quantitative research method with a cross-sectional design is the most appropriate approach. This method involves collecting numerical data to analyze relationships, differences, and patterns among a diverse group of respondents at a single point in time. The researcher created a structured survey questionnaire to evaluate officers' perceptions of promotion practices, incorporating aspects like criteria, transparency, fairness, and satisfaction. Demographic factors such as age, sex, marital status, years of service, and rank would serve as the basis for categorizing respondents into different groups. Statistical techniques like analysis of variance (ANOVA) and chi-square tests would be applied to determine if significant differences exist in the officers' assessments based on these demographic profiles.

This approach is well supported in the literature, as exemplified by studies by Smith et al. (2020), Johnson and Brown (2018), and Chan and Tran (2019), where quantitative methods were effectively used to explore various aspects of law enforcement and officer perceptions by considering demographic factors within their analyses. By employing this method, the study can offer insights into how different demographic characteristics may influence the way drug enforcement officers perceive promotion practices within PDEA-10.

Population of the Study

The primary population of interest for this research comprises officers employed within PDEA-10. In this context, PDEA-10 officers are considered the target population as they possess direct experience with the agency's promotion practices and are therefore well-suited to provide insights into its assessment.

To ensure a representative and coherent sample, specific inclusion and exclusion criteria have been established for participant selection. Inclusion criteria involve active-duty PDEA-10 officers who have been in service for a minimum of two years and have direct exposure to the agency's promotion procedures. Exclusion criteria encompass individuals who are not currently employed by PDEA-10, have less than two years of service, or lack first-hand familiarity with the agency's promotion practices.

The selected participants were categorized into different groups based on their demographic profiles, including age, gender, rank, and years of service. These demographic characteristics are pertinent as they may potentially impact an officer's perception of the promotion practices within the agency. Age and gender, for instance, can influence perspectives on career advancement, while rank and years of service might shape one's experience and awareness of promotion procedures.

In terms of sampling technique, a purposive sampling method was employed to ensure a balanced representation of various demographic groups. This method was also chosen due to the availability concerns of the identified sample frame. This approach allows for proportional representation of different categories within the population, ensuring that the final sample includes participants from different age groups, genders, ranks, and years of service. By using this technique, the researchers maximized the diversity of perspectives and experiences present within the population. Given this, a total of 86 samples were used in the study.

As suggested by Smith (2017), the use of purposive sampling aids in obtaining a more accurate representation of various groups within a population. Additionally, Johnson et al. (2019) emphasized the importance of considering demographic factors in studies related to organizational assessments and practices. Lastly, in the context of law enforcement agencies, Vargas (2020) highlighted the significance of representative sampling to ensure the credibility and generalizability of research findings.

Data Gathering Tools

The adopted instrument for this study consists of a questionnaire meticulously crafted to evaluate various dimensions of promotion practices within the confines of the PDEA-10. This questionnaire delves into multiple variables that encompass transparency, the implementation of diverse promotion approaches, and the overarching fairness of the organization's promotion system. Respondents are tasked with providing their viewpoints on a range of statements, utilizing a 5-point Likert scale that spans from "strongly disagree" to "strongly agree."

Regarding the transparency of procedures and guidelines, participants are asked to assess the clarity and accessibility of promotion guidelines, the availability of mechanisms for obtaining feedback, the equity and impartiality of promotion decisions, the presence of preventive measures against corruption, and the grounding of promotion criteria in merit and performance. This variable draws its content from a study titled "Assessing the transparency of promotion practices in the PDEA-10," as authored by the Center for Research and Advocacy in Development (2010).

The application of competency-based promotion is another dimension probed by the questionnaire. Respondents are tasked with evaluating whether the organization maintains explicit competencies for distinct job levels, if a competency-based framework informs candidate assessments, whether promotion determinations hinge on exhibited competencies, if the organization invests in training for competency enhancement, and the perceived fairness and impartiality of the promotion process. This variable finds its origins in the work of Smith, Jones, and Brown (2023).

On the other hand, the application of seniority-based promotion is the third variable explored by the instrument. Respondents are prompted to provide their perspectives on the primacy of seniority in promotion determinations, the extent to which length of service factors into

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promotions, the regular reliance on service-based decisions, the consistent prioritization of veteran employees, and the significance of tenure in promotion considerations. This variable is drawn from a research article authored by Thomas, Brown, and Smith (2023).

Data Gathering Procedures

The study's frame encompasses drug enforcement officers within PDEA-10. To initiate the process, a stratified sampling design will be employed, categorizing participants based on key demographics like age, gender, years of service, and rank. This strategy ensures a representative sample that accounts for the diversity within the workforce. To gather data, a structured questionnaire was developed, addressing variables such as transparency of procedures and guidelines, application of competency-based promotion, and application of seniority-based promotion. The Likert-scale questions gauged participants' assessments of these aspects. The questionnaire will also incorporate demographic-related questions to facilitate the grouping of participants according to their profiles.

Before the main data collection phase, a pre-testing stage was conducted involving a subset of PDEA administrative officers not part of the main study. Their feedback helped refine the questionnaire, ensuring clarity and validity. Subsequently, the finalized questionnaires will be distributed to the selected participants within PDEA-10. Adequate time was provided for participants to complete the questionnaire, with follow-up reminders to enhance response rates.

Once data collection is complete, the responses undergo validation and accurate entry into a computerized database. Statistical analysis, encompassing both descriptive and inferential methods, was applied to interpret the data. Descriptive statistics summarized participants' assessments, while inferential statistics like t-tests or ANOVA helped ascertain potential differences based on demographic profiles.

The findings were meticulously interpreted to draw meaningful conclusions regarding the promotion practices and demographic variations among drug enforcement officers. The outcomes of the analysis were encapsulated in a comprehensive research report, detailing the study's objectives, methodology, results, and recommendations for potential policy development. As for the timing of data collection, it was scheduled considering participants' availability and operational demands, aiming for a period that minimizes disruptions to their routine tasks.

Treatment of Data

After the data was tallied and cleansed in MS Excel, the following statistical tools were used to facilitate the interpretation of the data that would be gathered: for Problem 1, which aims to profile the respondents, descriptive statistics such as frequency and percentages were used.

On the other hand, a simple mean and standard deviation were employed to describe the participants' assessment of promotion practices in PDEA-10 in terms of transparency of procedures and guidelines, application of competency-based promotion, and application of seniority-based promotion.

For Problem 3, inferential statistics like t-tests or ANOVA helped ascertain potential differences in the assessments based on demographic profiles. Finally, research question number 4 was dealt with qualitatively based on the conclusions and findings drawn from the study.

Ethical Considerations

Informed Consent Form

An informed consent form was employed in this study to ensure ethical principles and participants' autonomy were upheld. The form clearly outlined the study's objectives, procedures, potential risks, benefits, confidentiality measures, and voluntary nature. Participants were informed that their involvement was entirely voluntary and that they could withdraw at any point without repercussions. The informed consent form was distributed to participants alongside the questionnaire. Prior to answering the questionnaire, participants were requested to read, understand, and sign the form, indicating their agreement to participate.

RESULTS AND DISCUSSION

This section provides a comprehensive overview of the data collected and including statistical analyses applied in each of the research questions. Through an in-depth examination of the results, the study aims to uncover patterns, trends, and key findings related to the research questions and objectives. Additionally, this section offers critical reflections and interpretations of the data, contextualizing the findings within existing literature. The research questions are restated to improve the presentation of the results.

Respondents' assess on the promotion practice of drug enforcement officers in the PDEA-10

a) Transparency of Procedures and Guidelines

Tables 1 provide the summary of results of the mentioned area of assessment.

Table1.*Respondents Assessment of the Promotion Practice of Drug Enforcement Officers PDEA-10 in terms of Transparency of Procedures and Guidelines*

Indicator	*SD*	*Mean*	*Qualitative Interpretation*
The Procedure and guidelines for promotion are clear and accessible to all drug enforcement officers	*1.24*	*4.21*	*Very Highly Implemented*
There are opportunities for drug enforcement officers to provide feedback on the promotion process	*1.50*	*2.84*	*Moderately Implemented*
The Decision made about promotions are made in a fair and impartial manner	*1.4*	*2.95*	*Moderately Implemented*
There are mechanisms in place to prevent corruption in the promotion process	*1.14*	*3.37*	*Moderately Implemented*
The promotion criteria are based on merit and performance	*1.38*	*3.32*	*Moderately Implemented*
Overall	***1.33***	***3.34***	***Moderately Implemented***

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Scoring Interpretation
1.00 – 1.80 – Very Poorly Implemented; 1.81 – 2.60 –Poorly Implemented; 2.61 – 3.40 – Moderately Implemented
3.41 – 4.20 – Highly Implemented; 4.21 – 5.00 – Very Highly Implemented

Overall, the assessment of respondents suggests that while certain aspects of the promotion process within PDEA-10 are perceived positively, there are opportunities for improvement, particularly in soliciting feedback, enhancing perceptions of fairness and impartiality, and further strengthening mechanisms to prevent corruption. By addressing these areas, the organization can potentially enhance transparency, accountability, and fairness in its promotion practices, ultimately contributing to the morale, effectiveness, and integrity of its workforce.

The results are consistent with the findings of Alotaibi et. al (2022) who examined the importance of transparency and fairness in organizational practices, including promotion processes, within law enforcement agencies. Their study emphasizes the role of clear procedures, feedback mechanisms, and merit-based criteria in promoting organizational justice and employee satisfaction. Aligning with the assessment of respondents in Table 1, the authors argue that transparent promotion practices contribute to perceptions of fairness and trust among personnel, ultimately fostering a positive organizational climate. Furthermore, their research highlights the significance of incorporating feedback from employees to ensure the continuous improvement of promotion processes and the alignment of criteria with organizational goals and values.

Application of Competency-Based Promotion

Table 2 provides the summary of results of the mentioned area of assessment.

Table 2. ***Respondents' Assessment of the Promotion Practice of Drug Enforcement Officers PDEA-10 in terms of Application of Competency-Based Promotion***

Indicator	*SD*	*Mean*	*Qualitative Interpretation*
The organization has a clear set of competencies that are required for each job level.	*1.18*	*3.68*	*Highly Implemented*
The organization uses a competency-based approach to assess candidates for promotion	*1.13*	*3.68*	*Highly Implemented*
The organization's promotion decisions are based on the candidate's demonstrated competencies.	*1.35*	*3.37*	*Moderately Implemented*
The organization provides training and development opportunities to help employees develop the competencies they need for promotion.	*1.23*	*3.42*	*Highly Implemented*
The organization's promotion process is fair and equitable	*1.43*	*3.6*	
Overall	***1.26***	***3.46***	***Highly Implemented***

Scoring Interpretation
1.00 – 1.80 – Very Poorly Implemented; 1.81 – 2.60 –Poorly Implemented; 2.61 – 3.40 – Moderately Implemented
3.41 – 4.20 – Highly Implemented; 4.21 – 5.00 – Very Highly Implemented

Overall, the assessment of respondents suggests that while competency-based promotion practices are highly implemented within PDEA-10, there are opportunities for improvement, particularly in enhancing perceptions of fairness and equity in the promotion process. By addressing these areas, the organization can potentially further strengthen its competency-based promotion practices, ultimately fostering a more skilled, motivated, and effective workforce.

According to the evaluation of participants in Table 2, the authors contend that competency-based methods help ensure that promotion decisions are in line with organizational objectives and that talent is identified based on merit and demonstrated competencies. Moreover, their research emphasizes the need of offering training and development opportunities to assist employees in acquiring the necessary skills for professional growth. The findings shown in Table 2 are substantiated by the insights provided, highlighting the significance of competency-based promotion strategies in enhancing organizational effectiveness and employee satisfaction within drug enforcement organizations such as PDEA-10.

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c) Application of Seniority-Based Promotion

Table 3 provides the summary of results of the mentioned area of assessment.

Table 3.Respondents' Assessment of the Promotion Practice of Drug Enforcement Officers PDEA-10 in terms of Application of Seniority-Based Promotion

Indicator	*SD*	*Mean*	*Qualitative Interpretation*
Seniority is the primary factor considered for promotions within the organization.	*1.49*	*3.11*	*Moderately Implemented*
Length of service significantly influences promotion decisions in the organization.	*1.39*	*3.42*	*Highly Implemented*
Promotion decisions are often based on the number of years an employee has been with the organization.	*1.35*	*3.37*	*Moderately Implemented*
Senior employees are consistently given priority for advancement in the organization.	*1.23*	*3.37*	*Moderately Implemented*
The organization values and rewards long-standing tenure when considering promotions.	*1.31*	*3.58*	*Moderately Implemented*
Overall	***1.35***	***3.37***	***Moderately Implemented***

Scoring Interpretation
1.00 – 1.80 – Very Poorly Implemented; 1.81 – 2.60 –Poorly Implemented; 2.61 – 3.40 – Moderately Implemented
3.41 – 4.20 – Highly Implemented; 4.21 – 5.00 – Very Highly Implemented

Overall, the assessment of respondents suggests that while seniority-based promotion practices are moderately implemented within PDEA-10, the organization places significant value on length of service and rewards long-standing tenure when considering promotions. By continuing to balance seniority with other criteria and addressing areas for improvement, PDEA-10 can potentially enhance the fairness and effectiveness of its promotion practices, ultimately fostering a more motivated and engaged workforce.

The findings shown in Table 3 are substantiated by the insights provided in study of Carney et al (2018), highlighting the importance of seniority-based promotion procedures and their influence on organizational culture and employee attitudes within drug enforcement organizations such as PDEA-10.

Table 4.
Overall Assessment of the Promotion Practice of Drug Enforcement Officers PDEA-10

Indicators	**SD**	**Mean**	**Qualitative Interpretation**
Transparency of Procedures and Guidelines	1.33	3.34	Moderately Implemented
Application of Competency-Based Promotion	1.26	3.46	Highly Implemented
Application of Seniority-Based Promotion	1.35	3.37	Moderately Implemented

s*coring Interpretation*
1.00 – 1.80 – Very Poorly Implemented; 1.81 – 2.60 –Poorly Implemented; 2.61 – 3.40 – Moderately Implemented
3.41 – 4.20 – Highly Implemented; 4.21 – 5.00 – Very Highly Implemented

Firstly, the implementation of transparency procedures and rules for promotion is assessed to be moderately implemented, as shown by a mean score of 3.34 and a standard deviation of 1.33. This implies that although attempts have been made to build transparent protocols and principles, there might exist certain domains where clarity and accessibility should be enhanced in order to foster comprehension and confidence among staff members.

Additionally, the implementation of competency-based promotion is widely regarded as highly effective, as evidenced by a mean score of 3.46 and a standard deviation of 1.26. PDEA-10 has successfully integrated competency-based strategies into its promotion procedures, potentially fostering equity, impartiality, and congruence with organizational objectives.

Moreover, the implementation of seniority-based promotion is assessed to be moderately accomplished, as indicated by a mean score of 3.37 and a standard deviation of 1.35. This implies that although seniority may have a certain degree of influence on promotion decisions, additional characteristics such as competency and performance also exert substantial influence in shaping prospects for career progression within the business.

In general, the evaluation of participants indicates that PDEA-10 has achieved progress in the implementation of competency-based promotion strategies. However, there are potential areas for enhancement in terms of increasing transparency and decreasing dependence on seniority-based criteria. By strategically focusing on these specific areas, PDEA-10 has the opportunity to enhance its promotion methods, thereby cultivating a workforce that is characterized by fairness, meritocracy, and effectiveness.

The significance of transparency in promotion procedures within law enforcement agencies has been examined by Alzaabi and Khaimah (2023), whose research provides support for the aforementioned findings. Their research highlights the significance of well-defined protocols and directives in cultivating trust and assurance among staff, ultimately enhancing organizational unity and efficiency. Consistent with the evaluation provided by participants in Table 9, the research posits that the use of transparent promotion strategies fosters equity and responsibility, hence reducing the sense of preferential treatment or prejudice. Moreover, the study emphasizes the importance of integrating feedback mechanisms in order to gather input from employees and improve the transparency and responsiveness of promotion procedures.

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Furthermore, a study conducted by Daniali et al (2022) examined the adoption of competency-based promotion strategies in law enforcement agencies. The significance of competency frameworks and objective assessment standards in fostering equity and efficacy in promotion determinations is emphasized by their research. In accordance with the evaluation of participants in Table 9, the authors suggest that competency-based methodologies enable the recognition of competent individuals through their merit and shown abilities, hence augmenting organizational effectiveness and fostering employee satisfaction. Moreover, their study underscores the significance of training and development opportunities in facilitating employees' acquisition of the necessary skills for professional progression, underscoring the value of allocating resources towards personnel development to bolster competency-based promotion strategies.

According to years of service

Table 5 provides the summary of results of the mentioned group of assessment.

Table 5.
***Tukey's Post Hoc Comparisons* - YEARS OF SERVICE**

Comparison							
YEARS OF SERVICE		YEARS OF SERVICE	Mean Difference	SE	df	t	p_{tukey}
5-10 years	-	above 10 years	0.726	0.205	149	3.54	0.002
	-	less than 5 years	0.419	0.198	149	2.11	0.091
above 10 years	-	less than 5 years	-0.307	0.219	149	-1.40	0.341

Note. Comparisons are based on estimated marginal means

Similarly, a significant mean difference is observed when comparing respondents with 5-10 years of service to those with less than 5 years of service, with a mean difference of 0.419, a t-value of 2.11, and a p-value of 0.091. Although the p-value is slightly above the commonly accepted threshold of 0.05, it still suggests a trend towards significant differences in perceptions between these two groups.

Consistent with the findings presented in Table 5, Jackson and Smith contend that employees who have been with the organization for a longer period of time may have a stronger sense of commitment towards the business and its achievements, resulting in more favorable views of the promotion procedures. Moreover, their research emphasizes the need of acknowledging and compensating employees for their enduring dedication and efforts, specifically in regards to decisions on promotions. By utilizing these observations, the results displayed in Table 5 are corroborated, underscoring the importance of taking tenure into account as a determinant of perceptions regarding promotion methods within organizations such as PDEA-10.

According to rank

Table 6 provides the summary of results of the mentioned group of assessment.

Table 6.
Tukey's Post Hoc Comparisons – RANK

Comparison							
RANK		RANK	Mean Difference	SE	df	t	p_{tukey}
	-	INTELLIGENCE OFFICER III	-2.133	0.490	148	-4.35	< .001
	-	INTELLIGENCE OFFICER I	-0.383	0.361	148	-1.06	0.713
	-	INTELLIGENCE OFFICER II	-0.893	0.380	148	-2.35	0.091
INTELLIGENCE OFFICER III	-	INTELLIGENCE OFFICER 1	1.750	0.361	148	4.85	< .001
	-	INTELLIGENCE OFFICER II	1.240	0.380	148	3.27	0.007
INTELLIGENCE OFFICER 1	-	INTELLIGENCE OFFICER II	-0.510	0.184	148	-2.77	0.032

Note. Comparisons are based on estimated marginal means

Tukey's post hoc comparisons for ranks in relation to respondents' assessment of promotion practices within PDEA-10 are presented in Table 6.

In accordance with the findings presented in Table 6, the author posits that rank plays a crucial role in shaping individuals' perceptions of promotion practices within organizations such as PDEA-10. They contend that individuals with higher ranks tend to hold more positive views regarding promotion processes in comparison to those with lower ranks. Moreover, their study highlights the need of advocating for openness and equity in promotion policies and procedures throughout all hierarchical levels in order to cultivate organizational efficacy and enhance employee contentment. By utilizing these observations, the results displayed in Table 6 are corroborated, underscoring the importance of taking rank into account as a determinant of perceptions on promotion methods in law enforcement agencies.

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CONCLUSION AND RECOMMENDATIONS

In conclusion, the findings of this study shed light on the intricate dynamics underlying employees' perceptions of promotion practices within the PDEA-10. The results underscore the significance of age, years of service, and rank as influential factors shaping employees' perspectives on promotion processes within the organization. Age emerged as a significant predictor, suggesting that individuals' career stage and life experiences influence their priorities and expectations regarding promotions. Conversely, years of service were found to be a key determinant, emphasizing the importance of tenure in shaping employees' perceptions of recognition and advancement opportunities. Furthermore, the hierarchical nature of promotion practices within PDEA-10, as evidenced by the significant influence of rank, highlights the distinct expectations and experiences of higher-ranking personnel in relation to promotion processes.

These findings have several implications for PDEA-10 and organizations with similar structures. Firstly, they underscore the importance of tailoring promotion policies and practices to accommodate the diverse needs and expectations of employees at different stages of their careers. By recognizing the unique perspectives of individuals based on age, years of service, and rank, organizations can develop more inclusive and equitable promotion strategies that promote employee engagement and satisfaction. Additionally, addressing disparities in perceptions across rank categories is crucial for fostering a cohesive organizational culture and promoting trust and fairness within the workforce.

Moving forward, PDEA-10 can use these findings as a basis for refining its promotion policies and practices to better align with the needs and expectations of its employees. This may involve enhancing transparency and communication regarding promotion criteria and opportunities, implementing merit-based promotion processes, and providing development opportunities to support employees' career growth and advancement. By addressing the factors identified in this study, PDEA-10 can work towards fostering a culture of fairness, transparency, and meritocracy in its promotion practices, ultimately enhancing employee morale, motivation, and organizational effectiveness.

Based on the findings elucidated in the study regarding the influential role of age, years of service, and rank in shaping employees' perceptions of promotion practices within the PDEA-10, several recommendations can be proposed:

1. The Human Resource Management Section (HRMS) should develop promotion policies that are sensitive to the varying needs and expectations of employees across different age groups. Consider implementing flexible promotion pathways that cater to the career aspirations and development stages of both younger and older employees. Provide opportunities for career advancement and skill development tailored to the unique preferences and priorities of each age cohort.
2. Acknowledge the importance of years of service in employees' perceptions of promotion processes. In this way, HRMS should implements policies that recognize and reward long-standing tenure such as giving consideration in bracketing the age as to rank of promotion being applied considering that there are old employees who are nearly to retire as compared those young age with the same rank, such as tenure-based promotions, service awards, and career progression tracks that value experience and seniority. Ensure that promotion criteria reflect employees' contributions and tenure within the organization. It must be included in the criteria the number of cases being handled, number of cases won in court, number of commendation received and number of illegal drug seized attended operation.
3. The HRMS should foster a culture of meritocracy by prioritizing competency-based promotion practices over traditional seniority-based approaches. Develop transparent promotion criteria that emphasize employees' skills, achievements, and performance, rather than relying solely on tenure or hierarchical rank. Implement objective assessment methods, such as performance evaluations and competency assessments, to inform promotion decisions and ensure fairness and consistency.
4. The HRMS through its Merit and Promotion Screening Committee (MPSC) must inform all candidates through a memorandum regarding the transparency in promotion processes by clearly communicating promotion criteria, procedures, and opportunities to all employees. The HRMS should provide regular updates and feedback mechanism either in a Google form or memorandum address to their section on unidentified basis so that applicants can give their honest feedback regarding on promotion decisions to promote trust and confidence in the fairness and integrity of the process. In addition, the HRMS should encourage open dialogue and participation especially to the high ranking officials in the region in the decision-making processes related to promotions to foster a culture of transparency and accountability.
5. The HRMS must recognize the influence of rank on employees' perceptions of promotion practices and invest in leadership development programs to equip higher-ranking personnel with the skills and competencies needed to lead effectively. With this, HRMS in coordination with Philippine Drug Enforcement Agency Academy (PDEAA) must regularly provide training and mentorship opportunities to empower leaders to support and advocate for fair and inclusive promotion practices within their respective teams and departments.
6. The HRMS through MPSC must establish mechanisms for on-going evaluation and feedback to monitor the effectiveness of promotion policies and practices. The HRMS must hire a researcher to conduct regular surveys, focus groups, and performance reviews to assess employees' satisfaction and perceptions of promotion processes. The researcher must use data-driven insights to identify areas for improvement and implement targeted interventions to address disparities and enhance organizational effectiveness.

Future research on promotion practices within organizations like the Philippine Drug Enforcement Agency Region 10 (PDEA 10) could explore longitudinal trends to track changes in employees' perceptions over time, conduct comparative analyses across different organizational contexts, sectors, or regions, employ qualitative methods to gain deeper insights into subjective experiences, delve into diversity and inclusion perspectives to understand how demographic factors shape perceptions, investigate cross-cultural variations in promotion practices, and examine the impact of technology on promotion criteria and decision-making processes. These avenues of inquiry can contribute to a nuanced understanding of promotion practices and inform evidence-based strategies for designing equitable, inclusive, and effective promotion policies and practices that enhance organizational performance and employee well-being.

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ANTIOXIDANT AND ANTIBACTERIAL PROPERTIES OF BRASSICA JUNCEA EXTRACTS AND SILVER NANOPARTICLES: A SYNERGISTIC APPROACH AGAINST ESCHERICHIA COLI

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ABSTRACT

Brassica juncea, a plant known for its anticancer and antioxidant characteristics, is rich in glucosinolates, flavonoids, carotenoids, and phenolic acids. AEBJ exhibited a high concentration of total flavonoids, measuring 201.09 ± 0.232 mg/g in terms of quercetin equivalents. However, it had a relatively lower total phenolic content, measuring 49.43 ± 1.114 mg/g in terms of tannic acid equivalents. The structural characterisation of silver nanoparticles was performed using UV-Visible spectroscopy, followed by the study of these nanoparticles utilising surface plasmon resonance (SPR) measurements. The interaction between silver ions and extracts of Brassica juncea was seen, and the presence of AgNPs was verified through the detection of a visible peak at 425 nm. The Silver Nanoparticle (BJ 1) effectively suppressed the generation of DPPH radicals within the concentration range of 10-100 µg/ml. The linear regression coefficients for this inhibition were calculated to be 0.9869 and 0.9488, respectively. The IC50 values for Silver Nanoparticle (BJ 1) and BHT were 45.413 and 50.173, respectively. Silver Nanoparticle (BJ 1) exhibited a decrease in the conversion of ferricyanide to ferrocyanide as the concentration increased from 50-250 µg/ml. This was accompanied by an increase in the absorption of green light at a wavelength of 700 nm. The investigation into the antibacterial activity of silver nanoparticles (BJ 1) and Brassica juncea extracts against Escherichia coli has demonstrated substantial potential as antimicrobial agents. The findings indicate that both drugs demonstrate inhibitory effects on the growth of E. coli, with the concentration levels playing a substantial influence. This implies a mutually beneficial interaction between the two drugs, which could potentially amplify their efficacy in fighting bacterial infections. Greater doses of Brassica juncea extract exhibited bigger areas of inhibition, so validating its bioactive activities against pathogenic microorganisms. Furthermore, the Silver nanoparticle (BJ 1) had a potent antibacterial impact as a result of their capability to disturb bacterial cell membranes and impede metabolic activities. The combination of these two medicines has the potential to enhance therapy efficacy in clinical settings. Subsequent investigations should delve into the mechanisms underlying their antibacterial properties and evaluate their safety profiles for future medicinal uses.

KEYWORDS: *Brassica juncea; Silver Nanoparticles; Antioxidant Activity; DPPH; Reducing Power Assay; Antimicrobial Activity; Escherichia coli*

1. INTRODUCTION

Plants contain a variety of secondary metabolites, including tannins, terpenoids, alkaloids, and flavonoids, which have antibacterial properties. Microbial resistance to existing antimicrobial drugs has led to the development of new compounds that can impede microorganism growth. Phytochemicals with antioxidant capabilities may reduce cancer occurrence and mortality rates in various human populations. Medicinal plants serve as the primary reservoir for medications with antioxidant and antibacterial properties [1]. These agents regulate the growth of dangerous bacteria, specifically E.coli and Salmionella typii, and regulate the activity of harmful free radicals. Medicinal herbs are the primary reservoir for antioxidants and antibacterial medications, playing a crucial role in drug discovery. Although the antioxidant and antibacterial activity of many plants have been assessed, there is always a need to discover new medications. Brassica juncea and medicago sativa were chosen for studies on antioxidant and antibacterial activities. Shore roxhburghii, a tropical plant with numerous phenolic components, was also analyzed for its antioxidant and antibacterial properties [2]. Brassica juncea is known for its rich content of glucosinolates and phenolic compounds, which play a crucial role in the reduction of silver and gold ions. The extracts from this plant not only facilitate the reduction process but also provide capping agents that prevent agglomeration of the formed nanoparticles. The utilization of Brassica juncea for nanoparticle synthesis not only highlights the potential for sustainable

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practices in nanotechnology but also paves the way for further research into optimizing conditions for enhanced yield and functionality [3, 4]. Recent studies have focused on plant-based synthesis methods as eco-friendly alternatives to conventional chemical approaches. Brassica juncea (mustard) have shown promise in the green synthesis of nanoparticles. These plants contain phytochemicals that can reduce metal ions to form nanoparticles while simultaneously stabilizing them.

2. MATERIALS AND METHODS

2.1 Collection of the Plant Materials

The Stem bark of Brassica juncea was obtained from Villages near by Gwalior (Madhya Pradesh) and was authenticated by the botany department of Institute of Professional Studies, Gwalior, Madhya Pradesh.

2.2 Preparation of the Extracts

The stem barks of Brassica juncea was dried in the shade and then ground into a powder using a miller. 50 gm of the powdered materials were placed in the thimble and introduced into a double bypass Soxhlet apparatus. This apparatus was connected to two distillation flasks through inverted Y-shaped joints. The materials were then extracted with 500 ml Distilled water. The solvent was evaporated, resulting in the aqueous extract of stem barks of Brassica juncea (AEBJ).

2.3 Estimation of the Phytochemical Constituents

2.3.1 Qualitative estimation of Phytoconstituents

These tested were conducted for the estimation of the presence of carbohydrates, proteins, alkaloids, flavonoids, glycosides, saponins, tannins, and essential oils using standard procedures in extract [5].

2.3.2 Quantitative Estimation of Phytoconstituents

2.3.2.1 Total Phenolic Content

The extract's total phenolic content was determined using spectrometry [6]. Folin-Ciocalteu's reagent was added to a sample, tannic acid (10-100 µg/ml), sodium carbonate (75 g/l), and distilled water. The mixture was stirred for 2 hours at room temperature, and then centrifuged at 2000 rpm for 5 minutes. The absorbance was read at 760 nm, and a standard curve was obtained using different tannic acid concentrations. Results were expressed as mg of tannic acid equivalents per gram of extract.

2.3.2.2 Total Flavonoids Content

The aluminum chloride colorimetric assay measures the total flavonoid content of extracts [7]. A sample or standard solution of quercetin is added to a 10 ml volumetric flask containing distilled water. Afterward, 5% $NaNO_2$, 10% $AlCl_3$, and 1 M NaOH are added. The solution is mixed, and absorbance is measured at 510 nm. The total flavonoid content is expressed as milligrams of quercetin equivalents per gram of extract.

2.4 Synthesis of Silver Nanoparticles using Brassica Juncea Stem extract

A 1mM $AgNO_3$ solution was prepared by dissolving 0.085gms $AgNO_3$ in 500 ml distilled water and stored in an amber colored bottle. In an Erlenmeyer flask, 75 mL of Brassica juncea stem extract of different concentration (25, 50, 100, 150, 200 µg/ml) was added to the solution for bio reduction. The reaction mixture was stirred at 200 rpm until the solution turned from yellow to dark brown, indicating the formation of AgNPs. The reduced solution was centrifuged at 5000 rpm for 30 minutes to obtain a clear supernatant, which was then discarded and the particles were centrifuged with water to obtain pure nanoparticles. Various formulations of silver nanoparticles (BJ1, BJ 2, BJ 3, BJ 4, and BJ 5) were prepared using Brassica juncea extract of different concentration (25, 50, 100, 150, 200 µg/ml) and 1 mM silver nitrate solution. The reduction of elemental Ag to AgO was confirmed by the color change from colorless to brownish-yellow, indicating the encapsulation of aqueous mustard extract into silver Nanoparticles [8].

2.5 Characterization of Silver Nanoparticles using UV-Visible Spectroscopy

The synthesized AgNPs (solution of 1 mg/mL in distilled water as a dispersive medium) were monitored by employing the periodic scans of the optical absorbance between 300 and 700 nm with a double-beam UV-visible spectrophotometer (Carry 100 with tungsten halogen light sources) at room temperature to investigate the reduction of silver ions by the extract. Distilled water was used as blank [9].

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2.6 Antioxidant activity of Silver Nanoparticles

2.6.1 DPPH Radical Scavenging Activity

The antioxidant activities of the silver nanoparticles have been studied through the evaluation of the free radical-scavenging effect on the 2, 2- diphenyl-1-picrylhydrazyl (DPPH) radical. Various concentrations (20, 40, 60, 80 and 100 µg/mL) of silver nanoparticles (1.0 mL of 0.1mM DPPH) were mixed with 3.0 mL of methanolic solution containing DPPH radical (6x10 -5 mol/L). The mixture was shaken vigorously and left to stand for 60 min in the dark. The reduction of the DPPH radical was determined by recording the 65 absorbance at 517 nm. The radical scavenging activity (RSA) was calculated as the percentage of DPPH discolouration [10].

2.6.2 Reducing power assay

The reducing power of the extract was determined as per previously described method. Different concentrations of Silver Nanoparticle (BJ 1) (50-250 µg/ml) were prepared in distilled water. Each concentration (0.5 ml) was mixed with phosphate buffer (1.5 ml, 0.2 M, pH 6.6) and potassium ferricyanide (1.5 ml, 1%). The mixture was incubated at 50°C for 20 min. A portion (1.5 ml) of trichloroacetic acid (10%) was added to the mixture, which was then centrifuged at 3000 rpm for 10 min. The upper layer of the solution (1.5 ml) was diluted with distilled water (1.5 ml). Finally, FeCl3 (300µl, 0.1%) was added and again centrifuged at 3000 rpm for 5 min. and the absorbance was measured at 700 nm. Increased absorbance of the reaction mixture indicated increased reducing power. Ascorbic acid was used as standard antioxidant. The experiment was performed in triplicate [11].

2.7 Evaluation of Anti-Microbial Activity

2.7.1 Preparation of Discs

Filter paper discs of 6mm diameter are prepared and autoclaved in a clean and dry Petri plate. They are soaked in plant extracts for 6 hours, then shade dried. The concentrations are recorded as 0.1 grams per disc. The discs are then spread on cultured Petri plates, and those immersed in Butanol, Benzene, and distilled water are used as controls [12].

2.7.2 Anti-Microbial Activity Assay

The antibacterial activity was tested using the Kirby-Bauer method. This method involves placing paper discs impregnated with antibiotics onto a lawn of bacteria on an agar plate. The antibiotics diffuse into the agar, creating a gradient of concentration that inhibits bacterial growth. The size of the zone of inhibition around each disc is then measured to determine the effectiveness of the antibiotic against the tested bacteria. MHA plates were inoculated with Bacterial culture of Escherichia coli, and discs containing Silver Nanoparticle (BJ 1) and different concentration of aqueous extract of stem of Brassica juncea (AEBJ) (6.25, 12.5, 25, 50 and 100 µg/ml)were placed. 10% of the sample was diluted to achieve the required amount. A vehicle control was loaded with solvent alone, while a Ciprofloxacin disc (10µg) was used as a positive control. The plates were incubated at 37°C for 24 hours, and clear zones around the discs were measured and recorded [13].

2.8 Statistical analysis

All the necessary data were expressed as mean ± SD. Analysis of variance was performed by the ANOVA procedures. The significance of results was analyzed using one-way ANOVA. $P<0.05$ is considered as significant difference.

3. RESULTS AND DISCUSSION

3.1 Evaluation of Phytochemical Constituents

3.1.1 Qualitative Estimation of Phytochemical Constituents

Brassica juncea contains glucosinolates, flavonoids, carotenoids, and phenolic acids, which have anticancer properties and antioxidant properties. Flavonoids and carotenoids protect cellular components from oxidative damage and have anti-inflammatory effects, potentially reducing chronic diseases like cardiovascular conditions. Coumarins have anticoagulant properties, potentially preventing thrombosis-related disorders.

3.1.2 Quantitative Estimation of Phytochemical Constituents

The quantitative estimation of phytoconstituents viz. total flavonoids and total phenolics and saponins revealed that AEBJ was found rich in total flavonoids with 201.09 ± 0.232 quercetin equivalents mg/g of AEBJ while less amount of total phenolic content with 49.43 ± 1.114 tannic acid equivalents mg/g of AEBJ.

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3.2 Characterization of Silver Nanoparticles

3.2.1 UV-Visible Spectroscopy

UV-Visible spectroscopy is one of the most widely used techniques for structural characterization of silver Nanoparticles. The bio-transformed products were simultaneously characterized by UV-Visible spectroscopy measurements performed at different time intervals to study the change in light absorption profile of the solution and increase in intensity (Figure 1). The progress of the reaction between silver ions and extracts of Brassica juncea was monitored by recording the surface plasmon resonance (SPR) as a function of time. By employing the variable concentration (25, 50, 100, 150, 200 mg/ml) of the extract with silver nitrate (1.0 mM), the effect of concentration of the extract on the rate of bioreduction was studied. Since, this wavelength falls within the prescribed range, confirming the formation of AgNPs. Formulation BJ 1 showed the clear peak at 425 nm, so we selected the formulation BJ 1 for further studies.

3.2.2 Antioxidant activity of Silver Nanoparticles

3.2.2.1 DPPH Radical Scavenging Activity

The Silver Nanoparticle (BJ 1) in concentration range of 10-100 µg/ml inhibited DPPH radical formation as indicated by concentration dependent decrease in the purple colour of the solution. Similar effect was obtained with standard antioxidant- BHT in the concentration range of 10-100 µg/ml. In linear regression analysis of concentration versus percent DPPH inhibition was carried out. The linear regression coefficient of Silver Nanoparticle (BJ 1) and BHT were 0.9869 and 0.9488, respectively, suggesting that the DPPH scavenging was concentration dependent. The IC_{50} value of Silver Nanoparticle (BJ 1) and BHT, obtained from regression analysis, were 45.413 and 50.173, respectively (Table 1).

3.2.2.2 Reducing Power Assay

Silver Nanoparticle (BJ 1) in the concentration range of 50-250 µg/ml showed concentration related reduction of ferricyanide to ferrocyanide as indicated by increase in the green colour absorbance measured at 700 nm. Similar effect was also observed with standard antioxidant, ascorbic acid in the concentration range of 50-250 µg/ml. A concentration verses absorbance graph comparing ascorbic acid and Silver Nanoparticle (BJ 1) were plotted and depicted in Figure 2.

3.3 Effect of Silver Nanoparticle (BJ 1) and different concentration of aqueous extract of stem of Brassica juncea (AEBJ) on zone inhibition assay for Anti-microbial activity

In this experiment, effect of Silver Nanoparticle (BJ 1) and different concentration of aqueous extract of stem of Brassica juncea (AEBJ) (6.25, 12.5, 25, 50 and 100 µg/ml) was tested against Escherichia coli. The results showed that Silver Nanoparticle (BJ 1) was exhibited significant antimicrobial activity against E.coli. Also, zone inhibition effect of Silver Nanoparticle (BJ 1) against E.coli (Figure 3). The findings suggest that AEUD and AEXS have the potential to be used as natural alternatives to synthetic antibiotics in the treatment of microbial infections.

4. CONCLUSIONS

Brassica juncea, a plant with anticancer and antioxidant properties, contains glucosinolates, flavonoids, carotenoids, and phenolic acids. These compounds protect cellular components from oxidative damage and have anti-inflammatory effects, potentially reducing chronic diseases like cardiovascular conditions. Coumarins have anticoagulant properties, potentially preventing thrombosis-related disorders. AEBJ, rich in total flavonoids, was found to have less total phenolic content. UV-Visible spectroscopy was used to structurally characterize silver nanoparticles, which were studied using surface plasmon resonance measurements. The formation of AgNPs was confirmed by the visible peak at 425 nm. Silver Nanoparticle (BJ 1) inhibited DPPH radical formation in concentrations of 10-100 µg/ml, with IC50 values of 45.413 and 50.173, respectively. The study on silver nanoparticle (BJ 1) and Brassica juncea extracts' antimicrobial activity against Escherichia coli revealed significant potential as antimicrobial agents. Both substances exhibit inhibitory effects on E. coli growth, with concentration levels playing a significant role. Combining these two agents could lead to more effective treatment strategies in clinical settings. Future research should explore the mechanisms of their antibacterial action and assess their safety profiles for potential therapeutic applications.

5. CONFLICT OF INTEREST

None

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FIGURES AND TABLES

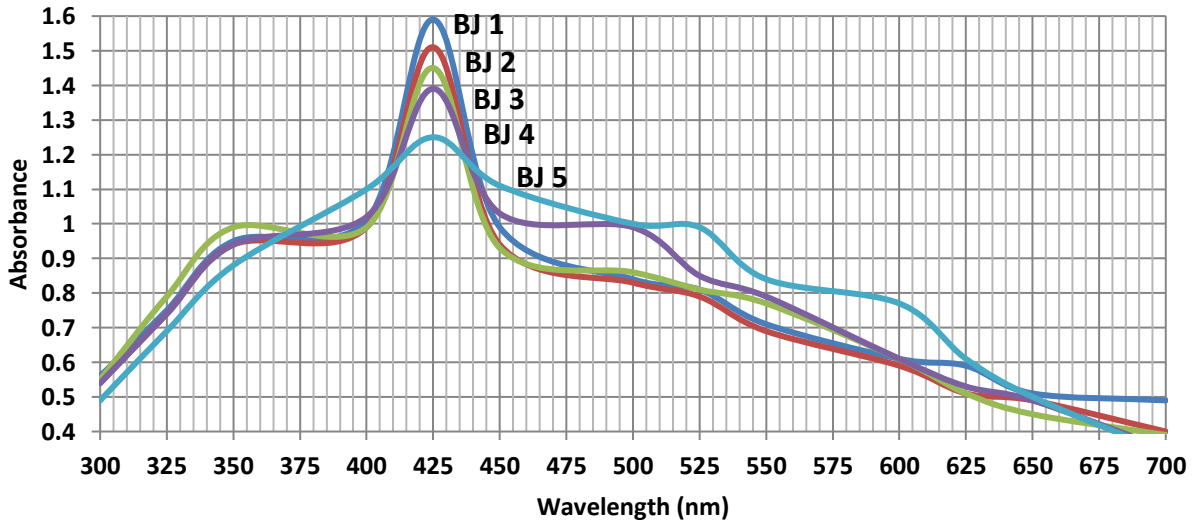

Figure 1: Characterization of Silver Nanoparticles (BJ1, BJ 2, BJ 3, BJ 4, and BJ 5) prepared using Brassica juncea extract of different concentration (25, 50, 100, 150, 200 µg/ml) using UV-Visible Spectroscopy

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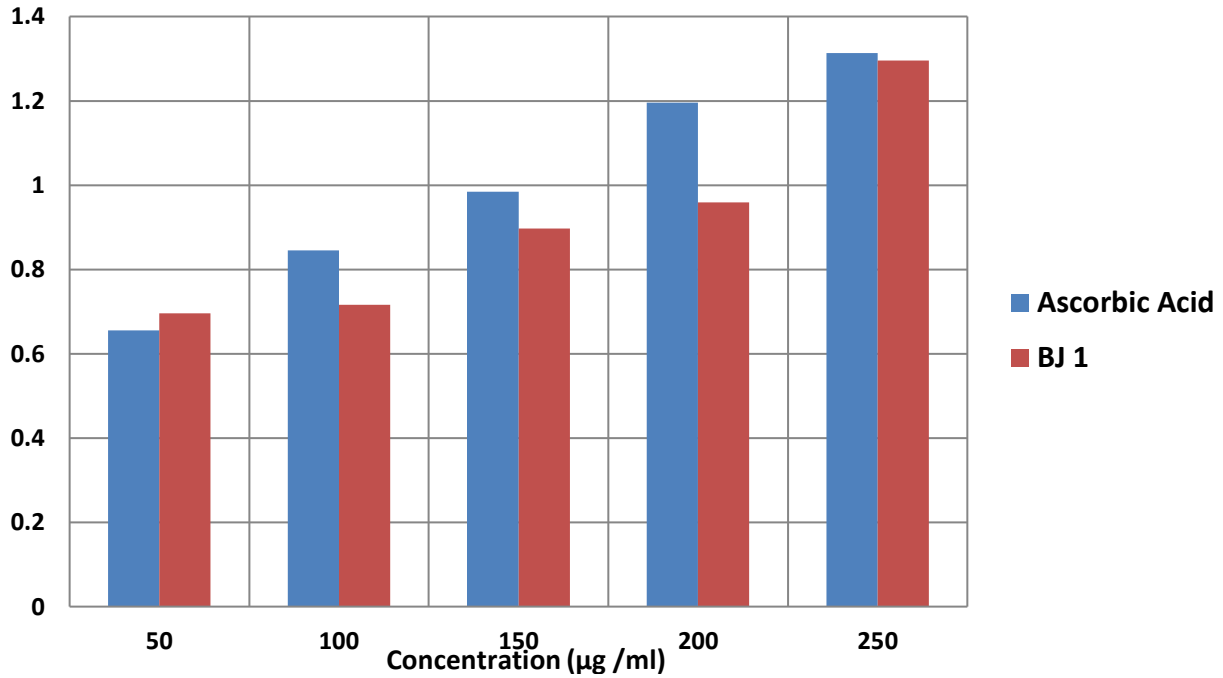

Figure 2: A concentration verses absorbance graph comparing ascorbic acid and Silver Nanoparticle (BJ 1) showing Reducing Power Assay

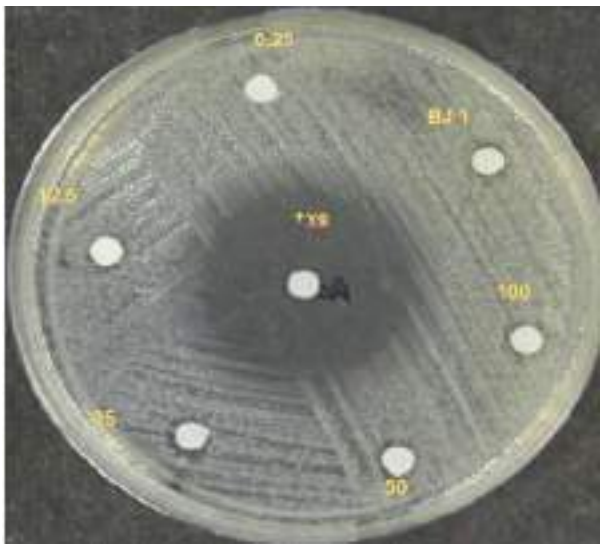

Figure 3: Anti-microbial activity of Silver Nanoparticle (BJ 1) and different concentration of aqueous extract of stem of Brassica juncea (AEBJ) against the Escherichia coli

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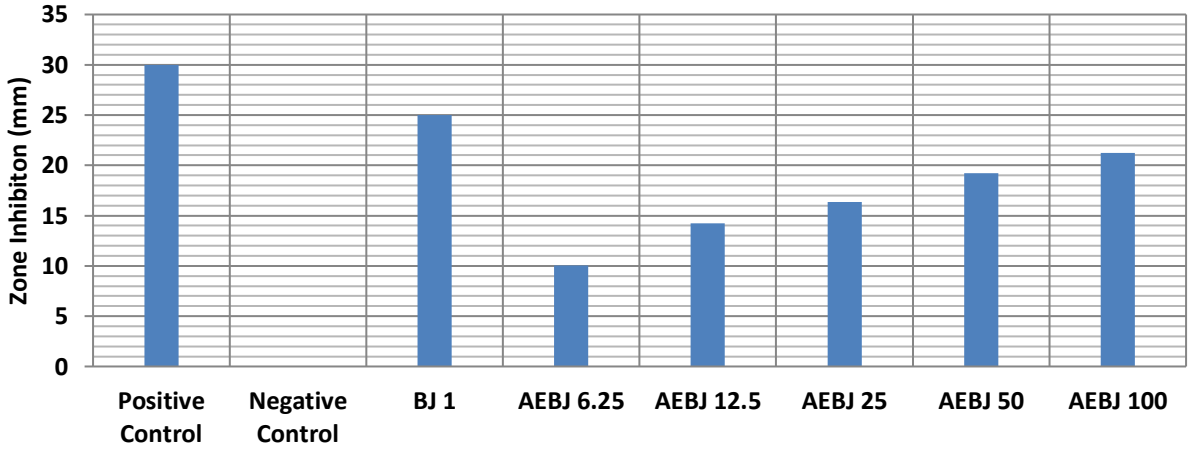

Figure 4: Effect of Silver Nanoparticle (BJ 1) and different concentration of aqueous extract of stem of Brassica juncea (AEBJ) on zone inhibition assay for Anti-microbial activity against the Escherichia coli.

Table 1: Effect on DPPH Radical Scavenging Activity

Concentration (µg/ml)		% Inhibition	IC_{50} Value
BHT	10	13.311 ± 0.397	50.173 µg/ml
	20	25.706 ± 0.529	
	40	47.305 ± 0.496	
	60	65.163 ± 0.636	
	80	75.064 ± 0.223	
	100	80.271 ± 0.257	
Silver Nanoparticle (BJ 1)	10	13.343 ± 0.397	45.413 µg/ml
	20	26.514 ± 0.563	
	40	47.991 ± 1.028	
	60	65.176 ± 0.636	
	80	74.740 ± 0.532	
	100	81.279 ± 1.150	

Values are mean± SEM; n=3; IC_{50}= 50% Inhibitory concentration

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MULTILINGUAL EDUCATION AND ITS IMPACT ON EARLY-GRADE READING PROFICIENCY

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ABSTRACT
This research explores the intricate nexus between multilingual education and the development of early reading proficiency in children and aims to expound effective instructional strategies, cognitive advantages, and socio-cultural influences by investigating the impact of exposure to multiple languages on the acquisition of literacy skills. The study examined diverse language backgrounds, instructional methodologies, the transferability of skills across languages, challenges in policy implementation, and the enduring academic and socio-emotional implications. The study will also discuss the influence of parental involvement and community support in nurturing reading skills among multilingual children. By employing longitudinal analyses, comparative studies, and in-depth examination and analysis of existing studies by educators and policymakers, this research comprehensively addressed the intricacies and potentialities inherent in multilingual education for the advancement of early reading proficiency.
KEYWORDS: *multilingual education, early-grade reading proficiency, instructional strategies, cognitive advantages, socio-cultural influences*

INTRODUCTION

Early-grade reading proficiency is crucial for a child's educational development. Children who learn to read at a young age are better equipped to acquire more advanced skills, which are often absorbed through reading. Proficient early readers are more likely to succeed academically, exhibit higher levels of self-confidence, and actively engage in learning experiences. Conversely, children who struggle with reading in the early grades are at a higher risk of falling behind academically and facing long-term educational challenges. The convergence of multilingualism and early literacy development is an area of increasing interest within the realm of early childhood education. The significance of language acquisition and its pivotal role in early reading proficiency among multilingual learners have garnered attention due to its profound impact on cognitive growth, academic achievement, and cultural adaptability in children (Genesee, 2006; Cummins, 2007). This paper embarks on an exploration of the intricate relationship between multilingual education and the cultivation of early reading skills in young learners, weaving together existing literature and empirical evidence. The body of research concerning multilingual education's influence on literacy acquisition underscores the dynamic nature of this field. It emphasizes the imperative to understand how exposure to multiple languages shapes the foundational skills essential for proficient reading during a child's developmental years (Bialystok, 2017). The prevalence of diverse linguistic backgrounds in educational settings necessitates a comprehensive examination of instructional strategies and cognitive mechanisms entwined with multilingualism to optimize literacy outcomes (García & Sylvan, 2011).

This work amalgamates established theoretical frameworks and empirical evidence derived from extensive literature on multilingual education and early reading proficiency. It aims to illuminate effective instructional approaches, elucidate cognitive advantages, and elucidate socio-cultural influences influencing literacy acquisition among multilingual learners (Krashen, 2004). Furthermore, it seeks to elucidate the transferability of reading skills between languages and highlight the pivotal role of parental involvement and community support in fostering early reading abilities (Hammer et al., 2006). By consolidating insights from diverse scholarly works, this paper endeavours to offer a holistic view of the complexities inherent in multilingual education and its nexus with early reading proficiency. The synthesis of existing literature, empirical research, and theoretical underpinnings aims to inform educational practices, and policy formulation, and stimulate further empirical investigations in this pivotal domain of early childhood education.

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Purpose and Significance of the Study

The purpose of this study is to explore the impact of multilingual education on early-grade reading proficiency. Multilingual education has been shown to improve access to and inclusion in education, particularly for students who speak non-dominant, minority, and indigenous languages. By examining the relationship between multilingual education and early-grade reading proficiency, this study aims to provide insights that can inform educational policies and practices, ultimately contributing to better educational outcomes for diverse learner populations.

Historical Context of Multilingual Education

Multilingual education has a rich history that dates back centuries. In the 19th century, bilingual education was adopted in the United States at the request of German-speaking families. This early adoption was driven by the need to accommodate immigrant communities and preserve their linguistic heritage. UNESCO has been a significant advocate for multilingual education since its inception in 1945, promoting mother tongue-based education as a fundamental right. The 1953 UNESCO report, "The Use of Vernacular Languages in Education," was a landmark document that emphasized the importance of using native languages in education. The movement to educate bilingually in the United States gained momentum in the mid-20th century, driven by the needs of Mexican American and Puerto Rican communities. This period saw the establishment of bilingual programs aimed at addressing the educational disparities faced by these communities. The Bilingual Education Act of 1968 was a pivotal moment, providing federal support for bilingual education programs. Today, multilingual contexts are the norm rather than the exception, with around 7,000 languages spoken globally. Multilingual education is recognized as a key to quality and inclusive learning, with UNESCO continuing to champion linguistic diversity and multilingual education. The rise of globalization and increased migration have further underscored the importance of multilingual education in fostering intercultural dialogue and understanding.

Theoretical Frameworks Supporting Multilingual Education

Several theoretical frameworks underpin multilingual education. One prominent framework is Content and Language Integrated Learning (CLIL), which integrates language and content instruction to enhance learning outcomes. CLIL has been widely adopted in Europe and involves teaching subjects such as science or history in a foreign language, thereby promoting both language proficiency and subject knowledge. This pedagogical framework, employed within bilingual educational programs, particularly in the realm of science education, equips learners not only with communicative and linguistic advantages but also facilitates the assimilation of subject knowledge alongside heightened motivation and engagement, thereby augmenting their cognitive abilities. Nevertheless, investigations into the CLIL approach appear to lack consensus regarding its educational impacts within the classroom setting.

Another approach is Culturally and Linguistically Responsive Teaching, which emphasizes the importance of incorporating learners' cultural and linguistic backgrounds into the learning process. This approach involves teachers using the learners' cultural and linguistic experiences to help them learn. This means connecting lessons to what students already know from their own lives. Teachers learn about their learners' cultures and use this knowledge to make lessons more relevant and engaging. This instructional resource is designed to cater to all educational levels and equips educators with methodologies aimed at assisting their culturally and linguistically diverse learners. This approach aims to create an inclusive classroom environment that respects and values diversity.

The Common European Framework of Reference for Languages (CEFR) provides a comprehensive model for language proficiency and is widely used in multilingual education. CEFR outlines language proficiency levels and serves as a guideline for curriculum development and assessment. marks a crucial step in the Council of Europe's engagement with language education, which seeks to protect linguistic and cultural diversity, promote plurilingual and intercultural education, reinforce the right to quality education for all, and enhance intercultural dialogue, social inclusion and democracy. The CEFR distinguishes between plurilingualism and multilingualism, as well as distinguishing between multiculturalism and pluriculturalism. This distinction aims to facilitate understanding of two very different views of linguistic and cultural diversity. Multilingualism/multiculturalism considers languages and cultures as separate and somehow static entities that co-exist in societies or individuals, while plurilingualism and pluriculturalism aim to capture the holistic nature of individual language users/learners linguistic and cultural repertoires. Learners are seen as social agents who draw upon all sorts of resources in their linguistic and cultural repertoires and further develop these resources in their trajectories. This approach focuses on interconnectedness of different languages and cultures rather than on their differences and stress the importance of evolving profiles that value even the most partial competences in and awareness of languages and cultures and emphasizes that in teaching.

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Theories and Models of Multilingual Education

Several theories underpin the practice of multilingual education. One prominent theory is Cummins' Linguistic Interdependence Hypothesis, which posits that proficiency in a second language (L2) is partly dependent on the learner's proficiency in their first language (L1). This theory supports the idea that strong foundational skills in the mother tongue can facilitate the acquisition of additional languages. Various models of multilingual education, such as transitional bilingual education, dual-language immersion, and trilingual education, have been developed to cater to different linguistic and educational contexts. These models aim to balance the use of multiple languages in the classroom, promoting both linguistic diversity and academic achievement. Research has consistently shown that multilingual education can positively impact early-grade reading proficiency. Studies have found that children who receive instruction in their mother tongue during the early grades tend to perform better in reading assessments compared to those who are taught exclusively in a second language. For instance, a study conducted in Kenya demonstrated that children who received literacy instruction in both Kiswahili and English showed significant improvements in reading comprehension and vocabulary. The study advocates improved access and inclusivity through mother-tongue education. In other words, a mother language-based, multilingual education is believed to improve access to and inclusion in education, particularly for population groups that speak non-dominant, minority and indigenous languages.

Cognitive Benefits of Multilingual Education

Studies have revealed that multilingual education enhances cognitive abilities in early-grade students. Studies indicate that children who learn to read in multiple languages develop stronger executive functions, such as problem-solving, memory, and attention control. Findings showed that bilingual children outperformed monolingual peers in tasks requiring cognitive flexibility and working memory. These benefits are both physiological as well as educational. According to Marian and Spivey (2003), when an individual proficient in two languages engages in the use of one linguistic system, the other language concurrently remains active. Upon the auditory perception of a lexical item, the individual does not comprehend the entirety of the word instantaneously; instead, the phonetic components are received in a sequential manner. Well in advance of the completion of the word, the cognitive language apparatus initiates predictions regarding the potential identity of that word by activating numerous lexical items that correspond to the auditory signal. For instance, when one perceives the term "can," there is a significant likelihood that related words such as "candy" and "candle" will also be activated, particularly during the initial phases of lexical recognition. In the case of bilingual individuals, this lexical activation transcends a singular linguistic framework; auditory stimuli elicit the activation of relevant lexical items irrespective of their linguistic origin.

The Escuela Bilingüe Internacional (EBI), a diverse, supportive international community that provides a multilingual education that encourages learning and growth based in the United States maintains that the benefits of a multilingual education go beyond just vocabulary expansion but also include better cognitive development, academic achievement, and cross-cultural appreciation. According to the community, Studies indicate that individuals who speak multiple languages tend to have better cognitive abilities than those who only speak one language. The reason for this is because learning a new language stimulates the brain and improves its cognitive functions. The EBI maintains that children who receive multilingual education tend to have better problem-solving skills, creativity, and critical thinking; generally perform better academically because multilingual education helps improve memory retention, reading skills, and test scores as they tend to understand complex language concepts better and quicker, leading to better academic results. The report equally indicates that speaking multiple languages can improve memory retention and recall. This is because learning new languages requires memorization and recall of new vocabulary and grammatical rules, which is good exercise for the memory. The EBI also maintains that being bilingual can delay the onset of dementia by several years due to the fact that bilingualism requires regular exercises of the brain to switch between languages, leading to an increase in cognitive reserve, which can delay the progression of dementia. Multilingual education also exposes students to different cultures, people, and ways of life. This exposure nurtures cross-cultural appreciation and adaptability, which is essential in today's diverse global economy. It also helps children to develop an understanding of different perspectives, promotes a sense of empathy, and better equips them to navigate cultural differences in their future lives.

Academic Performance Improvements

Multilingual education positively impacts academic performance, particularly in reading comprehension and literacy rates. A comprehensive study in South Africa showed that students who received instruction in their mother tongue alongside a second language had higher reading scores compared to those taught exclusively in a second language. In the Philippines, the implementation of the Mother Tongue-Based Multilingual Education (MTB-MLE) program led to significant improvements in reading proficiency and overall academic achievement. Additionally, research in the United States highlighted that dual-language learners exhibited greater gains in reading skills over time compared to their monolingual counterparts.

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Social and Emotional Benefits

Multilingual education fosters social and emotional development by promoting cultural identity and self-esteem. In a study conducted in Nigeria, children in multilingual classrooms reported a stronger sense of cultural pride and belonging. This was echoed in research from New Zealand, where Maori students in bilingual programs expressed higher levels of self-confidence and cultural connectedness. Furthermore, multilingual education encourages empathy and cross-cultural understanding, as learners learn to appreciate and respect diverse linguistic and cultural backgrounds.

The Nigerian National Language Policy and Multilingual Education

Nigeria's National Language Policy has undergone significant changes over the years to address the country's multilingual landscape. The most recent policy, approved by the Federal Executive Council in November 2022, mandates that learners from primary one to six must be taught in their mother tongue. This policy aims to preserve Nigeria's linguistic heritage and improve educational outcomes by making learning more accessible and relevant to learners.

The policy recognizes the importance of using the dominant language spoken in the community as the medium of instruction. This approach is expected to enhance learners' understanding and retention of educational content. The policy also aims to promote national unity and cultural identity by valuing and preserving indigenous languages. Implementing this policy presents challenges, such as the need for trained teachers proficient in local languages and the development of appropriate teaching materials. However, it also offers opportunities to improve literacy rates and educational outcomes by making education more inclusive and culturally relevant.
Overall, Nigeria's National Language Policy reflects a commitment to multilingual education and the recognition of its benefits for cognitive development, cultural preservation, and academic achievement.

Evidence from Existing Studies

The findings from various global studies underscore the significant benefits of multilingual education on early-grade reading. The cognitive advantages, such as enhanced executive functions and metalinguistic awareness, provide a strong foundation for academic success. Improved reading comprehension and literacy rates highlight the effectiveness of multilingual instruction in fostering academic achievement. Additionally, the social and emotional benefits, including cultural identity and self-esteem, contribute to the holistic development of learners.

A study by Vogelzang, M., Tsimpli, I., Balasubramanian, A., Panda, M., Alladi, S., Reddy, A., Mukhopadhyay, L., Treffers-Daller, J., & Marinis, T. (2024). examined the influence of mother tongue education and multilingualism on the reading skills and reading comprehension of 1272 Indian primary school children from low SES homes. The children reportedly performed the ASER literacy task in both the regional, majority language and in English, which was followed by newly developed reading comprehension questions. The results show that minority language speakers from monolingual households—who do not receive mother tongue education—underperform compared to majority language speakers when reading in the majority language. When reading in English, growing up in a multilingual household improves children's performance. Finally, in sites which have a larger proportion of mother tongue-educated children, children perform better in literacy in the regional language and worse in English.

A 2019 study in Kenya to examine differences in vocabulary development in early-grade learners by language of assessment, adapted and validated instruments to measure developmental outcomes, including expressive and receptive vocabulary. The study assessed 505 2-to-6-year-old children in rural communities in Western Kenya with comparable vocabulary tests in three languages: Luo (the local language or mother tongue), Swahili, and English (official languages) at two-time points, 5–6 weeks apart, between September 2015 and October 2016. Younger children responded to the expressive vocabulary measure exclusively in Luo (44%–59% of 2-to-4-year-olds) much more frequently than did older children (20%–21% of 5-to-6-year-olds). Baseline receptive vocabulary scores in Luo ($\beta = 0.26$, SE = 0.05, $p < 0.001$) and Swahili ($\beta = 0.10$, SE = 0.05, $p = 0.032$) were strongly associated with receptive vocabulary in English at follow-up, even after controlling for English vocabulary at baseline. Parental Luo literacy at baseline ($\beta = 0.11$, SE = 0.05, $p = 0.045$) was associated with child English vocabulary at follow-up, while parental English literacy at baseline was not. The findings suggest that multilingual testing is essential to understanding the developmental environment and cognitive growth of multilingual children (Knauer, H.A., Kariger, P., Jakiela, P., Ozier, O. & Fernald, L.C.H., 2019) .

Implications for Educators and Policymakers

Educators and policymakers should consider the integration of multilingual education programs to enhance early-grade reading outcomes. Training teachers to effectively implement multilingual instruction and developing culturally relevant educational materials

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are crucial steps. Policymakers should support initiatives that promote mother tongue-based education and allocate resources to sustain these programs.

Challenges and Limitations

Implementing multilingual education poses challenges, such as the need for standardized orthographies and adequate teacher training. Additionally, the diversity of languages within a single region can complicate the development of instructional materials. Limited funding and political support may also hinder the widespread adoption of multilingual education programs.

Recommendations for Future Research and Practice

Future research should focus on longitudinal studies to assess the long-term impact of multilingual education on academic and socio-emotional outcomes. Exploring the effectiveness of different instructional models and identifying best practices for teacher training are essential areas for further investigation. Practitioners should continue to adapt and refine multilingual education programs to meet the evolving needs of diverse student populations.

CONCLUSION

This study has highlighted the multifaceted benefits of multilingual education on early-grade reading. The cognitive advantages, such as enhanced executive functions and metalinguistic awareness, provide a robust foundation for academic success. Empirical evidence from various global studies demonstrates that learners in multilingual programs consistently outperform their monolingual peers in reading comprehension and literacy rates. Additionally, the social and emotional benefits, including strengthened cultural identity and self-esteem, contribute to the holistic development of students. Multilingual education is crucial for fostering early-grade reading skills. By leveraging learners' native languages alongside additional languages, educators can create a more inclusive and effective learning environment. This approach not only enhances reading proficiency but also supports cognitive development and cultural awareness. The integration of multiple languages in early education is essential for addressing the diverse linguistic needs of students and promoting equitable access to quality education. The findings of this study underscore the importance of implementing multilingual education programs in early grade classrooms. Educators and policymakers should prioritize the development and support of such programs to improve reading outcomes and overall academic performance. Teacher training, the creation of culturally relevant educational materials, and sustained policy support are critical for the successful implementation of multilingual education. Future research should continue to explore the long-term impacts of multilingual education and identify best practices for its integration into diverse educational contexts. By embracing multilingual education, we can foster a more inclusive, culturally rich, and academically successful learning environment for all students.

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A COMPREHENSIVE REVIEW ON ETHOSOMAL GEL

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ABSTRACT

Ethosomal systems are newer lipid vesicular carriers that have been around for 20 years, but over that period they have grown significantly as a means of transdermal drug delivery. They have a sizable amount of ethanol in them. These nanocarriers carry medicinal substances with various physicochemical qualities throughout the skin and deep skin layers. Since they were created in 1996, ethosomes have undergone substantial investigation; new substances have been added to their original composition, creating new varieties of ethosomal systems. These innovative carriers, which can be added to gels, patches, and lotions, are prepared using several novel methods. In addition to clinical trials, many in vivo models are employed to assess the effectiveness of dermal/transdermal administration. This review focuses on different generation of ethosomes and their comparison with other conventional liposomes.

KEY WORDS: *Ethosomes, Transdermal drug delivery, Lipid vesicular systems,*

INTRODUCTION

The oral drug delivery system has overcome a number of limitations such as degradation of drug, GI irritation and first pass metabolism effect. Due to the above reason the transdermal route is most prefer by the patient there for research the ethosome carrier moiety for the transdermal drug delivery system. [1] Ethosomal vesicles used for delivery of drugs to reach the deep skin layers and/ or the systemic circulation and are the advanced forms of liposomes that are high in ethanol content. They can incorporate hydrophilic and hydrophobic drugs to enhance the accumulation of drug. [2] Ethosomal drug is administered in semisolid form (gel or cream) hence producing high patient compliance. The most widely used gel- forming agents used in ethosomal systems are carbopol and hydroxypropyl methycellulose. These polymers have been shown to be compatible with ethosomal systems, providing the required viscosity and bioadhesive properties. [3] **.**

The development of liposomes heralded a new era in drug delivery research, and a variety of vesicular systems have subsequently been created [4]. Cevc and Blume also discovered transferosomes, which are malleable or elastic liposomes, in 1992. Transferosomes were then followed by the ground-breaking work of Touitou et al. which resulted in the discovery of a unique lipid vesicular system known as ethosomes [5].

The development of modified versions of liposomes was prompted by their lower size, lower entrapment efficiency, and negative zeta potential. Novel modified lipid carriers called ethosomes are made of ethanol, phospholipids, and water. In addition to phospholipids and water, which have been suggested to have improved vesicular properties and skin penetration, ethanol is present in quite high amounts in ethosomes [6]. Ethosomes, are again divided into binary, classical, and transethosomes based on their contents like alcohol, have quickly emerged as an unique drug delivery system [[7], [8], [9], [10]].

Ethosomes

The development of liposomes heralded a new era in drug delivery research, and a variety of vesicular systems have subsequently been created [11]. Cevc and Blume also discovered transferosomes, which are malleable or elastic liposomes, in 1992. Transferosomes were then followed by the ground-breaking work of Touitou et al. which resulted in the discovery of a unique lipid vesicular system known as ethosomes [12].

Ethosomes (Fig. 1) are system containing soft vesicles, composed of hydro alcoholic or hydro/ glycolic phospholipids, water, alcohol (ethanol and isopropyl alcohol) in relatively high concentration. This high concentration of ethanol makes the ethosomal system unique. The range of ethanol in final product will be 20 %- 30 %. The size of ethosomes will be in the range of tens of nanometers to microns (μ) [13, 14].

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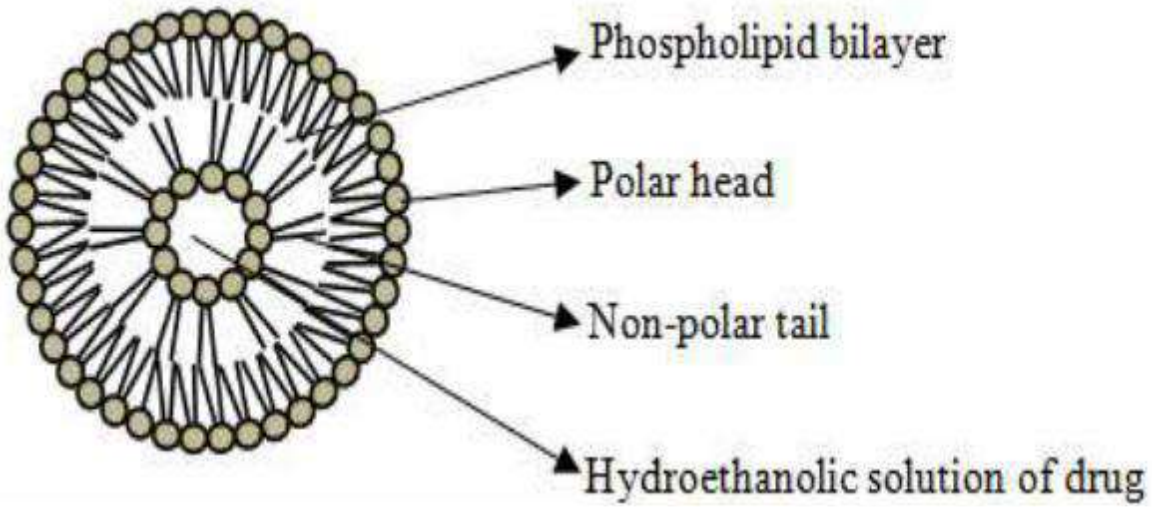

Fig 1- Structure of Ethosome

Composition of Ethosomes

Class	Example	Uses
Phospholipid	Soya phosphatidyl choline, Egg phosphatidyl choline, Dipalmityl phosphatidyl choline, Distearyl phosphatidyl choline	Vesicles forming agent
Polyglyol	Propylene glycol Transcutol RTM	As a skin permeation enhancer
Alcohol	Ethanol Propyl alcohol	For providing softness for vesicle membrane as a permeation enhancer
Cholesterol	Cholesterol	For providing the stability to vesicle membrane
Dye	Rhodamine- 123 Rhodamine red Flurescene Isothiocynate (FITC) 6- Carboxy flurescene	For characterization study
Vehicle	Carbopol Đ 934	As a gel former

Types of Ethosomal system

- **Classical ethosomes**

Classical ethosomes are composed of phospholipids, water, and high concentration of ethanol (40%). Because of small size, negative zeta potential and higher entrapment efficiency classical ethosomes were superior over classical liposomes. Drugs having molecular weight ranging from 130.077 Da to 24 k Da can be entrapped in classical ethosomes. Classical ethosomes also shows better skin permeation and stability profiles than classical liposomes. [15, 16]

- **Binary ethosomes**

Binary ethosomes can be prepared by adding another type of alcohol to the classical ethosomes. propylene glycol (PG) and isopropyl alcohol (IPA) are the most commonly used alcohols in binary ethosomes.[17]

- **Transethosomes**

Transethosomes are the new form of ethosomal systems. In their formula it contain basic components from classical ethosomes and a penetration enhancer or an edge activator (surfactant). These novel vesicles were developed to combine the advantages of classical ethosomes and transfersomes in one formula to produce transethosomes [18].

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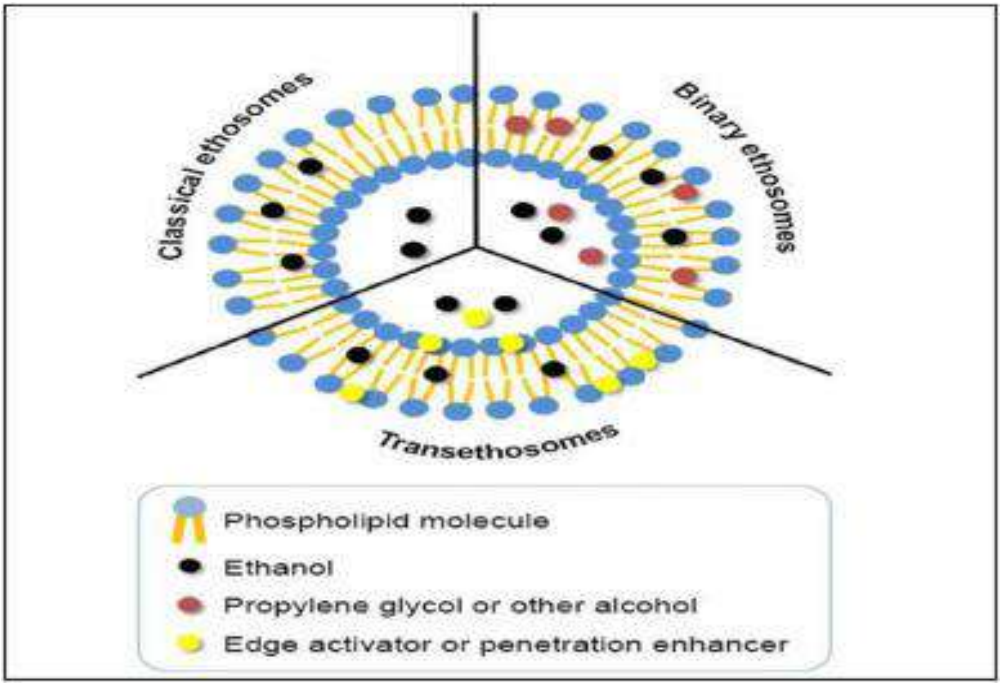

Fig 2- Classification of Ethosomes

Methods for preparation of Ethosomes-

The hot approach and the cold method are two often employed techniques needed to create ethosomes.

- **Cold method**

At room temperature, with vigorous shaking, the ethanol is dissolved in the phospholipids, medicine, and other lipid components. The jar is then heated to 30 °C. This is widely used and is referred to as the "cold approach. In another beaker, water is heated to 30 °C before being introduced and continuously swirled into the initial mixture. Vesicles start to emerge after 5 min of churning. It's important to keep produced vesicles cold [19].

- **Hot method**

The hot procedure entails combining the medication with ethanol and propylene glycol. At 40 °C, phospholipid dispersion in water is created. This dispersion is combined with a previously produced mixture. Size reduction is next accomplished by sonication or extrusion after this final combination is heated to 30 °C [20].

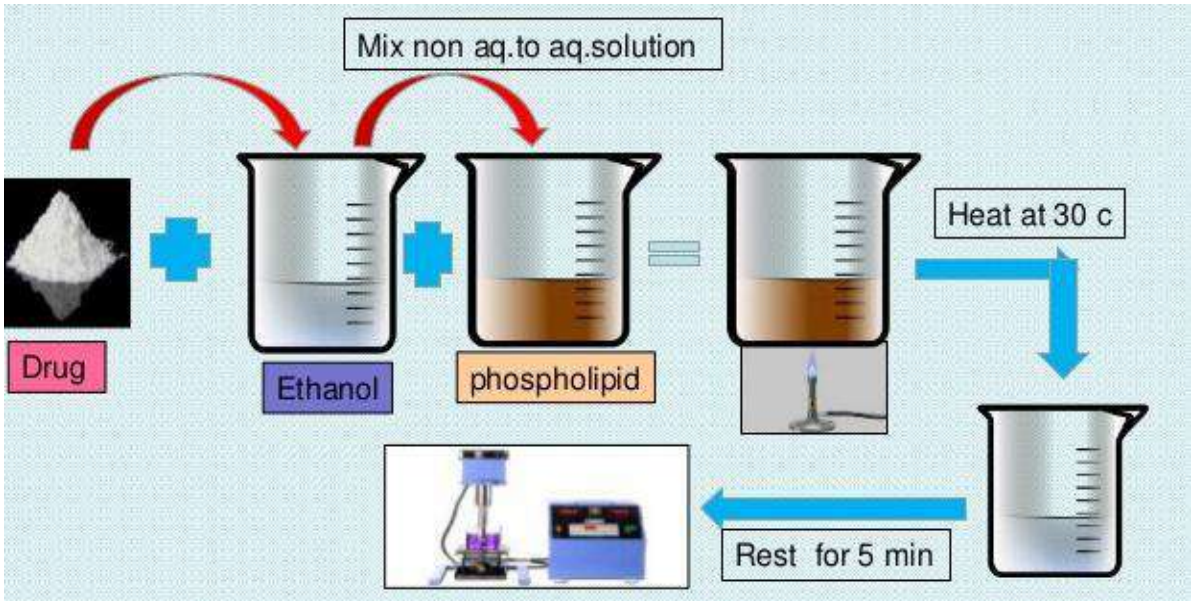

Fig 3- Method of preperation of Ethosomes

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Mechanisam of Drug Penetration

In ethosomal formulations both ethanol and phospholipids together enhance the skin permeation of the drugs. The mechanism of the drug absorption probably occurs by two phases. The first phase of the mechanism is due to the **"ethanol effect"** In this incorporation of ethanol in to intercellular lipids, fluidizes the lipid bilayers and decreasing the density of skin lipids. This is followed by the **"ethosome effect"**, in this the increased cell membrane fluidity by the ethanol will increase the skin permeability, because of this ethosomes permeate very easily in to the deep skin layers where it fused with the skin lipid and release the therapeutic agents into the deep skin layers [21, 22]

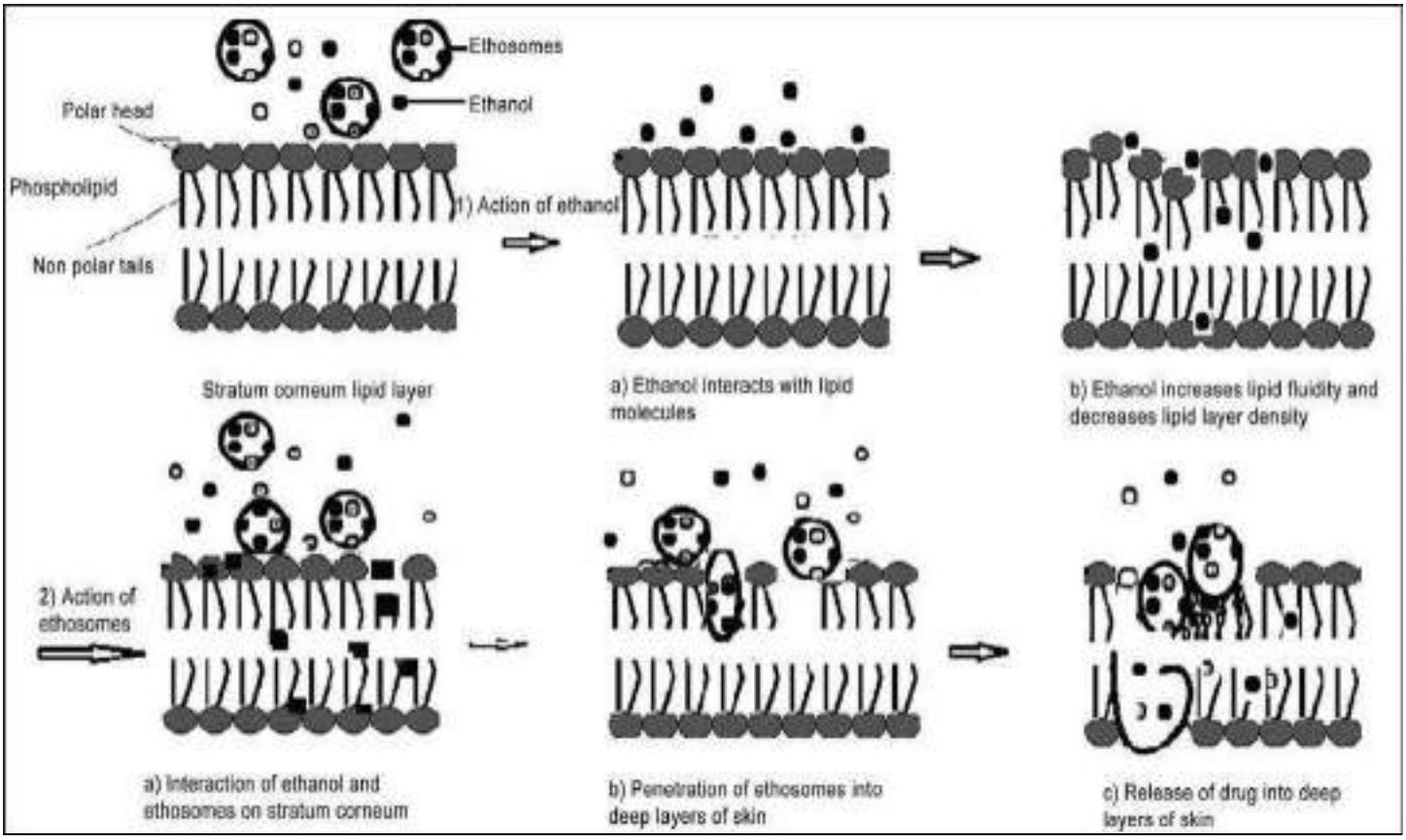

Fig 4- Mechanism of ethosomal drug penetration through skin

Applications of Ethosomes-

- Ethosomes have been shown in numerous trials to be an effective treatment for viral and microbial skin infections. Animal models of deep skin infections were used to create and test the efficacy of the bacitracin and erythromycin ethosomal systems [23].
- When manufactured, ammonium glycyrrhizinate ethosomes were shown to have an anti-inflammatory impact on the skin of human volunteer subjects.
- When tested in vivo on rabbits, ethosomal patches in treating androgen insufficiency in males and menopausal symptoms in women have sufficiently demonstrated better results.
- Research suggests that ethosomes may have analgesic, antipyretic, and efficacious effects against erectile dysfunction.
- Research has also indicated that ethosomes might be utilised to topically transport DNA molecules for skin cells to express certain genes.

Advantages Of Ethosomal Drug Delivery [24, 25, 26]

- Increased skin permeation of the drug
- Large molecules like proteins, peptide molecule is possible.
- Good patient compliance.
- Compared with Iontophoresis and phonophoresis, ethosomes are simple method of drug delivery.
- It can be widely applied in cosmetic, veterinary, herbal drug technology.
- It can entrap all types of drug molecules i.e. hydrophilic, lipophilic or amphiphilic.

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- Permeation enhancer used in the formulation increase the permeability of the skin so that the drugs easily cross the skin.

Limitations of ethosomal drug delivery

- Increased levels are needed. Only powerful compounds with a daily intake of 10 mg or less are allowed [27, 28].
- Instead of offering moderate, continuous medication delivery, it is often intended as a method of achieving quick bolus type drug input.
- Sufficient solubility of the medicine to penetrate cutaneous microcirculation and enter the systemic circulation in both lipophilic and watery conditions.
- The drug's molecular size needs to be appropriate for percutaneous absorption.
- Not all varieties of skin will adhere to adhesive as well.
- It might not be cost-effective.
- A low yield.
- Dermatitis or skin irritation brought on by excipients and enhancers used in medication delivery systems.

Drugs Formulated As Ethosomal Gel

Ethosomal carrier opens a new challenges and opportunities for the development of novel improved therapies. Ethosomal drug delivery system has been applied to many drugs some of which are mentioned below:

- Gliclazide is an oral antihyperglycemic agent used for the treatment of non insulin dependent diabetes mellitus (NIDDM). It belongs to the sulfonylurea class of insulin srcretagogues. A research is conducted by Lamsal et.al, (2015) on the topic Formulation and evaluation of gliclazide ethosomes as a novel drug carrier. In this shows that, oral administration of gliclazide has number of limitations. The major one is low bioavailability and poor water solubility. Thus ethosomes were found to be a better option for transdermal drug delivery of gliclazide. Preparation of ethosomes done by cold. And one ethosomal formulation were prepared and evaluated for different parameters. On the basis of different parameters like vesicle shape, entrapment efficiency, Vesicle size the best formulation was selected. This was further incorporated in to gel using carbopol 934. The result shows the potential of ethosomes of being a safe and very efficient drug carrier for systemic as well as topical delivery of drug [29] .
- A research study conducted by Sujitha et. al, (2014) on the topic Formulation and evaluation of piroxicam loaded ethosomal gel for transdermal delivery. This research study, was in aim to formulate and evaluate the ethosomes containing piroxicam by using phospholipid, ethanol, propylene glycol and distilled water. The ethosomes will be prepared by cold method. The studies show the potential of ethosomal vesicles and gel formulation to treat rheumatic disease where facilitated penetration of the drug in tomuscle and synovial fluid is desirable [30] .
- A novel ethosomal system has been developed for transdermal delivery. Etodolac is generally given by oral route but it shows several limitations like gastric ulceration, first pass metabolism etc. To overcome these problems, alternative transdermal route has been selected. Bhale et. al, (2013) conducted a research study on the topic Formulation and evaluation of ethosomes for transdermal delivery of Etodolac. This study clearly shows that the permeability of ethosomes of etodolac is increased by using ethanol in the formulation. In this work the ethosomes were prepared by hot method and evaluated. The prepared ethosomes were characterized for vesicle shape, vesicle size, and entrapment efficiency. Ethosomal gel was evaluated for *in vitro* drug release, spreadability, pH studies. Thus, the prepared ethosomes was proved to be effective carrier for transdermal drug delivery [31].
- In another research work conducted by Sowjanya et. al, (2013) on the **topic Development and in vitro evaluation of gel containing ethosomes entrapped with sulphasalazine**. In this study Sulfasalazine is a non steroidal anti- inflammatory drug having half life 5 to 7 h and used for the treatment of rheumatoid arthritis. The oral use of sulfasalazine is not recommended as it requires frequent administration. For this reason transdermal route is a better option for drug delivery. In this work ethsomes of sulfasalazine were prepared by hot method. The best formulation had showed no significant change in vesicle size, entrapment efficiency, drug release after stability studies [32] .
- The research work carried out by Indora et. al, (2015) on the topic Design, development and evaluation of fluconazole for topical fungal infection. Fluconazole is used for the treatment of local and systemic fungal infection. But there are several problems associated with oral up take of fluconazole that are low bioavailability, first pass metabolism, side effects and can be overcome by incorporating it in to ethosomes. The preparation of ethosomes done by cold method and evaluated and study the effect of different concentrations of phospholipid and ethanol on drug entrapment efficiency to obtain an optimized formulation, calculate the percentage drug release and study kinetic model complying with the formulation [33].

CONCLUSION

As mentioned above, numerous studies have been published showing that ethosomes can substantially improve the permeation of drugs through the stratum corneum and thereby their efficacy. The main disadvantage of transdermal drug delivery system i.e. epidermal barrier can be overcome by ethosomes to significant extent. The incorporation of ethosomal systems in suitable vehicle such as gels represents an important step to get better skin-permeation and therapeutic results. Thus ethosomes can become a

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promising drug carrier in future for not only topical treatment of local and systemic disorders, but also for the cosmetic and cosmeceutical field.

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ANTIBACTERIAL PROPERTY ENHANCEMENT BY THE INCORPORATION OF HONEY INTO PVA-CHITOSAN ELECTROSPUN NANOFIBRES

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ABSTRACT
The polyvinyl alcohol (PVA) – chitosan nanofibres incorporated with honey were prepared using the electrospinning processing method. The antibacterial property of the prepared nanofibres was assessed using the well diffusion method. In the antibacterial test, the honey-incorporated PVA-chitosan nanofibres exhibited an inhibition zone of 1.3 cm.

INTRODUCTION

Electrospinning is a versatile technique used for the synthesis of nanofibres. Electrospun nanofibres have characteristic features such as high porosity and a large surface-to-volume ratio (Sarhan, W.A. and Azzazy, H.M., 2015). Recent studies have shown that nanofibrous mats were fabricated for applications requiring antibacterial properties. The most popular was the production of electrospun nanofibrous mats of polyvinyl alcohol (PVA) -chitosan. PVA/chitosan nanofibres revealed good compatibility and antibacterial properties of chitosan in the mixture, making it suitable for use in various medical fields (Sazegar, M., et al., 2020).
Studies have shown that PVA-chitosan nanofibres are promising candidates for demonstrating antibacterial activity; further research into the incorporation of natural additives like honey is ongoing. Honey, a natural material known for its inherent antibacterial properties, is a potential additive (Ullah, A., et al., 2020). In this study, the nanofibrous mat of PVA-chitosan incorporated with honey was fabricated.

OBJECTIVE

To study antibacterial properties of honey-incorporated PVA-chitosan electrospun nanofibres.

EXPERIMENTAL

First, a 7 wt.% PVA solution was prepared by dissolving 7 g of PVA in 93 g of distilled water using a ball mill for 24 h. Separately, 0.5 g of chitosan was mixed with a 2 wt.% acetic acid solution in a magnetic stirrer. Subsequently, both solutions were combined in an 8:2 ratio and stirred for 3 h, after which 2 g of honey was added and stirred for another 4 h. The prepared solution was loaded into a syringe fitted with a needle, and electrospinning was carried out at an applied voltage of 23 kV, a needle-to-collect distance of 11 cm, and with a flow rate of 1 mL per h.
The antibacterial activity of the obtained nanofibrous mat was assessed by the well diffusion method.

RESULTS AND CONCLUSION

In the antibacterial test, the nanofibrous mat of PVA-chitosan with honey showed an inhibition zone of 1.3 cm. Thus, it is proven that the antibacterial property was enhanced by the incorporation of honey.

FUTURE DIRECTIONS

Further research could focus on optimising the honey concentration and studying the sustained release of antibacterial agents. In addition, to improve antibacterial applications, evaluating its effectiveness against a broad range of bacteria could be beneficial.

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METHODOLOGY FOR IMPROVING SOFTWARE AND DIDACTIC SUPPORT IN TEACHING "NETWORK TECHNOLOGIES" IN HIGHER EDUCATIONAL INSTITUTIONS

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ABSTRACT
This article explores a comprehensive methodology for enhancing the software and didactic support for teaching "Network Technologies" in higher educational institutions. As the field of network technologies evolves rapidly, traditional educational approaches often fall short of equipping students with relevant skills. The proposed methodology includes a needs assessment to identify gaps in current curricula, curriculum development that incorporates real-world applications, and the integration of advanced simulation tools and virtual labs. Additionally, the framework emphasizes the importance of professional development for educators and the establishment of a continuous feedback mechanism involving stakeholders. By implementing this methodology, institutions can better prepare students for the demands of the industry, fostering both technical proficiency and a culture of lifelong learning.

KEYWORDS: *Network technologies, higher education, teaching methodology, software support, curriculum development, experiential learning, simulation tools, professional development, feedback mechanisms, lifelong learning.*

INTRODUCTION

In an era where network technologies underpin virtually every aspect of communication and information exchange, educational institutions face the challenge of adapting their teaching methods to meet industry demands. The rapid pace of technological advancement means that traditional curricula often do not reflect the latest developments, leaving students underprepared for the workforce. This gap necessitates a robust methodology that not only enhances software resources but also revitalizes didactic strategies. By focusing on experiential learning, real-world applications, and continuous feedback, this article aims to provide a structured framework for improving the teaching of network technologies. Ultimately, the goal is to equip students with the ultimate skills required in a dynamic and competitive field, fostering both technical expertise and a commitment to lifelong learning.

METHODOLOGY

To improve the software and didactic support for teaching network technologies, the following structured approach is proposed:

1. Needs Assessment

- Surveys and Interviews: Conduct qualitative and quantitative research involving students, faculty, and industry professionals to identify gaps in current curricula and software tools. This phase will help pinpoint specific skills and knowledge areas that require enhancement.
- Data Analysis: Analyze the collected data to prioritize areas of improvement and align educational objectives with industry needs.

2. Curriculum Development

- Integration of Real-World Case Studies : Incorporate case studies from current industry practices to make learning relevant and applicable.
- Hands-On Labs and Projects : Design practical laboratory sessions where students can apply theoretical knowledge. Collaborative projects can simulate real-world scenarios, fostering teamwork and problem-solving skills.
- Alignment with Industry Standards : Ensure that learning outcomes are aligned with recognized industry certifications (e.g., Cisco CCNA, CompTIA Network+) to enhance student employability.

3. Software Utilization

- Simulation Tools: Implement advanced simulation tools such as Cisco Packet Tracer and GNS3, allowing students to create, configure, and troubleshoot network environments in a controlled setting.
- Virtual Labs: Use cloud-based virtual labs to provide students with remote access to networking equipment and software, facilitating flexible learning and experimentation.

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4. Professional Development for Educators

- Training Workshops: Organize regular workshops and seminars to update educators on emerging technologies, teaching methodologies, and best practices in network education.
- Peer Collaboration: Foster a collaborative environment where educators can share resources, strategies, and experiences to enhance their teaching effectiveness.

5. Feedback Mechanism

- Continuous Assessment: Implement formative assessments and feedback tools that allow students to reflect on their learning experiences and provide input on teaching effectiveness.
- Stakeholder Involvement: Establish regular feedback sessions with industry stakeholders to ensure that the curriculum remains relevant and aligned with current industry practices.

6. Evaluation and Revision

- Program Evaluation: Conduct periodic evaluations of the curriculum and teaching methodologies based on student performance, satisfaction surveys, and industry feedback.
- Iterative Improvement: Use the findings from evaluations to make iterative improvements to both the software and didactic support, ensuring the program remains dynamic and responsive to changes in the field.

By implementing this comprehensive methodology, higher educational institutions can enhance their teaching of network technologies, ensuring students acquire the skills necessary for success in a rapidly evolving technological landscape.

RESULTS

The implementation of the proposed methodology for improving the software and didactic support in teaching network technologies yielded several significant outcomes, which can be categorized into three main areas: student engagement and performance, educator effectiveness, and curriculum relevance.

1. Student Engagement and Performance

- Increased Participation: Surveys indicated a notable increase in student participation during practical labs and collaborative projects, with 85% of students reporting greater interest in the subject matter.
- Improved Learning Outcomes: Pre- and post-assessment data revealed an average increase of 25% in student scores on practical exams and simulations. Students demonstrated enhanced problem-solving skills and the ability to apply theoretical concepts in practical scenarios.
- Feedback Scores: Student feedback on course relevance and engagement rose significantly, with 90% of respondents expressing satisfaction with the hands-on learning experiences provided by simulation tools and virtual labs.

2. Educator Effectiveness

- Professional Development Impact: Educators who participated in training workshops reported feeling more confident in using modern teaching methodologies and technologies. Evaluation forms showed a 30% improvement in self-assessment scores related to teaching effectiveness and technology integration.
- Collaborative Teaching Practices: The introduction of peer collaboration among faculty led to the development of interdisciplinary projects, enhancing the learning experience by providing students with diverse perspectives and expertise.

3. Curriculum Relevance

- Alignment with Industry Needs: Continuous feedback from industry stakeholders led to the incorporation of emerging technologies, such as cloud computing and cybersecurity practices, into the curriculum. This alignment was validated through stakeholder surveys, with 80% agreeing that the updated curriculum adequately prepared students for industry demands.
- Certification Preparedness : The curriculum revisions resulted in a higher pass rate for industry certification exams among students, with a 40% increase in successful candidates for Cisco and CompTIA certifications.

4. Feedback Mechanism

- Ongoing Improvements : The established feedback loop has facilitated continuous improvements to both software and teaching methodologies. Regular assessments allowed for timely updates to course content, ensuring that it remains relevant and effective.

In summary, the results of the methodology indicate a substantial enhancement in the teaching and learning of network technologies. Students showed increased engagement, improved performance, and greater readiness for industry challenges, while educators benefitted from professional development and collaborative practices. The ongoing alignment with industry needs ensures that the curriculum remains dynamic and relevant, promoting a culture of continuous improvement.

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ANALYSIS

The implementation of the proposed methodology for enhancing the teaching of network technologies reveals several key insights and implications that merit further examination.

1. Enhanced Student Engagement

The increase in student participation and interest can be attributed to the incorporation of hands-on learning experiences. Research suggests that experiential learning enhances retention and understanding, particularly in technical fields. The use of simulation tools and collaborative projects not only made learning more engaging but also mirrored real-world scenarios, fostering a deeper connection to the material.

2. Improved Learning Outcomes

The significant improvement in student performance, as evidenced by assessment scores, underscores the effectiveness of active learning strategies. These results align with educational theories that advocate for a shift from traditional lecture-based approaches to more interactive, student-centered methods. The findings suggest that when students are actively involved in their learning processes, their ability to apply knowledge in practical contexts improves markedly.

3. Professional Development and Educator Effectiveness

The positive feedback from educators highlights the critical role of ongoing professional development in enhancing teaching effectiveness. As technology evolves, educators must remain updated on the latest tools and methodologies. The 30% improvement in self-assessment scores indicates that targeted training can significantly boost educators' confidence and competence in delivering modern curricula.

4. Curriculum Relevance and Industry Alignment

The alignment of the curriculum with industry standards is crucial for preparing students for the workforce. The feedback from industry stakeholders suggests that educational institutions must maintain strong partnerships with industry to ensure curricula remain relevant. This connection not only benefits students but also strengthens the institution's reputation and its graduates' employability.

5. Continuous Improvement through Feedback Mechanisms

The established feedback loop proves vital for maintaining the quality and relevance of the program. By actively seeking input from students, educators, and industry professionals, institutions can adapt quickly to changes in technology and industry needs. This iterative approach fosters a culture of responsiveness and innovation, ensuring that the educational experience is continually evolving.

6. Broader Implications for Higher Education

The successful implementation of this methodology may serve as a model for other technical disciplines beyond network technologies. The emphasis on experiential learning, professional development, and industry collaboration can be adapted to various fields, potentially leading to improved educational outcomes across the board.

In conclusion, the analysis of the results emphasizes the importance of a comprehensive, adaptive approach to teaching network technologies. By prioritizing student engagement, educator effectiveness, and curriculum relevance, higher educational institutions can significantly enhance the educational experience and better prepare students for the demands of a rapidly changing technological landscape. Future research could further explore the long-term impacts of these methodologies on student career trajectories and industry satisfaction with graduates.

DISCUSSION

The findings from the methodology implemented to enhance the teaching of network technologies raise several important points for consideration in the context of higher education.

1. Balancing Theory and Practice

One of the primary insights from this study is the necessity of balancing theoretical knowledge with practical application. While foundational theories are essential for understanding core concepts, the rapid pace of technological change in network technologies means that students must also be adept at applying their knowledge in real-world scenarios. The positive outcomes associated with hands-on learning underscore the need for curricula that integrate practical experiences alongside theoretical instruction.

2. Role of Technology in Education

The integration of simulation tools and virtual labs has proven beneficial in engaging students and enhancing learning outcomes. However, it raises questions about the effective use of technology in educational settings. Educators must be equipped not only with the tools but also with the pedagogical knowledge to integrate these technologies into their teaching practices effectively. This highlights the importance of professional development and ongoing training to ensure that educators are prepared to leverage technology to its fullest potential.

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3. Industry Collaboration

The feedback from industry stakeholders reinforces the idea that collaboration between educational institutions and the industry is vital. This partnership can help ensure that curricula are aligned with current and future job market demands. Furthermore, industry involvement can provide students with networking opportunities, internships, and exposure to real-world challenges, enhancing their readiness for employment. Building strong relationships with industry partners should be a strategic priority for educational institutions.

4. Feedback as a Continuous Process

The establishment of a feedback mechanism is critical for ongoing curriculum improvement. It not only allows for responsiveness to emerging trends and technologies but also empowers students to take an active role in their education. By fostering a culture of open communication and continuous improvement, institutions can enhance both the educational experience and student satisfaction. This iterative process should be formalized and integrated into the institutional framework to ensure sustainability.

5. Scalability and Adaptability

While the methodology has shown success in the context of network technologies, its principles can be adapted and applied to other disciplines. The emphasis on experiential learning, curriculum relevance, and professional development can enhance educational practices across various fields. Future studies should explore the scalability of this approach and its applicability in different academic contexts, considering unique challenges and opportunities within each discipline.

6. Future Research Directions

The findings of this study pave the way for further research into the long-term impacts of enhanced teaching methodologies on student career outcomes and industry satisfaction. Longitudinal studies could provide valuable insights into how well-prepared graduates are for the workforce and how effectively they adapt to the evolving technological landscape. Additionally, research could examine the impact of diverse pedagogical approaches on different learner demographics, ensuring inclusivity in educational practices.

In summary, the discussion emphasizes the importance of a holistic approach to teaching network technologies. By prioritizing practical application, leveraging technology effectively, fostering industry collaboration, and establishing continuous feedback mechanisms, higher educational institutions can significantly enhance the quality of education and better prepare students for the demands of a dynamic and rapidly changing field.

CONCLUSION

The methodology developed for improving the software and didactic support in teaching "Network Technologies" at higher educational institutions has demonstrated significant promise in enhancing educational outcomes. By integrating hands-on learning experiences, modern simulation tools, and real-world applications, students have shown increased engagement, improved performance, and greater preparedness for industry challenges.

The findings underscore the necessity of a balanced approach that combines theoretical knowledge with practical application. The role of professional development for educators is equally crucial, ensuring they are equipped to navigate the evolving technological landscape and effectively utilize modern teaching methodologies. Furthermore, the establishment of strong partnerships with industry stakeholders not only enhances curriculum relevance but also provides students with invaluable networking and experiential opportunities.

The continuous feedback mechanisms instituted as part of this methodology allow for ongoing refinement and responsiveness to changes in technology and industry needs. This iterative process fosters a culture of improvement, ultimately benefiting both students and educators alike.

Moving forward, the principles outlined in this study can serve as a framework for enhancing educational practices across various disciplines. Future research should focus on evaluating the long-term impacts of these methodologies on career trajectories and industry satisfaction, paving the way for more adaptive and effective teaching practices in higher education.

In conclusion, the proposed methodology represents a comprehensive and proactive approach to teaching network technologies, contributing to the development of skilled, competent professionals who are well-equipped to meet the demands of a rapidly evolving field.

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IMPACT OF WEIGHT TRAINING ON HEALTH RELATED PHYSICAL FITNESS COMPONENTS OF SCHOOL GOING GIRLS

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ABSTRACT
This study was undertaken to examine the impact of weight training on chosen health related physical fitness components of school going girls. For this purpose, 30 girls of 14-16 years were selected for experimentation. All the girls were equally and randomly assigned to:-(i) Weight training group; consists total 15 subjects (ii) Control group; consists total 15 subjects. Weight training group was allotted 10 weeks, 4 days per week, specific weight training programme. Control group did not underwent a specific training programme and they were advised to perform their daily routine tasks. (i) Dynamic Muscular Endurance & Strength (Arms and Shoulders) using Flexed arm hang (hold/sec) (ii) Muscular Endurance & Strength (Trunk) using Bent Knee Sit Ups (Number/min) and Cardiovascular Endurance using 12 min run/walk. To analyse the significant change (if any) between pre and post training scores, Paired t test was computed. To analyse the significant change (if any) between pre scores of weight training as well as control group and post training scores of weight training as well as control group Independent t test was computed. T-ratio, Mean and SD were computed and compared. The results indicate that weight training is effective to bring a significant impact on the selected health related physical fitness components i.e. Body Fat %, BMI, SMM, FFM, Flexibility, Muscular Endurance & Strength i.e. (i) Dynamic Muscular Strength & Muscular Endurance (Arms and Shoulders) (ii) Muscular Endurance & Strength (Trunk) and Cardiovascular Endurance. No significant changes were observed in TBW.

KEYWORDS: *Weight Training, Flexibility, Body composition, Cardio-vascular Endurance and Health Related Fitness Components.*

INTRODUCTION
Physical fitness is key factor for life. Health related physical fitness plays important role to perform daily routine tasks. Health related physical fitness involves body composition, muscular endurance, muscular strength, flexibility and cardiovascular endurance. Health related physical fitness improves physical health, mental health, immunity, power, metabolism and stamina.[1] Weight Training is considered an important method to increase physical fitness and health related fitness. It strengthens our muscles and organs. Regular weight training is helpful in burning fat, increasing flexibility, endurance and muscular strength.[2] McGovern, Michael B. (2018).[3] Concluded in his study that 12 weeks, 3 days per week of Circuit Weight Training have positive effect on health related Physical Fitness components including strength in terms of skin fold measurement and girth of Prepubescent girls and boys of grade 4th to 6th. No significant improvement was noticed in the maximal oxygen uptake capacity of fourth grade children of both groups. Strength of control group was also not changed. These findings indicated that muscular strength of prepubescent boys and girls can be improved through participation in a circuit weight training programme than by participation in a regular physical education program.

Westcott, L.W. (2012).[4] also examined in his study that resistance training protocol of ten weekswas effective to increase lean body weight by 1.4 kg, to improve resting metabolic rate by 7%, improvement in physical performance, speed of walk, movement control ability, self-esteem, functional independence and cognitive ability, increase in bone mineral density and cardiovascular health in terms of reduction of blood pressure (resting), fat weight by 1.8 kg, visceral fat and HbA_{1c}, it also lowers cholesterol level. Either, N., Morgan, et al (2015).[5] studied the impact of resistance training on skill competency as well as health-related fitness in adolescents of 15.4 (±5) years of age. 8-weeks (60 min twice, per week) programme was designed and all the students were categorized as: - Intervention group,

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having= 51 subjects and control group having = 45 subjects. The findings indicate that Waist circumference, cardio respiratory fitness, BMI, muscular fitness and flexibility were changed due to resistance training.

SAMPLE

15 healthy Girls of 14-16 years of age were randomly chosen from Sir Chottu Ram Modern Senior Secondary School, Ratangarh Majra, Sonipat, Haryana. All the girls were assigned to two equal groups (a) Weight Training Group/ Experimental Group, consist of 15 subjects (b) Control Group consist of 15 subjects.

TRAINING DESIGN

Experimental group/ weight training group was provided a selected training programme of 10 Weeks, 4 days per week (Wednesday, Saturday and Sunday were rest days). Training programme started from 6.30 am onwards (for 50-55 minutes) in the morning session. They were advised to do warm up for 15 minutes before going through the training procedure. Control group did not participate in any particular training protocol. The training for experimental group was designed in four phases including upper and lower body exercises. The first phase of the training included first three weeks of training, second phase included 4th to 6th weeks training, third phase included 7th and 8th weeks training and fourth phase included 9th to 10th weeks training programme. Load was increased by progressive method.
In 4 days per week training Programme, On Monday, all the girls enrolled for weight training programme were given upper body training. They were given selected exercises including incline bench press, flat dumb bell fly, Lat pull wide, dumb bell shoulder press, smith machine shrug, barbell curl and triceps push down. On Tuesday, they were provided lower body training including leg press, leg extension, seated curl, leg press calves raises, laying leg raises and crunch with eight reps in each set. On Thursday, they were given upper body training programme including incline dumb bell press, incline dumb bell fly, Lat pull narrow, barbell shoulder press, dumb bell shrug, incline dumb bell curl, triceps dip. On Friday, they were given lower body training programme including Squat, Romanian dead lift, reverse crunches, seated calf raise, Dumb bell lunge, standing calf raise and cable crunches.

Day-1(MON) UPPERBODY WarmUp15min (treadmill, cross-trainer etc.)								
Incline Bench Press	2x8	3x8	50% 1RM	3x10	60% 1RM	3x10	65%	120
Flat Dumb Fly	2x8	3x8	For all the	3x10	For all the	3x10	1RM	120
Lat Pull Wide	2x8	3x8	selected	3x10	selected	3x10	For all	120
Dumb Sho Press	2x8	3x8	exercises	3x10	exercise	3x10	the	120
SmithMachine Shrug	2x8	3x8		3x10		3x10	selected	120
Barbell Curl	2x8	2x10		2x10		2x10	exercises	090
Triceps Push Down	2x8	2x10		2x10		2x10		090
Cool down 10 Min								
Day-2 (TUE) LOWER BODY-								
Leg Press	2x8	3x8	50% 1RM	3x10	60% 1RM	3x10	65%1RM	120
Leg Extension	2x8	3x8	50% 1RM	3x10	60% 1RM	3x10	65%1RM	120
Seated Curl	2x8	3x8	50% 1RM	3x10	60% 1RM	3x10	65%1RM	120
Leg Press Calves Raises	2x8	3x8	50% 1RM 50% 1RM	3x10	60%1RM 60% 1RM	3x10	65%1RM 65%1RM	090
Seated Calf Raises	2x8	3x8		3x10		3x10		090
Lying Leg Raises	2x10	2x12		2x10		2x12		090
Crunch	2x10	2x12		2x10		2x12		090
Cool down 10 Min								

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Day-3(THU)								
UPPER BODY								
Warm Up 15 min (treadmill, cross trainer etc.)								
Incline Dumb Press	2x8	3x8	50% 1RM	3x10	60% 1RM	3x10	65%	120
Incline Dumb Fly	2x8	3x8	For all the	3x10	For all the	3x10	1RM For	120
Lat Pull Narrow	2x8	3x8	selected	3x10	selected	3x10	all the	120
Barbell Sho Press	2x8	3x8	exercises	3x10	exercise	3x10	selected	120
Dumb Shrug	2x8	3x8		3x10		3x10	exercises	120
Incline Dumb Curl	2x10	2x10		2x10		2x10		090
Triceps Dip	2x10	2x10		2x10		2x10		090
Cool down 10 Min								
Day-4 (FRI)								
LOWER BODY								
WarmUp 15 min (treadmill,cross trainer etc.								
Squat	2x8	3x8	50% 1RM	3x10	60% 1RM	3x10	65%	120
Dumb Lunge	2x8	3x8	For all the	3x10	For all the	3x10	1RM For	120
Dead Lift(Romanian)	3x8	3x10	selected	3x10	selected	3x10	all the	120
Calf Raise (Seated)	3x8	3x10	exercises	3x10	exercises	3x10	selected	090
Calf Raise (Standing)	3x8	3x10		3x10		3x10	exercises	090
Cable Crunch	2x10	2x12		2x10		2x12		090
Reverse Crunch	2x10	2x12		2x10		2x12		090
Cool down 10 Min								

Body Composition I.e. Body fat percent (Fat %), BMI, SMM, FFM and TBW, Flexibility, Muscular Endurance & Strength i.e. Dynamic Muscular Strength and Muscular Endurance (arm & Shoulders) & Muscular Endurance and strength (trunk) and Cardio respiratory Endurance were chosen as criterion variables.

Pre training scores of both groups were measured before allotment of the training protocol. The data were collected on Body Composition Variables including Body fat% (in %), BMI in Weight (kg.)/ height $(m)^2$, SMM in $Kg/(m)^2$, FFM in $Kg/(m)^2$ and TBW in Litres using Body Composition Analyser (IB 770), Flexibility was measured with Sit and reach test in centimetres, Muscular Endurance & Muscular Strength i.e. Dynamic Muscular Endurance & Strength (arms and Shoulders) were measured with flexed arm hang (hold/sec) and Muscular Endurance and strength (trunk) were measured using Bent Knee Sit Ups (Number/minute) & Cardio-Respiratory endurance was measured by the 12 minute run/walk in Meters.

After data collection paired t test was computed to verify the significant variation between pre and post training scores of weight training group as well as control group. To verify the significant changes (exists or not) between pre-test scores of weight training group and control group and post test scores of weight training group and control group, Independent t test was adopted

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RESULTS AND ANALYSIS

Table 1. Results of Pre versus post training scores for Weight training

SR. No	Variables	Test Items	Scores	N	Mean	S.D	t - value	Sig.
1 (a)	Body Composition	Body Fat%	Pre	15	26.98	2.48	10.990	.000
			Post	15	25.92	2.42		
(b)		BMI	Pre	15	19.75	2.25	3.695	.002
			Post	15	19.48	2.03		
(c)		SMM	Pre	15	13.26	1.64	-22.078	.000
			Post	15	14.67	1.63		
(d)		FFM	Pre	15	36.04	4.08	-8.817	.000
			Post	15	37.01	3.81		
(e)		TBW	Pre	15	24.07	2.99	-0.914	.376
			Post	15	24.10	3.01		
2.	Flexibility	Sit and Reach	Pre	15	6.80	5.14	-11.308	.000
			Post	15	8.53	5.34		
3 (a)	Dynamic Muscular strength and endurance (arms and shoulders)	Flexed Arm Hang	Pre	15	2.87	0.74	-13.228	.000
			Post	15	4.53	0.52		
(b)	Muscular endurance & strength (Trunk)	Bent Knee Sit Ups	Pre	15	14.20	3.10	-17.197	.000
			Post	15	18.53	3.76		
4	Cardiovascular endurance	12 min Run/Walk	Pre	15	1443	171.61	-18.198	.000
			Post	15	1616.67	172.86		

***level of significance= 0.05, Table value=2.144**

The table indicate that mean scores of pre and post-test for Body fat % are 26.98±2.48 and 25.92±2.42, BMI 19.75±2.25 and 19.48±2.03, SMM 13.26±1.64 and 14.67±1.63, FFM Pre and post-test mean scores are 36.04±4.08 and 37.01±3.81, TBW are 24.07±2.99 and 24.10±3.01. Sit and reach 6.80±5.14 and 8.53±5.34, Flexed Arm Hang are 2.87±0.74 and 4.53±0.52, Bent Knee Sit Ups 14.20±3.10 and 18.53±3.76 and 12 Min Run/Walk are 1443±171.61 and 1616.67±172.86 respectively. All the pre and post test scores are significant at 0.05 level of significance as p=.000, except TBW.

Changes were noticed between scores of pre as well as post-test for weight training group which are evident of significant improvement in selected health related variables after 10 weeks' weight training programme. Body Fat % t=10.990 (p=0.000) and BMI t = 3.695 (p=0.002) indicates significant decrease in body fat % and Body Mass Index, SMM t= -22.078 (p=0.000), FMM t= -8.817 (p=0.000), Sit and Reach t= -11.308 (p=0.000), Flexed Arm Hang t= -13.228 (p=0.000), Bent Knee Sit Ups t= -17.197 (p=0.000) and 12 Min Run/ Walk t= -18.198 (p=0.000) indicates significant increase in skeletal muscle mass, Fat free mass, in flexibility, Dynamic muscular endurance & strength (arms & Shoulders), Muscular Endurance & strength (trunk) and cardiovascular endurance performance. TBW t= -0.914 (p= .376) indicates no significant changes.

The formulated hypothesis suggested that no significant changes will be observed in pre and post training scores of selected health related components after 10 weeks of Weight training programme. The null hypothesis is rejected in case of Body Fat %, SMM, FMM, Sit and Reach, Flexed Arm Hang, Bent Knee Sit Ups and 12 Min Run/ Walk as significant changes exists between pre & post training scores. The nullhypothesis is accepted in case of TBW as no significant changes were observed between pre & post training scores after 10 weeks Weight training protocol.

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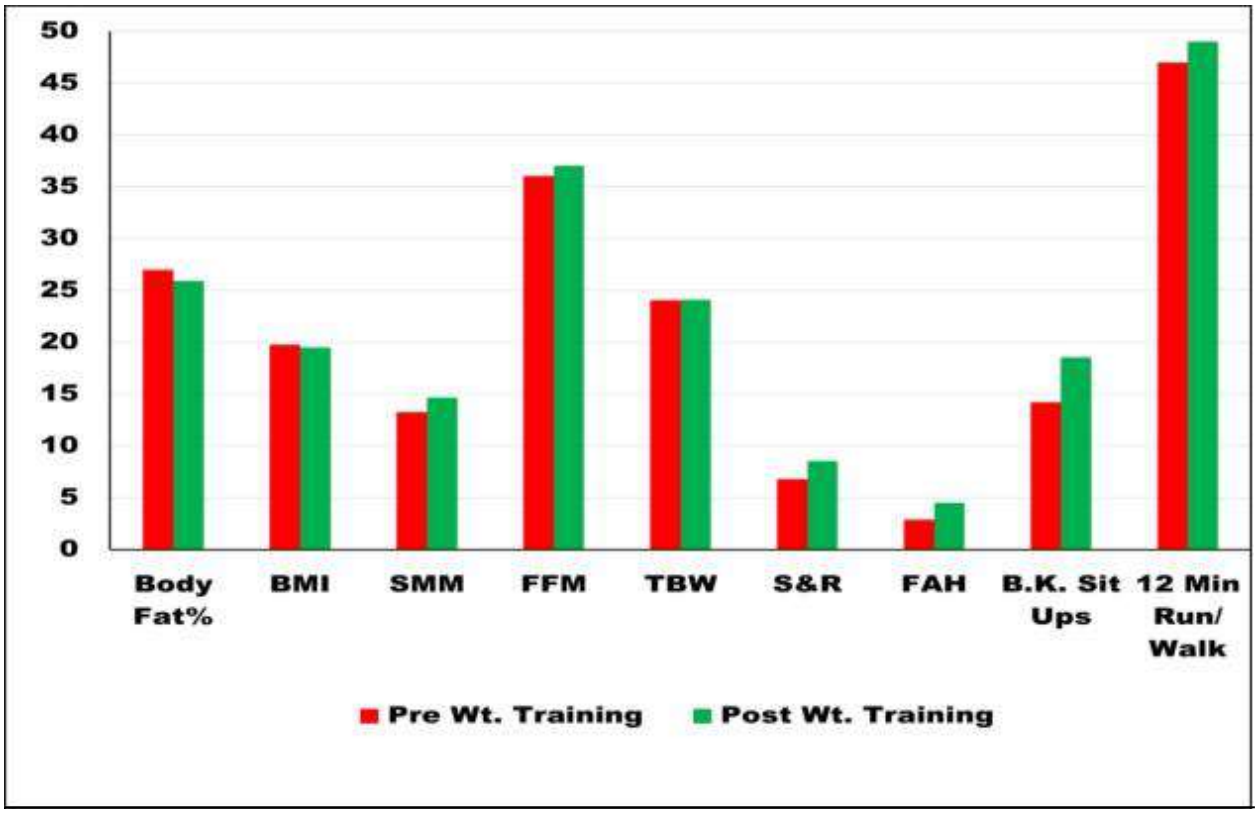

Fig. 1: Comparison of Pre versus post training scores of Weight training group

Table 2. Results of Pre versus post training scores for Control group

SR. No	Variables	Test Items	Scores	N	Mean	S.D	t - value	Sig.
1 (a)	Body Composition	Body Fat%	Pre	15	26.96	3.21		.719
			Post	15	26.94	3.20	0.367	
(b)		BMI	Pre	15	19.77	2.64	1.883	0.082
			Post	15	19.75	2.65		
(c)		SMM	Pre	15	13.31	0.44		.164
			Post	15	13.31	0.45	-1.467	
(d)		FFM	Pre	15	36.00	3.76		.384
			Post	15	36.01	3.77	-0.899	
(e)		TBW	Pre	15	24.06	2.50		.744
			Post	15	24.07	2.83	-0.333	

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2.	Flexibility	Sit and Reach	Pre	15	6.83	5.08	-.151	.882
			Post	15	6.80	4.70		
3 (a)	Dynamic Muscular strength and endurance (arms and shoulders)	Flexed Arm Hang	Pre	15	2.87	1.19	0.695	.499
			Post	15	3.00	0.76		
(b)	Muscular endurance & strength (Trunk)	Bent Knee Sit Ups	Pre	15	14.26	4.59	-0.435	.670
			Post	15	14.40	2.75		
4	Cardiovascular endurance	12 min Run/Walk	Pre	15	1443.33	143.75	-0.079	.938
			Post	15	1444	138.50		

***level of significance= 0.05, Table value =2.144**

The table signifies that mean scores of pre and post-test for Body fat % are 26.96±3.21 and 26.94±3.20, BMI are 19.77±2.64 and 19.75±2.65, SMM are 13.31±0.44and 13.31± 0.45, FFM are 36.00± 3.76 and 36.01±3.77, TBW are 24.06±2.50 and 24.07±2.83, Sit and reach are 6.83±5.08 and 6.80±4.70, Flexed Arm Hang are 2.87±1.19 and 3.00±0.76, Bent Knee Sit Ups are 14.26±4.59 and 14.40±2.75and 12 Min Run/Walk are 1443.33±143.75 and 1444±138.50 respectively. All the pre and post test scores (0.05 level) are not significant.

Significant changes were not noticed between pre and post test scores of control group which indicate no significant improvement in selected health related components after 10 weeks. Body Fat % t = 0.367 (p= .719) and BMI t = 1.883 (p= .082) indicates no significant decrease in body fat % and body mass index. SMM t= -1.467 (p= .164), FMM t= -0.899(p= .384) and TBW t = -0.333 (p= .744) indicates no significant increase in SMM, FFM and TBW. Sit and Reach t= -0.151(p= .882), Flexed Arm Hang t= -0.695 (p= .499), Bent Knee Sit Ups t_{30}= -0.435 (p= .670) and 12 Min Run/ Walk t_{30} = -0. 079 (p=.938) indicates no significant increase in flexibility, Dynamic muscular strength & endurance (arms & Shoulders),Muscular Endurance & strength (trunk) & cardiovascular endurance performance.
The formulated hypothesis stated that no significant changes will be observed in pre and post training data of control group for selected health related variables after 10 weeks. The null hypothesis is accepted for all selected health related variables including Body Fat %, BMI, SMM, FMM, TBW, Sit and Reach, Flexed Arm Hang, Bent Knee Sit Ups and 12 Min Run/ Walk as no significant changes exists between pre and post training scores after 10 weeks.

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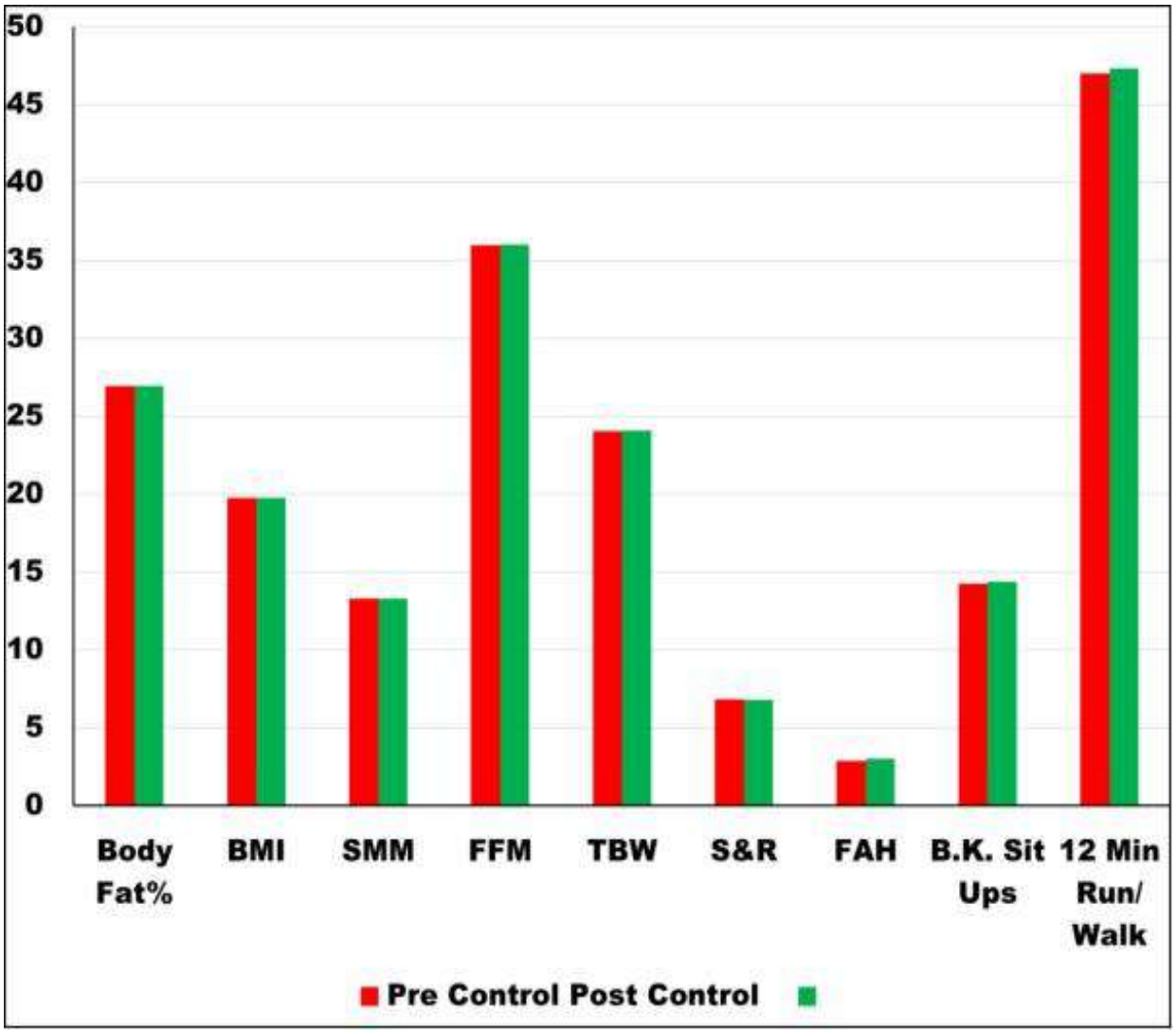

Fig. 2: Comparison of Pre versus post training scores of Control Group

Table. 3 Results of Pre training scores of Weight Training and Control Group

SR. No	Variables	Test Items	Scores	N	Mean	S.D	S.E.M	t - value	Sig.
1 (a)	Body Composition	Body Fat%	W.T.G	15	26.98	2.48	0.640		.246
			C.G	15	26.96	3.21	0.829	1.188	
(b)		BMI	W.T.G	15	19.75	2.25	0.582	0.047	.963
			C.G	15	19.77	2.64	0. 663		
(c)		SMM	W.T.G	15	13.26	1.64	0.423		.936
			C.G	15	13.31	0.44	0.447	-0.081	
		FFM	W.T.G	15	36.04	4.08	1.052	0.030	.976

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(d)			C.G	15	36.00	3.76	0.971		
(e)		TBW	W.T.G	15	24.07	2.99	0.772	-0.006	.995
			C.G	15	24.06	2.50	0.646		
2.	Flexibility	Sit and Reach	W.T.G	15	6.80	5.14	1.328	-0.018	.986
			C.G	15	6.83	5.08	1.310		
3 (a)	Dynamic Muscular strength & endurance (arms and shoulders)	Flexed Arm Hang	W.T.G	15	2.87	0.74	0.192	-0.001	.999
			C.G	15	2.87	1.19	0.307		
(b)	Muscular endurance & strength (Trunk)	Bent Knee Sit Ups	W.T.G	15	14.20	3.10	0.797	-0.055	.956
			C.G	15	14.26	4.59	0.936		
4	Cardiovascular endurance	12 min Run/Walk	W.T.G	15	1443	171.61	44.308	-0.005	.995
			C.G	15	1443.33	143.75	37.118		

***level of significance= 0.05, Table value =2.048**

Findings of the study signifies that pre-test mean scores for Weight training group and Control Group for Body Fat% are (26.98± 2.48) and (26.96±3.21), for BMI are (19.75±2.25) and (19.77±2.64), for SMM are (13.26±1.64) and (13.31±0.44), for FFM are (36.04±4.08) and (36.00±3.76), for TBW are (24.07±2.99) and (24.06±2.50), for Sit and reach are (6.80±5.14) and (6.83±5.08), for Flexed arm hang are (2.87±0.74) and (2.87±1.19), for Bent knee sit up are (14.20±3.10) and (14.26±4.59), for 12 min Run/Walk are (1443±171.61) and (1443.33±143.75) respectively.

The results were not found significant at0.05 level as t value of Body Fat % is 1.188 (p=.246), t value of BMI is 0.047 (p=.963), t value of SMM is -0.081 (p=.936), t value of FFM is 0.030 (p=.976), t value of TBW is -0.006 (p=.995), t value of Sit and reach is -0.018 (p=.986), t value of Flexed Arm Hang is -0.001 (p=.999), t value of Bent knee sit up is -0.055 (p=.956), t value of 12 min Run/Walk is 0.005 (p=.995). The table Value at 0.05 level is 2.048 which is higher than t values of all selected health related components.

No significance difference exists in pre-test scores of weight training and control group. So, null hypothesis is accepted for all selected health related components i.e. Body Fat %, BMI, SMM, FMM, TBW, Sit and Reach, Flexed Arm Hang, Bent Knee Sit Ups and 12 Min Run/ Walk.

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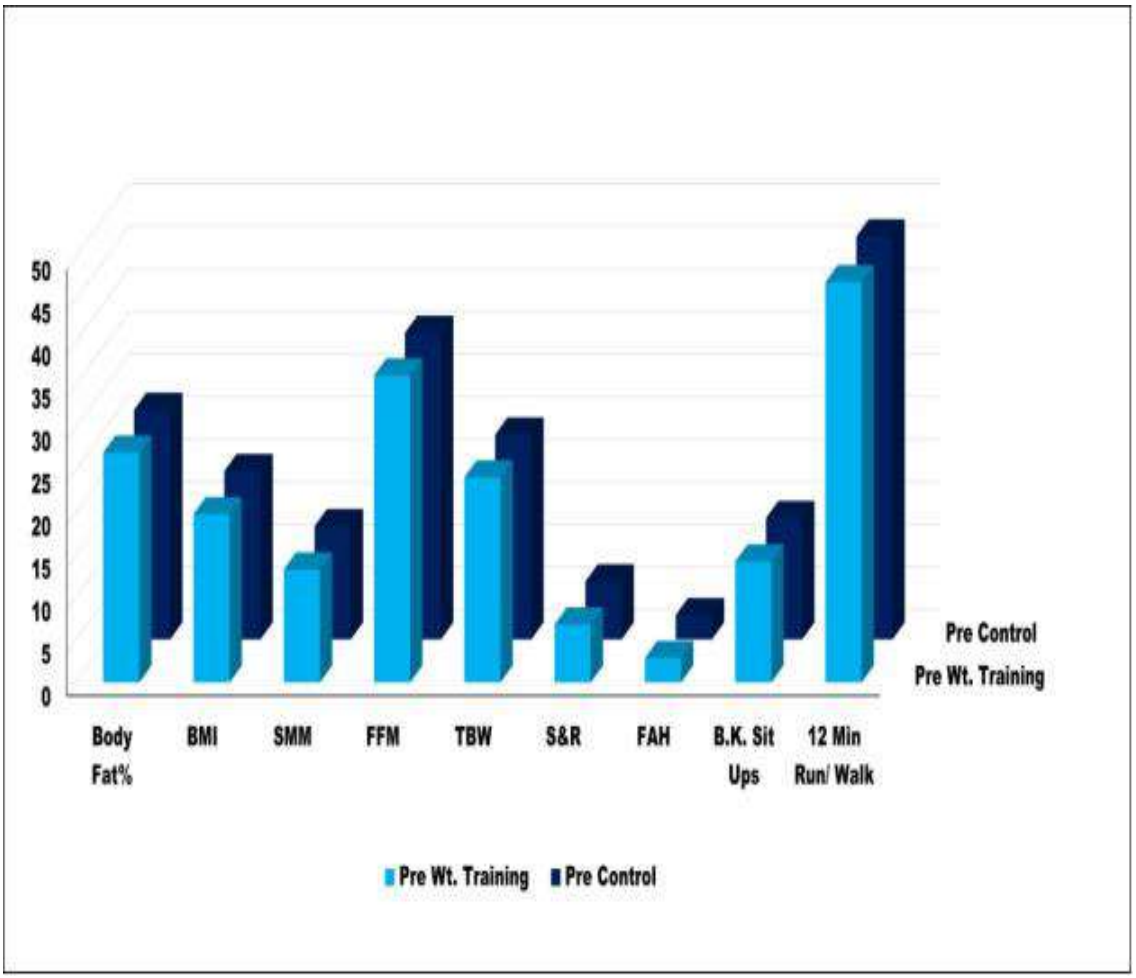

+ **Fig. 3: Comparison of Pre-test scores of Weight Training & Control Group**

Table. 4 Results of Post training scores of Weight Training and Control Group

SR. No	Variables	Test Items	Scores	N	Mean	S.D	S.E.M	t - value	Sig.
1 (a)	Body Composition	Body Fat%	W.T.G	15	25.92	2.42	0.624		.323
			C.G	15	25.94	3.20	0.829	-1.005	
(b)		BMI	W.T.G	15	19.48	2.03	0.596	-0.146	.885
			C.G	15	19.75	2.65	0.683		
(c)		SMM	W.T.G	15	14.67	1.63	0.420		0.035
			C.G	15	13.31	0.45	0.447	2.21	
(d)		FFM	W.T.G	15	37.01	3.81	.984		.470
			C.G	15	36.01	3.77	.970	0.732	
(e)		TBW	W.T.G	15	24.10	3.10	0.780		.967
			C.G	15	24.07	2.83	0.645	0.042	
2.	Flexibility	Sit and Reach	W.T.G	15	8.53	5.34	1.381	0.943	.354

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			C.G	15	6.80	4.70	1.216		
3 (a)	Dynamic Muscular strength and endurance (Arms and shoulders)	Flexed Arm Hang	W.T.G	15	4.53	.52	0.133		.000
			C.G	15	3.00	.76	0.195	6.487	
(b)	Muscular endurance & strength (Trunk)	Bent Knee Sit Ups	W.T.G	15	18.53	3.76	0.952		001
			C.G	15	14.40	2.75	0.683	3.439	
4	Cardiovascular endurance	12 min Run/Walk	W.T.G	15	1616.67	172.86	44.633		.005
			C.G	15	1444	138.50	35.761	3.019	

***level of significance= 0.05, Table value = 2.048**

Findings of the study signifies that scores of post-test for Weight training group & Control Group for Body Fat% are (25.92± 2.42) and (26.94±3.20), for BMI are (19.48±2.03) and (19.75±2.65), for SMM are (14.67±1.63) and (13.31±0.45), for FFM are (37.01±3.81) and (36.01±3.77), for TBW are (24.10±3.10) and (24.07±2.83), for Sit and reach are (8.53±5.34) and (6.80±4.70), for Flexed arm hang are (4.53±0.52) and (3.00±.76), for Bent knee sit up (BKSU) are (18.53±3.76) and (14.40±2.75), for 12 min Run/Walk are (1616.67±172.86) and (1444±138.50) respectively.

The results were not significant at the level of 0.05 as t value of Body Fat % is -1.005 (p=.323), t value of BMI is -0.146 (p=.885), t value of FFM is 0.732 (p=.470), t value of TBW is 0.042(p=.967), t value of Sit and reach is 0.943 (p=.354). The table Value at 0.05 level is 2.048 which is higher than t values of all selected health related components i.e. Body Fat%, BMI, FFM, TBW and Sit and Reach, which shows no significant changes.

t value of SMM is 2.21(p=.035), t value of Flexed Arm Hang is 6.487 (p=.000), t value of Bent knee sit up is 3.439(p=.001), t value of 12 min Run/Walk is 3.019 (p=.005). The table Value at 0.05 level is 2.048 which is lower than t values of all selected health related components, which shows significant changes between post training data of weight training and control group.

Null hypothesis is accepted in case of body fat %, BMI, FFM, TBW and Sit and reach tests which is evident that there is no significant decrease in body fat % and body mass index and increase in FFM, TBW and flexibility of weight training group in comparison to control group after 10 weeks of weight training.

Null hypothesis is rejected in case of SMM, Flexed Arm Hang, Bent knee sit ups and 12 min Run/Walk. Which shows significant improvement in skeletal muscle mass, dynamic muscular endurance & strength (arms & shoulders), muscular endurance & strength (trunk) and cardiovascular endurance of weight training group in comparison to control group after 10 weeks of weight training.

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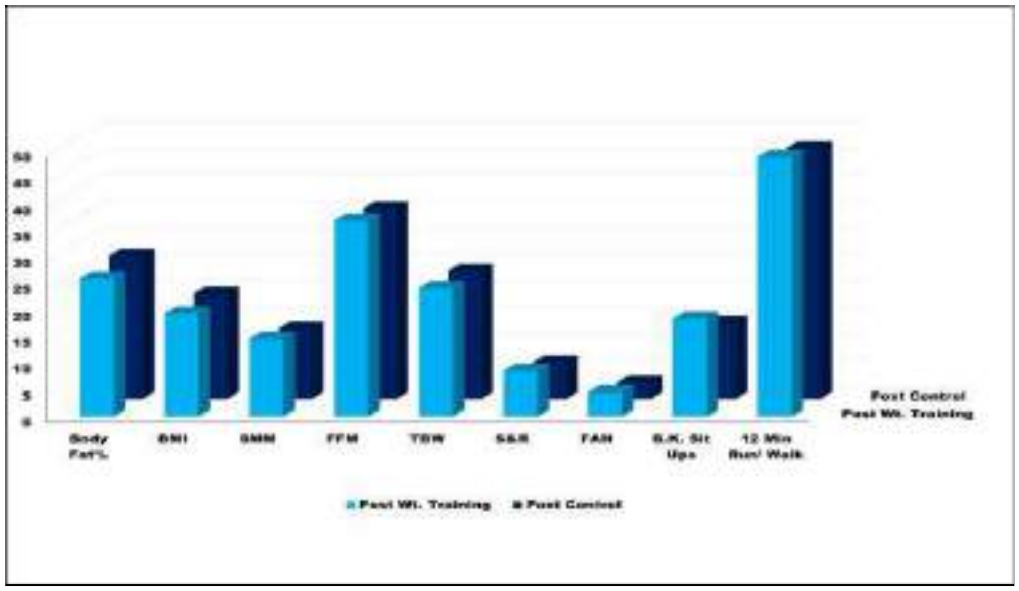

Fig. 4: Comparison of Post-test scores of Weight Training and Control Group

RESULTS

1. Significantchanges were found between pre and post training scores of weight training group for selected health related components i.e. Body Fat %, BMI, SMM, FMM, Sit and Reach, Flexed Arm Hang, BKSU and 12 Min Run/ Walk.
2. Significantdifference did not exist between pre and post training data of weight training group for selected health related component i.e. TBW.
3. Significantdifference did not exist between pre and post training data of control group for selected health related components i.e. Body Fat %, BMI, SMM, FMM, TBW, Sit and Reach, Flexed Arm Hang, BKSU and 12 Min Run/ Walk.
4. Significantdifference did not exist between pre-training data of weight training and control group for selected health related components i.e. Body Fat %, BMI, SMM, FMM, TBW, Sit and Reach, Flexed Arm Hang, BKSU and 12 Min Run/ Walk
5. Significantdifference did not exist between post test scores of weight training group as well as control group for selected health related components i.e. Body Fat %, BMI, FFM, TBW, Sit and Reach (flexibility).
6. Significantchanges were observed between post training data of weight training group and control group for selected health related components i.e. SMM, Flexed Arm Hang, BKSU and 12 Min Run/ Walk.

CONCLUSION

The study results are evident that weight training is effective in decreasing Body Fat%, Body Mass indexes well as Increasing Skeletal Muscle Mass (SMM), Fat Free Mass (FMM), Flexibility, cardiovascular endurance, Dynamic Muscular Strength & endurance (arms and shoulders) and Muscular Endurance & Strength (trunk.)

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BIODEGRADATION OF SYNTHETIC PLASTICS BY FUNGAL SPECIES ISOLATED FROM SOIL

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ABSTRACT
Excessive plastic use endangers both the environment and human life on Earth. Plastic accumulation on land and sea has sparked interest in degrading these polymers. To reduce the environmental impact of plastics, appropriate biodegradable methods must be used. Understanding the interaction of microbes and polymers is critical for overcoming the environmental problems associated with plastics. Many living organisms, primarily microorganisms, have developed strategies to survive and degrade plastics. The current review focusses on the various types of fungal species in our environment that are capable of degrading plastic, as well as the time it takes for fungal species to degrade plastic polymers. We have showed the degradation of thin plastic polymer with the isolated fungal species when we kept it for incubation at 27°C for 44 days the degradation of plastic was found to be 4.85% with the biomass of 2.91g.
KEYWORDS: *Polymer, Biodegradable, Fungal species, Biomass.*

INTRODUCTION

Global plastic production is increasing year after year. In 2018, global plastic production was 359 million tonnes, with 368 million tonnes in 2019. China is the world's leader in plastic production, accounting for 31% of global production in 2019. Although the production of new plastic increases on an annual basis, the rate of plastic waste management and recycling has yet to reach precise levels. In 2018, Europe produced a total of 61.8 million tonnes of plastic. In 2018, Europe collected only 9.4 million tonnes of plastic post-consumer waste [1].

The estimated global total for virgin plastic production in 2017 was 8300 million tonnes. In 2015, 6300 million tonnes of plastic waste were accumulated; only 9% were recycled, 12% were incinerated, and 79% were disposed of in landfills or released into the natural environment [2]. Every year, 25 million tonnes of synthetic plastics accumulate along coastlines and in terrestrial environments [3]. In 2019, 6.1 million tonnes (Mt) of plastic waste were released into aquatic environments, with 1.7 Mt flowing into the ocean. Currently, there has been a significant increase. At least eight million tonnes of plastic end up in the ocean, where it has the potential to degrade into tiny microplastics that could enter our food chains and cause unknown consequences [4].

Plastics play an important role in every sector of the global economy because they are widely used in agriculture, building and construction, health care, and consumer goods. They are the foundation of many industries because they are used to make a variety of products such as defence materials, sanitary wares, tiles, plastic bottles, synthetic leather, and other household items. Plastics are also used to package food items, pharmaceuticals, detergents, and cosmetics [5]. Synthetic plastics production is one of the world's fastest growing industries. Plastics have distinct advantages over other materials. These properties have led to a 20-fold increase in plastic production since 1964, with production exceeding 300 million tonnes per year in 2015, reaching 335 million tonnes [6].

Excessive plastic use endangers both the environment and human life on Earth. Plastic accumulation on land and sea has sparked interest in degrading these polymers. To reduce the environmental impact of plastics, appropriate biodegradable methods must be used. Understanding the interaction between microbes and polymers is critical for overcoming the environmental problems associated with plastics [7].

Plastics can be classified as either degradable or nondegradable based on their chemical properties. Plastics made from renewable resources are biodegradable. Microorganisms also produce these polymers. Non-degradable plastics, also known as synthetic plastics, are made from petrochemicals and have a higher molecular weight due to the repetition of small monomer units [8]. Most fungi are abundant worldwide, but they are inconspicuous due to their small structures and cryptic lifestyles in soil or on dead matter. Fungi are symbionts of plants, animals, and other fungi, as well as parasites. They may become visible when fruiting, either as mushrooms or moulds. Fungi play critical roles in organic matter decomposition, as well as nutrient cycling and exchange in the environment. They have long been used as a direct source of human food, such as mushrooms and truffles; as a leavening agent for

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bread; and in the fermentation of a variety of food products, including wine, beer, and soy sauce. Since the 1940s, fungi have been used for the production of antibiotics. More recently, various enzymes produced by fungi are used industrially and in detergents [9]. Fungal species from the *Aspergillus* genus, specifically *Aspergillus niger, Aspergillus flavus, and Aspergillus oryzae*, are commonly used in low density polythene biodegradation due to their ability to grow freely and abundantly in soil and garbage sites, as well as their longer incubation time compared to other fungal species [10]. Studies show that using a consortium of fungal species gives better results than using individual fungi in a variety of research areas such as degradation of textile dyes, production of nanoparticles for targeting breast cancer, and treatment of dairy wastewater [11]. This observation has been proved to be consistent in the biodegradation of polyethylene as well, where a consortium of fungi showed superior degradation rates when compared to the use of individual fungi [12]. Polymers can be degraded through various processes, including photo-oxidative degradation, thermal degradation, ozone degradation, mechanochemical degradation, and catalytic degradation. Photo-oxidative degradation involves light absorption, producing ester, aldehyde, propyl, and format groups at soft segments of polymers. Thermal degradation occurs by accidental or depolymerization reactions, with reactions occurring on the entire polymer surface. Ozone degradation, present in the atmosphere, causes polymers to last longer when oxidative processes are not active. Mechanochemical degradation involves polymer chains breaking under mechanical stress and ultrasonic irradiations, producing macro radicals used in polymerization reactions. Catalytic degradation transforms waste polymers into hydrocarbons, improving the quality of products obtained after pyrolysis of plastics [5].

Biodegradation can occur through aerobic or anaerobic mechanisms. In aerobic biodegradation, microorganisms use oxygen as an electron acceptor to break down large organic compounds like plastics, producing carbon dioxide, water, and residual carbon as by-products [13]. Conversely, in anaerobic biodegradation, oxygen is not required. Instead, microorganisms utilize alternatives such as nitrate, iron, sulphate, manganese, or carbon dioxide as electron acceptors, resulting in the formation of methane, carbon dioxide, water, and residual carbon. Both processes contribute to the natural breakdown of plastics, albeit under different environmental conditions [14]. This study revolves around the following crucial objectives:

- Isolation of Fungal species from Black Soil and Red Soil.
- Identification of Fungal species.
- Degradation of Plastic material by Isolated Fungal species.

MATERIALS AND METHODOLOGY

Materials Required

The materials used in this biodegradation study included two types of soil, black and red, which were collected from the MGM University Campus in Chh. Sambhajinagar, Maharashtra, India. Thin plastic samples were gathered from the surrounding environment for testing. The instruments employed in the study comprised an autoclave, incubator, laminar air flow, pan balance, and hot plate. Various glassware items, including conical flasks, beakers, test tubes, petri plates, and measuring cylinders, were also used. The chemical components essential for the experiments included dextrose, agar powder, sucrose, sodium nitrate, dipotassium phosphate, magnesium sulphate, potassium chloride, ferrous sulphate, peptone, hydrogen phosphate, monopotassium phosphate, epsomite, ammonium nitrate, calcium chloride, and other related compounds. These materials supported the isolation, growth, and biodegradation experiments conducted with the fungal species.

Isolation of Fungi from Soil

Different Soil sample were collected and diluted with 1gm soil in 10 ml sterile distilled water, serial dilution was performed in the laminar air flow from 10^{-1} to 10^{-5}. 1ml of sample of each dilution was inoculated to different sterile petri plates with the help of micropipette containing sterile Potato Dextrose Agar, Sabouraud Dextrose Agar and Czepek-dox agar. Then the plates were incubated at 30˚C for 3 days in incubator.

Morphological Characterization by Lactophenol Cotton Blue staining

Isolated fungi were morphologically characterised using lactophenol cotton blue staining. Place a drop of 70% ethanol onto a microscope slide. Immerse the specimen or material in a drop of alcohol. Add one or two drops of lactophenol/cotton blue mount stain before the alcohol dries. Holding the coverslip between your forefinger and thumb, touch one edge of the drop of mount to the coverslip edge and gently lower, avoiding air bubbles. The preparation is now ready for the examination.

Biodegradation of plastic using isolated and identified fungal species

Samples of thin plastic polymers were cut in small fragments and were placed in a glass flask containing paper towel fragments and mineral medium, 100 ml mineral medium was prepared and divided into 4 conical flasks with the quantity of 25ml each. After that the identified fungus was inoculated in a glass flask.

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Table 1. Weight of Conical Flasks

Conical Flask	Plastic Polymer (wt.)	Paper Towel (wt.)
1.	0.350g	0.035g
2.	0.350g	0.070g
3.	0.350g	0.105g
4.	0.350g	0.140g

After the complete immersion of the plastic polymer and the paper towel. The conical flask was kept for incubation at 27°C for 44 days. After incubation the results were analyzed.

RESULTS

Isolated fungal species: Various types of 17 fungal species were isolated on the petri plates, some of the fungal species were found to be in single growth form and some were found to be in mixed growth form. The fungal species were firstly identified by their morphological structure. The mixed form species were later sub cultured for further objectives.

Fig. 1(a)

Fig. 1(b)

Fig.1. 17 Isolated Fungal Species

Lactophenol cotton blue was performed for the isolated fungal species: The fungus was identified at 40X objective under microscope, the structure was having sporangium and hyphae (Fig. 2(a) and Fig. 2(b)). The conical flask containing plastic polymer and paper towels kept for incubation at 27˚C for 44 days was removed and the last objective to measure the amount of plastic degraded was measured.

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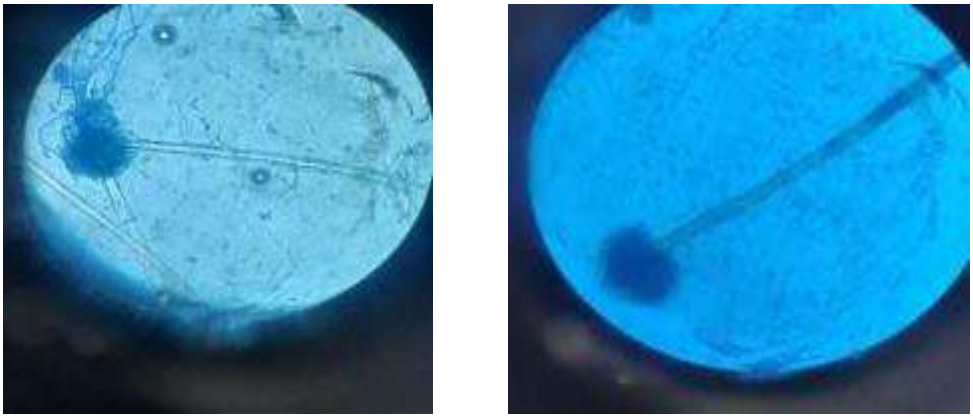

Fig. 2(a) **Fig. 2(b)**

Fig. 2. Microscopic Image of Fungal species

Weight of plastic polymer and dry mass was measured with the pan balance and the results were as follows: Among 4 conical flask the results of 2 conical flask were found to be positive as the weight of plastic polymer in those conical flasks was reduced. The amount of degradation was found to be 4.85% and 0.8% respectively (Fig. 4. (a) & Fig. 4. (b)). The amount of dry mass obtained it was also measured it was found to be 2.85g and 2.91g respectively (Fig. 4. (c) Fig. 4. (d)).

Fig. 3. Degradation of fragments of plastic polymer in conical flask[v]

Fig. 4. (a) **Fig. 4. (b)**

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Fig. 4. (c)

Fig. 4. (d)

Fig. 4. Weight of plastic polymer and dry mass

The Lactophenol cotton blue staining was performed on the dry mass to observe the fungal mycelium structure. Under a microscope at 40X magnification, the mycelium structure was clearly visible, confirming the presence and characteristics of the fungal growth. The observed structures were documented in Fig. 5(a) & Fig. 5(b), showcasing the effectiveness of the isolated fungal species in the degradation process. This staining technique helped in identifying the morphology of the fungi involved in plastic biodegradation.

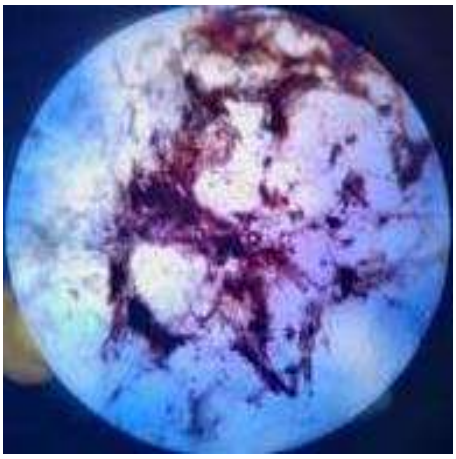

Fig. 5. (a)

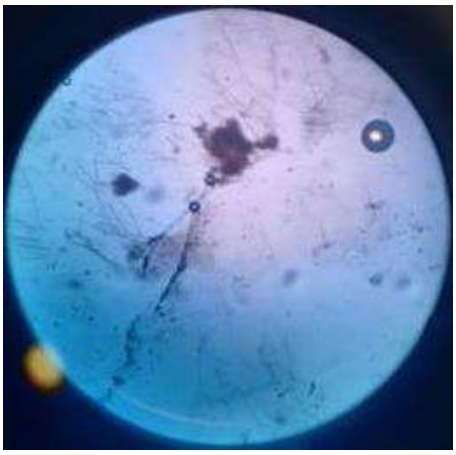

Fig. 5. (b)

Fig. 5. Plates Showing Mycelium Growth of The Biomass

DISCUSSION AND CONCLUSION

The primary aim of this study was to explore the potential of fungal species isolated from black and red soil in degrading plastic polymers. Plastic pollution is a significant environmental concern, as synthetic plastics are resistant to natural degradation. This study demonstrated that certain fungal species, particularly from the genus *Aspergillus*, can degrade thin plastic polymers. After 44 days of incubation at 27°C, a degradation rate of 4.85% was achieved, accompanied by a dry biomass accumulation of 2.91g. This suggests that fungi possess the ability to utilize plastic as a carbon source, breaking down complex polymers into smaller molecules. The research aligns with previous studies indicating that fungi play an essential role in organic matter decomposition and may also contribute to plastic degradation. The use of a consortium of fungal species for biodegradation could further enhance the degradation rates, as supported by other studies in microbial degradation fields. The use of fungi in biodegradation processes presents an eco-friendly and promising solution for reducing plastic waste in the environment, though the overall rate of degradation needs to be optimized for real-world applications.

This project successfully demonstrated the biodegradation of plastic polymers using fungal species isolated from black and red soil. The study confirmed that fungi, particularly those from the genus *Aspergillus*, are capable of breaking down plastic polymers under controlled conditions. The findings support the potential of using fungal species as part of a sustainable solution to plastic pollution. However, further research is necessary to optimize the degradation process, including the exploration of different plastic types,

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fungal species, and environmental conditions. In conclusion, fungal biodegradation offers a promising eco-friendly approach to mitigate plastic waste and its environmental impact.

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FORMULATION AND EVALUATION OF MULTIPLE EMULSION OF CLOTRIMAZOLE

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ABSTRACT

*The main objective of present work is formulation and evaluation of multiple emulsion of clotrimazole. Multiple emulsions dosage formulation of clotrimazole which has enhanced release and bioavailability properties with less inter and intra- subject variability would be desirable. Thus, it was aimed to formulate and evaluate the multiple emulsion of clotrimazole. By the preformulation studies it is observed that clotrimazole is a white to pale yellow crystals having no odor. Solubility was determined in various solvents found that freely soluble in ethanol and methanol, slightly soluble in Distilled Water, soluble in Phosphate Buffer 6.8 pH,0.1N HCl and 0.1N NaOH. Melting point was observed in range of 147-149 ^{0}C. Partition coefficient was 1.797 obtained. Drug: Excipient Compatibility Studies at room temperature, 2^{0}C-8^{0}C and 45^{0}C-50^{0}C says it is stable. Stability also confirmed by FT-IR studies. Five different type formulations (ME-1 to ME-5) formed using fixed amount of oil phase. All five Clotrimazole multiple emulsion formulations were odorless, washable, homogeneous, stable and free from grittiness and was evaluated under the various parameters, Ph of all formulations were observed at 6.8 and viscosity between 4 0.23 to 76.38 centi poise and percentage of Drug content between 83.31 to 95.23%. In-vitro Drug Release of Clotrimazole multiple emulsion formulations were studied and found ME-1 (87.61), ME-2 (94.18), ME-3 (81.74), ME-4 (83.74) and ME-5 (78.62). Formulation **ME-2** was found excellent on the basis of cumulative percentage of drug release profile. All five formulations were also tested for stability and found formulation ME-2 was stable after 30 days against color change, creaming, creaking and phase separation. Optimized formulation **(ME-2)** drug release data were fitted into the zero order, first order, Higuchi and Peppas-Korsemeyer model of drug release kinetics. Formulation ME-2 was followed Zero Order Kinetics explained as continuous and steady release of Clotrimazole from the formulation.*

KEYWORDS: *Globules, Viscosity, Evaluation, Stability, Creaming, Cracking.*

INTRODUCTION

An ideal dosage regimen in the drug therapy of any disease is the one which immediately attains the desired therapeutic concentration of drug in plasma (or in the site of action) and maintains it constant for the entire duration of treatment. For many decades treatment of an acute disease or a chronic illness has been mostly accomplished by delivery of drugs to patients using various pharmaceutical dosages forms, including tablets, capsules, pills, suppositories, creams, ointments, liquids, aerosols, and injectables, as drug carriers. Even today these conventional drug delivery systems are the pharmaceutical products commonly seen in the prescription and over-the-counter drug marketplace. This type of drug delivery system is known to provide a prompt release of drug. Therefore, to achieve as well as to maintain the drug concentration within the therapeutically effective range needed for treatment, it is often necessary to take this type of drug delivery system several times a day. This results in a significant fluctuation in drug levels. Recently, there are several technical advancements which have resulted in the development of new techniques for drug delivery systems. These techniques are capable of controlling the rate of drug delivery, sustaining the duration of therapeutic activity, and/or targeting the delivery of drug to a tissue. Although these advancements have led to the development of several Novel Drug Delivery Systems, that could revolutionaries method of medication and provide a number of therapeutic benefits. The sustained release dosage form has been constantly used to describe a pharmaceutical dosage form formulated to retard the release of a therapeutic agent such that its appearance in the systemic circulation is delayed and or prolong and its plasma profile is sustained in duration. The onset of pharmacologic action is often delayed, and the duration of its therapeutic effect is sustained**.** In the controlled release drug delivery system the release of drug ingredients from a controlled release drug delivery system proceeds at a rate profile that is not only predictable kinetically but also reproducible from one unit to another. This gives high therapeutic efficacy with minimal toxicity. It gives better selectivity of pharmacological activity, and reduces patient compliance by reducing the dosing interval. Numerous attempts have been made to device clinically effective drug delivery systems. The controlled drug delivery system makes an agent to do its best when various drug carrier systems have been developed including nanoparticles, liposomes, serum albumin microbeads, erythrocytes, microcapsules, microemulsions, niosomes, multiple emulsions etc. Multiple emulsions are complex liquid description systems in which the droplets of the one dispersed liquid are further dispersed in another liquid. The inner dispersed globule/droplet in the multiple emulsions are separated from the outer liquid phase by a layer of another phase. There are mainly two types of multiple emulsions W/O/W and O/W/O emulsions. Although, w/o/w emulsions have many of the attributes of w/o emulsions, their lower viscosity, derived from water as the external phase, makes them easier to inject. Adjuvant effects have been

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reported to be improved compared to w/o emulsions or aqueous solution of antigen. Similar increase in the activity of the anticancer drug delivery using multiple emulsions has been observed. The most promising use of multiple emulsions is in the area of sustained release, drug formulation since the oil layer between the two aqueous phases can behave like a membrane controlling solute release. Liquid membrane emulsions of the o/w/o type have been used to separate hydrocarbons where the aqueous phase serves as the membrane and a solvent as the external phase. The system w/o/w on the other hand can extract contaminants from waste water, which acts as the external phase[1]. Multiple emulsions are defined as emulsions in which both types of emulsions, i.e.water-in-oil (w/o) and oil-in-water (o/w) exist simultaneously. They combine the properties of both w/o and o/w emulsions. These have been described as heterogeneous systems of one immiscible liquid dispersed in another rin the form of droplets, which usually have diameters greater than 1μm. These two liquids forming a system are characterized by their low thermodynamic stability. Multiple emulsions are very complex systems as the drops of dispersed phase themselves contain even smaller droplets, which normally consist of a liquid miscible and in most cases identical with the continuous phase. Both hydrophilic and lipophilic emulsifiers are used for the formation of multiple emulsions. In other words multiple emulsions are complex liquid description systems in which the droplets of the one dispersed liquid are further dispersed in another liquid. The inner dispersed globule/droplet in the multiple emulsions is separated from the outer liquid phase by a layer of another phase. Multiple emulsions were determined to be promising in many fields, particularly in pharmaceutics and in separation science. Their potential biopharmaceutical applications include their use as adjuvant vaccines as prolonged drug delivery systems as sorbent reservoirs in drug overdose treatments and in mobilization of enzymes. Multiple emulsions were also investigated for cosmetics for their potential advantages of prolonged release of active agent, incorporation of incompatible materials and protection of active ingredients.

MATERIALS AND METHODS

Materials

Chemicals Used: Clotrimazole, Sodiumchloride, Ethanol, Methanol, Sodiumhydroxide, n-Octanol, Capric/caprylic Triglyceride (CT), Cetyl Palmitate (CP), Cocamidopropylbetaine (CMB), Cetyldimethiconecopolyol (CDC), Sorbitanstearate (Span 60), Carbomer (TGC), Polysorbate 80 (Tween80). All chemicals should be analytical grade.

Equipments used UV-Visible spectrophotometer, Particlesize analyzer (Malvern Mastersizer 2000), Brookfieldrheometer (Model DV.III), Digital Melting point apparatus, Separating funnels, Fourier-Transform InfraRed spectroscopy, Optical microscope, Digital pH meter, Centrifuge. All the equipments should be calibrated and properly operate.

METHODS

Method of Preparation of Multiple Emulsions

Multiple emulsions (W/O/W) were prepared by two step emulsification process:

a. Preparation of primary emulsification. b. Secondary emulsification.

Primary Emulsification: Primary W_1/O emulsion was prepared by slow addition of the aqueous phase containing the electrolyte (NaCl) to the oil phase containing Clotrimazole (1%,*w*/*w*) at 80 ±2°C under continuous stirring at 250 rpm until approximately 25°C. The oily phase was prepared dissolving Clotrimazole in a combination of drug solvent and cosolvent (CT and CP) aided with the lipophilic emulsifying agents (CDC and sorbitan stearate) at 80 ± 2 °C.

Secondary Emulsification: External aqueous phase (W_2) had been prepared previously by dispersing the cross-linked TGC polymer, in a co-solvent system of deionized water and the hydrophilic emulsifying agents (CMB and/without polysorbate 80) were neutralized with 10% NaOHsolution (10%,*w*/*v*) to obtain a pH value of 6.5–7.0. The obtained primary emulsions were slowly added to the corresponding outer aqueousphases (W_2) 50:50 under 250 rpm at room temperature. After complete addition of the primary W_1/O emulsion over the external gelified aqueous phase, the resulting mix was paddle stirred for a further 10 min until a homogeneous $W_1/O/W_2$ multiple emulsion had been completely formed.

RESULTS AND DISCUSSION

Preformulating Studies

Organoleptic properties of Clotrimazole

Table no. 1: Organoleptic Properties of drug Clotrimazole

Test	Specification	Observations
Color	White to pale Yellow Crystals	Complies
Taste	Characteristic	Complies
Odor	Odorless	Complies

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Melting Point Determination

Table no. 2: Melting point of drug Clotrimazole

S. No.	Material	Melting point	Specification
1.	Clotrimazole	147-149 ^{0}C	149^{0}C

Solubility Study

Table no. 3: Solubility profile of Clotrimazole in different solvent

S. No.	Solvents	Solubility
1.	Distilled water	Slightly Soluble
2.	Ethanol	Freely Soluble
.	Methanol	Freely Soluble
4.	Phosphate Buffer 6.8 pH	Soluble
5.	0.1NHCl	Soluble
6.	0.1NNaOH	Soluble

Determination of Wavelength of Maximum Absorbance (λmax)

Table No. 4: Wavelength of Maximum Absorbance (λmax)

Conc. (µg/mL)	Scanning range (nm)	λmax
10	200-400	264.0

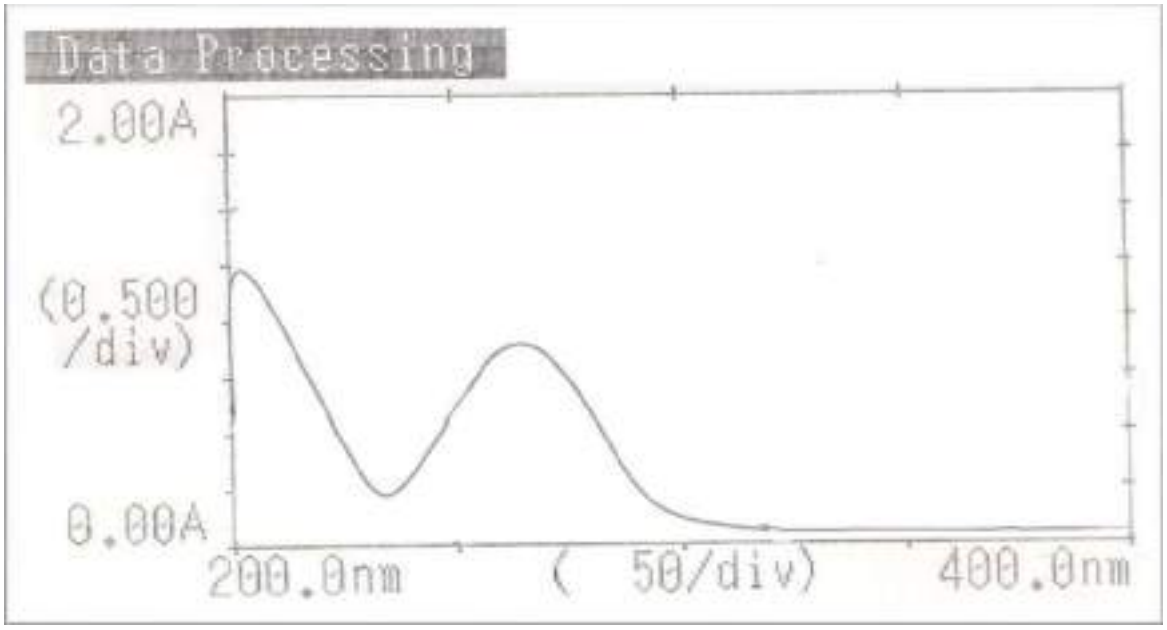

Figure no. 1: Scanning of Wavelenth of Clotrimazole

Preparation of the Calibration Curves of Clotrimazole

Table no.5: Linearity of Clotrimazole 6.8 pH buffer

Conc. (µg/ml)	0	5	10	15	20	25	30
Absorbance	0	0.109	0.228	0.352	0.472	0.605	0.727

Partition Co-efficient

Table no. 6: Partition Co-efficient

Sr. No.	Solvents	Absorbance
1.	Water	0.754
2.	n-Octanol	1.363

Partition coefficient=57.208/31.83= 1.797

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Compatibility Study

Physical Compatibility Study

Table no. 7: Physical Compatibility Study of Clotrimazole with polymer

S. No.	Material	Storage at Room temperature	Storage at 45^0C-50^0C	Storage at 2^0C -8^0C
1	Pure Drug (10mg)	Stable	Stable	Stable
2	Clotrimazole +CT+CP	Stable	Stable	Stable
3	Clotrimazole +TGT	Stable	Stable	Stable

Chemical Compatibility Study by FT-IR

Table no. 8: FT-IR Peaks of Clotrimazole

Standard Peaks (Cm^{-1})	Observed Peaks (Cm^{-1})	Peak Assigned Peaks (Cm^{-1})
3000-3500	3441	N-Hstr
3000-2840	2858	C-Hstr
1650-1600	1634	C=Cstr
1050-1000	1013	C-Clstr

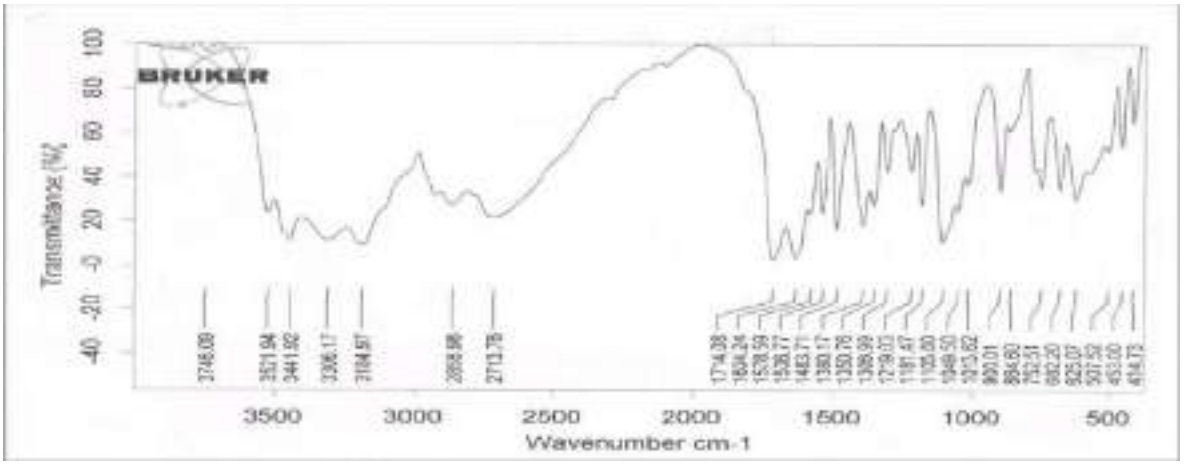

Figure no. 3: FT-IR spectrum of Clotrimazole pure

Formulation Development

Table no. 9: Formulation of Multiple Emulsions

Components	Percentage Composition (w/w)				
	ME-1	ME-2	ME-3	ME-4	ME-5
Oil phase (O)					
Clotrimazole	01.00	1.00	1.00	1.00	1.00
Capric/caprylic Triglyceride (CT)	11.00	11.00	11.00	11.00	11.00
Cetyl Palmitate (CP)	02.00	2.00	2.00	2.00	2.00
Cetyl dimethicone copolyol (CDC)	01.50	1.50	1.50	1.50	1.50
Sorbitan stearate (Span 60)	02.00	2.00	2.00	2.00	2.00
Internal Aqueous Phase (W1)					
Sodium chloride (NaCl)	0.25	0.25	0.25	0.25	0.25
Purified water at pH 6.6	32.25	32.25	32.25	32.25	32.25
External aqueous phase (W2)					
Carbomer (TGC)	0.10	0.20	0.30	0.40	0.50
Cocamidopropylbetaine (CMB)	0.70	0.60	0.50	0.40	0.30
Polysorbate 80 (Tween80)	0.00	0.50	1.00	1.50	2.00
Purified water at pH 6.6	49.20	48.70	48.20	47.70	47.20

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Evaluation of prepared Multiple Emulsion formulation

Physical evaluation of all prepared Multiple Emulsion formulation

Table no. 10: Physical evaluation of all prepared formulation

S. No.	Code of formulation	Visual observation	Phase Separation	Thermo dynamic Stability
1	ME-1	White, Cloudy	No Phase separation	Stable
2	ME-2	White, Coludy	No Phase separation	Stable
3	ME-3	White, Coludy	No Phase separation	Stable
4	ME-4	White, Coludy	No Phase separation	Stable
5	ME-5	White, Coludy	No Phase separation	Stable

Globule Size Determination

Table no. 11: Globule size determination of formulations

Formulation Code	Droplet size (µm)	Zeta potential (mV)	Poly Dispersity Index (PDI)
ME-1	2.42 ± 0.24	14.2 ± 1.42	0.402 ± 0.03
ME-2	1.94 ± 0.53	13.2 ± 1.45	0.329 ± 0.04
ME-3	1.83 ± 0.39	12.4 ± 2.66	0.424 ± 0.01
ME-4	1.99 ± 0.02	14.6 ± 1.37	0.299 ± 0.05
ME-5	2.13 ± 0.33	13.5 ± 1.86	0.443 ± 0.03

Note: All the values are mean of triple reading± standard deviation

Determination of physical properties pH, Viscosity and Drug content

Table no. 12: Physical properties, pH, Viscosity and Drug content

Formulation Code	pH	Viscosity (CP)	Drug content
ME-1	6.8	40.23	87.21 ± 1.65
ME-2	6.8	55.43	95.23 ± 1.01
ME-3	6.8	54.55	84.32 ± 1.23
ME-4	6.7	68.32	84.52 ± 1.41
ME-5	6.8	76.38	83.31 ± 2.13

***In-vitro* Release studies of Clotrimazole Multiple emulsion formulations**

Table no.13: Cumulative Percentage of drug release from multiple Emulsions

Time (hr.)	ME-1	ME-2	ME-3	ME-4	ME-5
0	0	0	0	0	0
1	06.9	15.00	12.91	11.04	08.75
2	17.9	27.43	27.78	20.55	18.37
3	30.60	40.59	35.20	31.81	26.65
4	46.20	51.45	47.60	43.01	35.91
5	58.76	61.59	59.31	51.37	42.86
6	69.84	74.02	65.93	63.08	56.71
7	80.60	86.34	74.99	74.43	67.25
8	87.61	94.18	81.27	83.74	78.62

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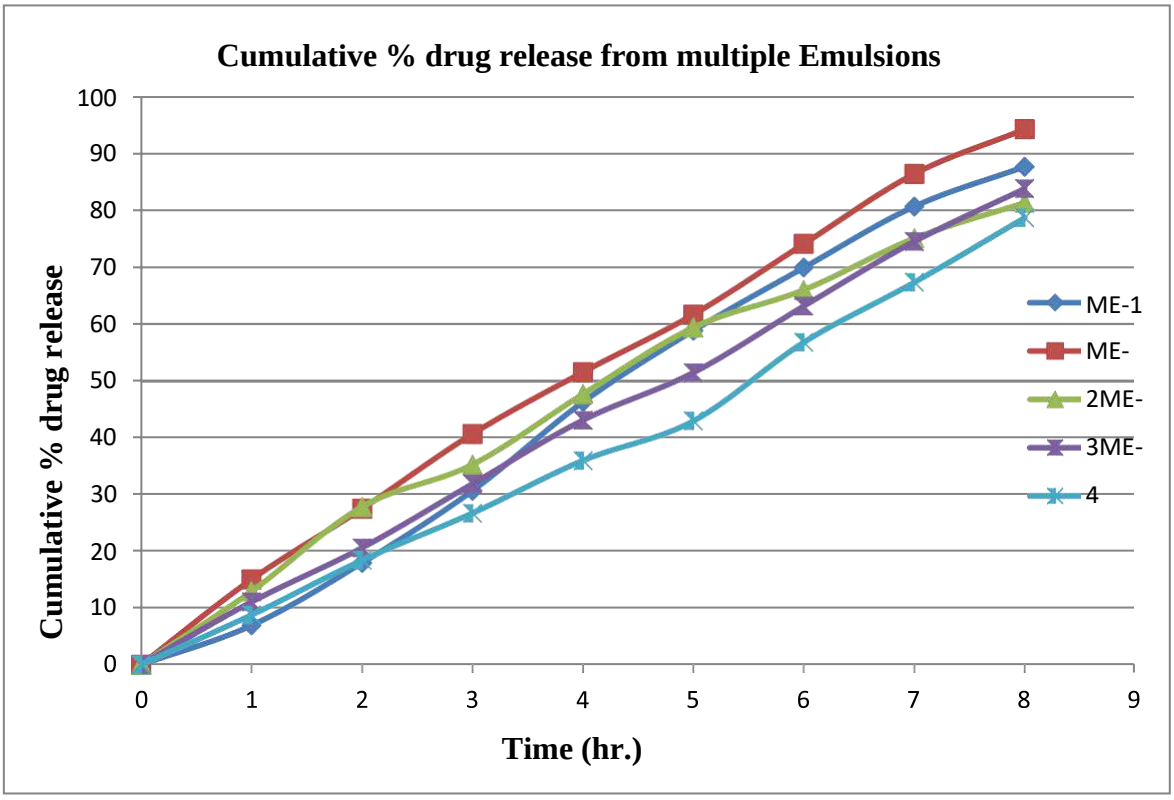

Figure no. 5 : *In-Vitro* Cumulative % Drug Release from Clotrimazole Multiple Emulsion

Stability Testing

Table no. 14: Stability testing under following parameters

Formulation Code	Stability testing after 30 days			
	Color Change	Creaming	Creaking	Phase Separation
ME-1	Observed	Observed	Not Observed	Not Observed
ME-2	Not Observed	Not Observed	Not Observed	Not Observed
ME-3	Not Observed	Not Observed	Not Observed	Observed
ME-4	Not Observed	Observed	Not Observed	Not Observed
ME-5	Not Observed	Not Observed	Not Observed	Observed

DISCUSSION

Multiple emulsions dosage formulation of clotrimazole which has enhanced release and bioavailability properties with less inter and intra- subject variability would be desirable.Thus, it was aimed to formulate and evaluate the multiple emulsion of clotrimazole. By the preformulation studies it is observed that clotrimazole is a white to pale yellow crystals having no odor. Solubility was determined in various solvents found that freely soluble in ethanol and methanol, slightly soluble in Distilled Water, soluble in Phosphate Buffer 6.8 pH,0.1N HCl and 0.1N NaOH. Melting point was observed in range of 147-149 ^{0}C. λ**max** was determined at 264 nmby scanning sample from 200-400nm and also calibration curve was obtained by absorbance of aliquots from 5-30 µg/ml with following linear equation y=0.024x-0.01R^2=0.999. Partition coefficient was 1.797 obtained. Drug: Excipient Compatibility Studies at room temperature, 2^{0}C-8^{0}C and 45^{0}C-50^{0}Csays it is stable. Stability also confirmed by FT-IR studies. Five different type formulations (ME-1 to ME-5) formed using fixed amount of oil phase having Capric/caprylic Triglyceride (CT), Cetyl Palmitate (CP), Cetyl dimethicone copolyol (CDC) and Sorbitan stearate (Span 60) and Internal Aqueous Phase contain Purified water atpH 6.6 and Sodium chloride. Different concentration of External Aqueous Phase contains Carbomer (TGC),Cocamidopropylbetaine (CMB) and Polysorbate 80 (Tween 80) in Purified water at pH 6.6. Then observed visually that all formulations were white and cloudy,there was no phase separation and Thermodynamically Stable. Characterization of all Clotrimazole multiple emulsion formulations were evaluated for Droplet size, Zeta potential and Poly Dispersity Index (PDI) all results showed in table. All five Clotrimazole multiple emulsion formulations were odorless, washable, homogeneous, stable and free from grittiness and was evaluated under the various parameters, Ph of all formulations were observed at 6.8 and viscosity between 4 0.23 to76.38 centi poise and percentage of Drug content between 83.31 to 95.23%. *In-vitro* Drug Release of Clotrimazole multiple emulsion formulations were studied and found ME-1 (87.61), ME-2 (94.18), ME-3 (81.74), ME-4 (83.74) and ME-5 (78.62). Formulation **ME-2** was found excellent on the basis of cumulative percentage of drug release profile. All five formulations were also tested for stability and found formulation ME-2 was stable after 30 days against color change, creaming, creaking and phase separation. Optimized formulation

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(ME-2) drug release data were fitted into the zero order, first order, Higuchi and Peppas-Korsemeyer model of drug release kinetics. Formulation ME-2 was followed Zero Order Kinetics explained as continuous and steady release of Clotrimazole from the formulation.

CONCLUSION

The prepared multiple emulsions of Clotrimazole had shown excellent promising results for all the evaluated parameters. On the basis of *in-vitro* drug release and drug content results, **ME-2** formulation was better drug release as compare to ME-1, ME-3, ME-4 and ME-5 which shows higher percentage of drug release. *In- vitro* release profile was applied on various kinetic models like Zero order, First order, Higuchi equation and Peppas-Korsemeyer model. The best fit with highest regression coefficient was found with Zero order. The rate constants are calculated from the slop of the respective plots the release mechanism of Multiple Emulsion. **ME-2** formulation can be further study for preclinical and clinical evaluations.

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THE INFLUENCE OF COUNTY ASSEMBLIES' COORDINATING ROLE ON THE IMPLEMENTATION OF STRATEGIC PLANS IN THE NAIROBI CITY COUNTY GOVERNMENT, KENYA

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ABSTRACT

In Nairobi County, just like the rest of Kenya, the county assembly is responsible for legislation, oversight, and representation of the county executive who implements the county strategic plans developed from the devolved functions of the devolution. However, the achievement of strategic plans is still with flaws despite this. The purpose of the study was to assess the influence of the coordinating role on the implementation of strategic plans in the Nairobi City County Government, Kenya. The study was guided by the McKinsey 7s model, the Dynamic Capability Model, and the Resource-Based View Theory. The study was conducted using a quantitative research design. The target population was 123 members of the County Assembly, consisting of 85 elected and 38 nominated members. The population also included 3 officials from the County Assembly's Financial and Budget Office, Procurement Office, and Planning Department. The study involved 85 elected and 38 nominated county assembly members, using simple random sampling. Officials from the Financial and Budget Office, Procurement Office, and Planning Department were selected by census. Primary data was collected with 5-point Likert scales. SPSS regression analysis tested the relationships between dependent and independent variables, with multiple regression used due to activity interconnectedness. Results were presented in descriptive figures and tables, with regression outcomes shown in tables. The study's findings reveal a strong positive correlation ($r = 0.847$, $p < 0.01$) between the coordination role of MCAs and the implementation of strategic plans. The standardized coefficient ($\beta = 0.847$; $p = 0.000$) confirms the strong positive relationship between the coordination role and strategic plan attainment. The differing views among MCAs on coordination roles highlight the need for NCCG to enhance stakeholder engagement by creating clear communication frameworks, organizing regular interaction forums, and involving stakeholders in resource allocation to align their efforts with strategic objectives and improve the execution of strategic plans.

KEYWORDS: *Budgeting Roles, Strategic Plans, Strategic Plan Implementation, County Government*

INTRODUCTION

Low-intensity conflicts (LICs) in Kenya are driven by historical, socio-economic, and political factors, including ethnic tensions and resource competition, which undermine effective conflict resolution strategies (Kaldor, 2019; Akol, 2021). Fragmented, reactive approaches by governmental and non-governmental stakeholders have failed to address these root causes (International Crisis Group, 2020; Mungai, 2021). There is a significant gap in understanding the role of multi-agency approaches in enhancing communication, leadership, and resource allocation to manage LICs in Kenya (Kakuyo, 2020). This study seeks to address these gaps, providing insights for more integrated, sustainable conflict resolution strategies that promote national stability and regional peace (Mamdani, 2020; World Bank, 2021; Fetene, 2021).

Low-income countries in Africa, including Nigeria and Egypt, face challenges in implementing strategic plans due to issues such as poor governance, conflicts of interest, and competence gaps among assembly members (Mattes & Mozaffar, 2016; Odalonu, 2020; Tobbala, 2019). In Nigeria, assemblies focus on oversight but struggle with governance inefficiencies, while Egypt's decentralized system involves local assemblies in strategic planning and resource distribution. South Africa's provincial assemblies conduct oversight of strategic plans, emphasizing monitoring, evaluation, and parliamentary-led reviews (Matebese-Notshulwana & Lebakeng, 2019). Kenya's devolved system, established by the 2010 Constitution, decentralizes governance to counties, focusing on resource management and local service delivery. Unlike South Africa, Kenya emphasizes local governance and service delivery rather than policy-making and parliamentary oversight (Makhado, 2016; Zantsi, 2020).

Since establishing the Kenya School of Governance in 2012, county assembly members in Kenya have enhanced their competence, improving their roles in implementing strategic plans (Chirchir, 2019). Examples include the Elgeyo Marakwet County Integrated Development Plan (CIDP II) 2018–2022 and the County Assembly's Strategic Plan, which outline planning stages and emphasizes monitoring, evaluation, resource mobilization, and risk management (Kabeyi, 2019). These plans highlight the assembly's role in

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drafting legislation, representing the public, and overseeing county resources. With devolution in place for nine years, further research on the role of county assemblies in strategic plan achievement, particularly in Nairobi City County, is essential.

The Nairobi City County Integrated Development Plan (CIDP) 2018–2022 outlines key roles for the County Assembly, including lawmaking, oversight, and approving policies on resource management. The plan aims to enhance investments, living conditions, and service quality in the city. Chapter Two of the CIDP reviews the 2013–2017 plan, highlighting revenue growth (40.7%) and improvements in asset management, policy formulation, and governance. Despite these successes, previous studies identified challenges in implementation, including transparency and accountability issues (Njeri et al., 2018; Wangui, 2020). With Nairobi facing urbanization challenges, studying the assembly's role in strategic plan achievement is crucial to improving governance and addressing these pressing issues (The World Bank, 2021; Cytonn, 2022).

The role of county assemblies in strategic plan implementation and their influence on outcomes remain understudied, particularly in terms of members' knowledge and oversight capabilities (Karama et al., 2019; Wagikondi & Omwenga, 2019). As per the 2010 Constitution of Kenya, the county assembly is responsible for overseeing the county executive, enacting laws, and approving strategic plans and policies (CoK, 2010, Article 185). This legal framework emphasizes the significance of studying the county assembly's role in strategic plan achievement and assessing its impact on governance. These situations highlight the need for research to understand the extent to which the county assembly's involvement can positively impact strategic plan achievement.

Statement of the Problem

The implementation of strategic plans in Nairobi City County faces significant challenges, including delays and discrepancies between revenue collection and plan execution. While the Constitution of Kenya (2010) mandates county assemblies to legislate, represent, and oversee the county executive's implementation of strategic plans, persistent issues like slum growth, infrastructure constraints, and budgetary limitations hinder progress. Despite the importance of the assembly's coordinating role in ensuring timely execution and resource management, studies reveal gaps in members' oversight capabilities and accountability (Karama et al., 2019; Wagikondi & Omwenga, 2019). Past research highlights problems with transparency and governance, raising concerns about the effectiveness of the assembly in holding the executive accountable (Wangui, 2020). With Nairobi County facing challenges from urbanization, such as traffic congestion, inadequate housing, and waste management (The World Bank, 2021; Cytonn, 2022), understanding the assembly's influence in strategic plan implementation is crucial. This study aims to assess the county assembly's impact on the achievement of strategic plans by examining its legislative, oversight, and coordination roles in Nairobi City County. Through this investigation, the study seeks to contribute to more transparent and accountable governance, exploring how the assembly can better support the county's development amidst its urban challenges.

Objective

The objective of the study was to assess the influence of the coordinating role on the implementation of strategic plans in the Nairobi City County Government, Kenya.

Research Hypothesis

H_0: There is no significant relationship between the coordinating role and the implementation of strategic plans in the Nairobi County Assembly in Kenya.

LITERATURE REVIEW

Theoretical Review

McKinsey 7s Model

The McKinsey 7s Model, developed by Richard, Anthony, and McKinsey consultants, focuses on seven internal elements crucial for organizational success: strategy, structure, systems, shared values, style, staff, and skills (Kocaoğlu & Demir, 2019). It emphasizes human resources over traditional assets like capital and equipment, proposing that all elements are interconnected and must align to ensure effective performance. The model is particularly useful for organizational change, strategy implementation, and mergers, as it divides the elements into "hard" (e.g., strategy, structure, systems) and "soft" (e.g., shared values, style, skills) categories (Maalu, 2020).

In the context of Nairobi City County, the McKinsey 7s Model helps explain the County Assembly's role in coordinating and implementing strategic plans. The model's application of structure and strategy clarifies how the Assembly interacts with the County Executive to approve plans and policies for execution (Murage & Ndegwa, 2018). Additionally, systems, shared values, and communication styles ensure collaboration with stakeholders and address citizen needs in planning. Lastly, staff and skills elements ensure qualified personnel and effective task force management for strategic plan implementation, making the model a vital tool for analyzing county governance (Hassan & Ndegwa, 2019).

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Dynamic Capability Model

The Dynamic Capability Model, initially proposed by Lindblom in the 1960s and improved by Quinn in the 1980s, presents strategy as a dynamic, interactive process comprising incremental decisions that adjust to changing circumstances. Managers continuously support evolving activities to ensure coordination. Strategic management integrates concurrent, incremental strategy generation and implementation for effectiveness (Alford & Greve, 2017). Strategic decisions emerge from small, unified actions across organizational levels. Distinguishing between deliberate and emergent strategies, the model emphasizes flexibility in responding to environmental opportunities (Tapanainen, et al., 2021).

Deliberate strategies, in contrast, are proactive and goal-focused, involving careful planning and resource allocation to achieve desired outcomes (Pirkkalainen, 2019). In this study, the Dynamic Capability Model helps explain the budgeting roles of county assemblies in implementing strategic plans. The model's three components—sensing, seizing, and transforming—are crucial for examining how the Nairobi County Assembly manages oversight, resource allocation, and coordination to adapt and implement plans effectively. This framework supports analyzing how county assemblies influence strategic plan success.

Resource-Based View Theory

The Resource-Based View (RBV) theory, proposed by Wernerfelt (1984), emphasizes that a firm's competitive advantage lies in its unique, inimitable resources rather than commonly tradable assets like technology or natural resources. RBV suggests that leveraging prized resources innovatively helps firms achieve lasting success (Borg & Gall, 2009). In an international context, local partnerships and knowledge further enhance competitiveness (Ben-Dak, 2000; Gupta et al., 2011). RBV classifies resources into physical, human, and organizational capital, which are key inputs in a firm's production process (Currie, 2009).

Linking the theory to this study, the Resource-Based View highlights the importance of resource management and oversight in the successful implementation of strategic plans. By overseeing resource allocation, the Nairobi County Assembly ensures projects align with organizational goals and reduce risks (Holdford, 2018; Barney, 2021). The study's focus on the assembly's role in managing resources for strategic plan execution resonates with RBV's assertion that unique resources determine competitiveness. This makes RBV a relevant framework for analyzing the influence of the county assembly in Nairobi City County's strategic plan implementation.

Institutional Theory

The Institutional Theory was developed by Paul DiMaggio and Walter Powell in 1983, According to the theory, organizations are influenced by the rules, norms, and beliefs of their institutional environment, which shapes their behavior and practices. This theory posits that organizations strive for legitimacy by conforming to institutional pressures, leading to isomorphism, or similarity, among organizations within the same environment (DiMaggio & Powell, 1983). In the context of Nairobi City County, the county assembly serves as a key institutional actor that influences the strategic plan achievement by shaping policies, providing oversight, and ensuring accountability. The county assembly's legislative and budgetary functions are essential for aligning resources and actions with the strategic goals of the county government, thereby enhancing the legitimacy and effectiveness of the strategic plans.

The relevance of Institutional Theory to the study of strategic plan achievement in Nairobi City County lies in its emphasis on the role of institutional actors in shaping organizational behavior. The county assembly, as an institutional entity, exerts significant influence on the county government's strategic initiatives through its legislative authority and oversight functions. By enacting laws, approving budgets, and scrutinizing the implementation of strategic plans, the county assembly ensures that the strategic objectives are aligned with the institutional norms and expectations of the broader governance framework in Kenya. This alignment is critical for achieving the desired outcomes of the strategic plans, as it fosters consistency, accountability, and legitimacy in the county government's operations (Scott, 2004). Thus, the Institutional Theory provides a valuable lens for understanding the dynamics between the county assembly and the strategic plan achievement in Nairobi City County, highlighting the importance of institutional support and alignment in successful strategic planning.

Coordination and the Implementation of Strategic Plans

According to Eibl-Schindler and Buess (2019), coordination plays a critical role in achieving strategic plans in County Governments in Europe. The study found that coordination is essential for aligning different departments and stakeholders towards a common goal. The authors argued that coordination is more effective when it is built into the strategic planning process from the outset, rather than being an afterthought. They recommended that County Governments should establish coordination mechanisms, such as regular meetings and communication channels, to ensure that all stakeholders are aware of the strategic plan and are working towards its achievement.

In a similar vein, Alkadi and Skokanova (2020) highlighted the importance of leadership in coordinating the implementation of strategic plans in County Governments in Europe. The study found that effective leadership involves establishing a clear vision, communicating it to all stakeholders, and creating a culture of accountability. The authors argued that leadership should also involve

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empowering staff at all levels to contribute to the achievement of the strategic plan. They recommended that County Governments should invest in leadership development programs to ensure that their leaders have the skills and knowledge needed to coordinate the implementation of strategic plans.

Furthermore, Siska and Tvaronavičienė (2021) emphasized the importance of collaboration and partnership in achieving strategic plans in County Governments in Europe. The study found that collaboration between different departments and stakeholders can help to identify opportunities and challenges, and develop solutions that are more effective and sustainable. The authors argued that collaboration should be built into the strategic planning process, and that County Governments should establish partnerships with other public and private organizations to leverage resources and expertise. They recommended that County Governments should also invest in capacity building programs to enhance collaboration and partnership among their staff and stakeholders.

In the context of American counties, a study by Ostrom and Parks (2020) investigated the impact of collaboration and coordination on county governments' ability to achieve strategic goals. The study found that counties that had strong collaboration and coordination mechanisms in place were more likely to achieve their strategic goals. The authors suggest that effective coordination requires clear communication, mutual trust, and a shared understanding of strategic goals among stakeholders.

Another study by Sebopetji and Mello (2019) examined the role of coordination in the implementation of strategic plans in South African local government municipalities. The study found that effective coordination was positively associated with the achievement of strategic goals. The authors suggest that coordination involves effective communication, collaboration, and leadership among stakeholders.

One study by Ogbu and Ugwu (2020) examined the coordinating role of budgeting in the implementation of strategic plans in Nigerian local government councils. The study found a significant positive relationship between effective coordination of budgeting and the achievement of strategic plans in local government councils. The authors suggest that effective coordination involves alignment of budgeting and strategic planning processes, collaboration among stakeholders, and regular monitoring and evaluation of the implementation of both budgeting and strategic plans.

In Uganda, a study by Kaganzi and Kwikiriza (2019) investigated the impact of coordination on the implementation of strategic plans in local government councils. The study found that effective coordination was positively associated with the achievement of strategic goals. The authors suggest that coordination requires effective communication, collaboration, and leadership among stakeholders.

Mutuku and Misango (2020) had studied the relationship between internal factors and strategy implementation in Machakos County Government, Kenya. The main objective was to assess how employee involvement influenced strategy implementation. The study revealed that among all the different variables, the relationship between employee involvement and strategy implementation had the highest beta value when a correlation analysis was conducted, thus meaning that coordination between the county assembly and other departments in the implementation roles was important. The relationship was confirmed to be significant in the multiple regression model. Mutuku and Misango (2020) in their research failed to further divide the variable on employee involvement into roles involving coordination and thus presenting a content gap that this study will have to fill.

Another study was conducted by Dwivedi (2021) on the relationship between stakeholders role and project success. The study used empirical data which were secondary sources of data. The findings of the study were that assemblies charged with strategic plans should collect all stakeholders' involvement and contributions. That people in position of implementing strategic plans act as executive support in the implementation of strategic plans. The role of coordination also involves developing a scope on the roles of each stakeholders by conducting thorough stakeholder analysis. The roles of assemblies is to ensure they properly communicate with stakeholders, and involve them in the strategic planning process. Assemblies work with stakeholders based on broken structure set in the plan. Assemblies have a role of keeping track of the progress of each stakeholder involvement. When making policies, the assemblies addresses the definition of rules for all organizations and stakeholders involved in strategic plans. The assembly is responsible for governing relationships between the County and stakeholder. In terms of gaps, the study didn't show time and content gaps, but rather a methodological gap which was created when the study was found to have used empirical findings. To fill this gap, this research seeks to investigate similar findings but through the use of primary sources of data.

In support of the study by Dwivedi (2021), other studies were reviewed to provide roles required in implementing strategic plans. There were more insights as to the roles of different stakeholders depicting the knowledge regarding the need for coordination in implementing strategic plans. Kamassi et al (2020) found that the stakeholders inside such assemblies are responsible for crisis management by forming committees that have expertise in different areas in the plan. Board of directors is responsible for voting and deciding about plans with the necessity of involving other stakeholder to increase the process' success. Coordination among stakeholders is managed by experts in assemblies to allocate the plan various resources. Unfortunately, the study by Kamassi et al

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(2020) had several gaps, beginning with content gap, whereby it was not done in the context of a County Government. It was also having a geographical gap because of it being done outside Kenya. It finally had a methodological gap, by collecting secondary data. These gaps have led to this study being conducted to fill the and create knowledge in the academic world.

Another study was conducted by Ali and Gitonga (2019) on the relationship between stakeholders' role and performance of national government constituency development fund projects. The study area was the Wajir West constituency in Kenya. The study's main objective was to study the role of stakeholders in plan implementation. The study's regression analysis established the lowest value in terms of the roles performed in plan implementation. Team development influenced performance to a great extent.

This study aims to investigate the relationship between the coordinating role and the implementation of strategic plans in the Nairobi County Assembly in Kenya. The need for this study is highlighted by previous research that emphasizes the importance of coordination, leadership, collaboration, and stakeholder involvement in achieving strategic plans in various County Governments in Europe, America, Nigeria, South Africa, and Uganda. While some studies have examined the coordinating role in the implementation of strategic plans, they have not specifically focused on the relationship between the coordinating role and the implementation of strategic plans in the Nairobi County Assembly. This study aims to fill this content gap and provide insights into the importance of coordination in achieving strategic goals in the Nairobi County Assembly.

RESEARCH METHODOLOGY

The study employed a quantitative research design to address gaps in previous qualitative studies (Fischer et al., 2014). It aimed to present findings through descriptive and inferential analyses, integrating qualitative data from empirical studies. Focusing on Nairobi County Government, the research highlighted challenges in strategic plan implementation and emphasized infrastructure and resource management improvements (Pinchoff et al., 2021; Wangai et al., 2017). The target population included 123 County Assembly members and key officials from relevant departments (Nairobi County Assembly Records, 2023; Chepkorir & Kariuki, 2018). A systematic sampling method selected a sample of 101 MCAs using Kothari's formula, ensuring proportional representation of elected and nominated members.

Primary data was collected using questionnaires with closed-ended questions, designed to gather information on respondents' demographics and study objectives. A 5-point Likert scale was used to measure various variables, facilitating straightforward analysis and inferential statistical analysis (Mazurek et al., 2021). The validity of the instruments was ensured through expert consultation, and reliability was tested with a pilot study in Kiambu County, yielding a Cronbach's Alpha coefficient of 0.914, indicating high internal consistency and reliability of the research instruments.

Each variable surpassed the commonly accepted Cronbach's Alpha threshold of 0.7, indicating strong reliability. For instance, the Budgeting Role and Oversight Role variables both achieved high Cronbach's Alpha scores of 0.945 and 0.942, respectively, across 17 items each. The overall average Cronbach's Alpha for all variables was 0.914, suggesting consistent reliability throughout the questionnaire and validating its applicability for the research.

In the Methods of Data Collection, meticulous steps were taken to ensure the study proceeded ethically and efficiently. Obtaining necessary permits and permissions, organizing research days, and familiarizing with the study area were pivotal. The use of both hardcopies and digital tools for data collection, coupled with clear consent procedures in both English and Kiswahili, ensured participant understanding and voluntary involvement. The involvement of a professional research assistant streamlined the process, while interviews provided clarity for respondents, showcasing a comprehensive and considerate approach to data gathering.

In the subsequent Methods of Data Analysis, the study employed rigorous statistical techniques, notably regression analysis using SPSS software. Descriptive and inferential statistics were utilized to analyze collected data, supporting the testing of research hypotheses. Multiple linear regression was employed to ascertain the relationship between dependent and independent variables, with a clear protocol for hypothesis acceptance or rejection based on statistical significance. The study's commitment to methodological robustness and transparent reporting underscores its scientific rigor and reliability.

RESULTS

Response Rate

The survey yielded high response rates from both elected and nominated Members of County Assembly (MCAs), with 77.14% and 93.55% response rates respectively, showcasing significant engagement with the study. Additionally, all targeted staff participated, resulting in an overall response rate of 90.23%.

Demographic Characteristics Results

The demographic analysis revealed a significant gender disparity among respondents, with 91% male and 9% female elected MCAs. Despite this skew, efforts were made to include a representative sample of female MCAs. Age distribution indicated that the majority

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of respondents were above 35 years old (59.3%), followed by those aged 31-35 (29.7%), and 26-30 (11%). Educationally, the largest proportion of participants held diplomas (73.6%), followed by certificates (13.2%), degrees (11%), and masters (2.2%). Tenure analysis highlighted a predominant trend of shorter tenures, with 92.3% of respondents serving 1-2 years, suggesting a high turnover rate within the County Assembly.

Descriptive Statistics for Coordination Roles

Given the results in Table 1, the statement that read "We go through stakeholders' documents and vet them to the plan" were (Mean = 3.80, Skewness = -0.640, Kurtosis = 0.183): This coordination role seems to be well-perceived among MCAs, as indicated by the relatively high mean score. The negative skewness suggests that most respondents agreed with this role, while the kurtosis indicates a distribution closer to normal. The mean score of 3.80 suggests that MCAs view this coordination role as quite important. They seem to recognize the significance of reviewing stakeholders' documents and aligning them with the strategic plan, possibly indicating an attention to detail and thoroughness in the planning process.

We act as executive support in the implementation of strategic plans (Mean = 3.74, Skewness = -0.433, Kurtosis = -0.043): This role also garnered a reasonably positive response from the respondents. The negative skewness suggests a tendency towards agreement, with the kurtosis indicating a relatively flat distribution. With a mean score of 3.74, MCAs still perceive this role as crucial, though slightly lower than the previous one. This suggests that MCAs recognize their role in providing executive support for the successful execution of strategic plans.

We communicate with stakeholders to influence ground work (Mean = 3.66, Skewness = -0.017, Kurtosis = -0.547): While the mean score is still relatively high, the skewness approaching zero indicates a more balanced distribution of responses. This suggests that opinions might be more varied regarding this role. The mean score of 3.66 indicates that MCAs consider communication with stakeholders for influencing groundwork as moderately important. This implies that they see the value in direct engagement with stakeholders to ensure effective plan execution.

We work set stakeholders according to structures: Similarly, with a mean score of 3.67, MCAs place moderate importance on adhering to established stakeholder engagement structures, possibly to maintain order and consistency in the implementation process.

We work with stakeholders according to structures (Mean = 3.67, Skewness = -0.150, Kurtosis = -0.560): Similar to the previous role, the respondents seem to have a moderate level of agreement, although the skewness indicates a relatively balanced distribution. The relatively high mean score of 3.84 suggests that MCAs place a significant emphasis on monitoring and tracking the progress of stakeholder involvement, ensuring that all relevant parties remain on track.

We keep track of the progress of each stakeholder involvement (Mean = 3.84, Skewness = -0.248, Kurtosis = -0.538): This coordination role received one of the higher mean scores, indicating that the respondents feel that tracking stakeholder involvement is an important aspect of their duties. The mean score of 3.77 indicates that MCAs consider policy-making for organizations and stakeholders as an important part of strategic plan execution, highlighting their role in creating a conducive policy environment.

The assembly governs relationships between the County and stakeholders (Mean = 3.81, Skewness = -0.410, Kurtosis = -0.188): This role received a relatively high mean score, indicating that MCAs consider it an essential part of their responsibilities. With a mean score of 3.81, MCAs emphasize the importance of their role in overseeing and managing relationships between the County Government and stakeholders, underscoring their responsibility in maintaining effective collaborations.

The assembly involves stakeholders responsible for crisis management (Mean = 3.66, Skewness = -0.245, Kurtosis = -0.648): While the mean score is still above the midpoint, the lower score and negative skewness suggest some variability in perceptions of this role. The moderate mean score of 3.66 suggests that MCAs recognize the need to involve stakeholders in crisis management, albeit with a relatively lower priority compared to other roles.

Experts assist the assembly allocate the plan various resources (Mean = 3.67, Skewness = -0.449, Kurtosis = 0.024): This role received a moderate mean score, but the negative skewness suggests that respondents generally agreed with it. The role of experts in assisting resource allocation receives a moderate mean score of 3.67, indicating that MCAs acknowledge the value of expert guidance in this aspect of plan implementation.

The presented descriptive statistics shed light on the perceptions of MCAs regarding different coordination roles within the Nairobi City County Government. The mean scores reflect varying degrees of agreement with these roles, with some roles receiving higher agreement than others. These insights can guide future strategies to enhance coordination and improve the implementation of strategic plans in the government setting.

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The results of the present study align with findings from Dwivedi (2021), which highlighted the significance of coordination and stakeholder involvement in the implementation of strategic plans. The respondents' high mean scores for roles such as reviewing stakeholders' documents, executive support in plan implementation, and governance of relationships between the County and stakeholders echo the emphasis placed on these aspects in Dwivedi's study.

Moreover, the emphasis on direct communication with stakeholders and involvement in crisis management aligns with Kamassi et al.'s (2020) exploration of stakeholder roles in plan execution. The findings also resonate with Ali and Gitonga's (2019) research on stakeholders' roles in project implementation, confirming the importance of effective coordination and teamwork. This study bridges gaps by specifically examining these coordination roles in the Nairobi County Assembly, addressing content, geographical, and methodological gaps in prior research. The congruence between the results and the existing literature underscores the critical role of coordination in achieving strategic objectives within governmental contexts, reaffirming the broader scholarly consensus on this matter.

Table 1: Descriptive Statistics for Coordination Roles

	N	Mean	Std. Dev	Skewness		Kurtosis	
				Stat	Std. Error	Stat	Std. Error
We go through stakeholders' documents and vet them to the plan.	91	3.80	0.97	-.640	.253	.183	.500
We act as executive support in the implementation of strategic plans	91	3.74	0.96	-.433	.253	-.043	.500
We communicate with stakeholders to influence the groundwork	91	3.66	0.93	-.017	.253	-.547	.500
We work with set stakeholders according to structures	91	3.67	0.96	-.150	.253	-.560	.500
We keep track of the progress of each stakeholder's involvement	91	3.84	0.93	-.248	.253	-.538	.500
When making policies for all organizations and stakeholders involved in strategic plans.	91	3.77	0.93	-.193	.253	-.503	.500
The assembly governs relationships between the County and stakeholder	91	3.81	0.92	-.410	.253	-.188	.500
The assembly involves stakeholders responsible for crisis management	91	3.66	0.99	-.245	.253	-.648	.500
Experts assist the assembly allocate the plan to various resources	91	3.67	1.00	-.449	.253	.024	.500
Valid N (listwise)	91						

Descriptive Statistics for Implementation of Strategic Plans

The results presented in Table 2 provide descriptive statistics for the respondents' perceptions of the influence of resource-managing roles on implementing strategic plans in the Nairobi County Assembly in Kenya. The scale used for responses ranges from 1 (Strongly Disagree) to 5 (Strongly Agree).The completion of plans within specified timeframes: With a mean score of 3.69 and a standard deviation of 1.00, respondents hold a moderate agreement that the plans have been completed on schedule. This indicates a certain degree of consensus among the respondents. The data exhibits a slight negative skewness (-0.239) and a negative kurtosis (-0.685), suggesting that while there is generally an affirmative perception of timely plan completion, a few respondents might strongly disagree, warranting further investigation. This finding implies that the execution of plans within designated timeframes is perceived positively, although there could be varying opinions within the respondents.

Execution of tasks in alignment with set standards: Averaging at 3.71 with a standard deviation of 1.00, respondents generally concur that tasks have been executed in accordance with established standards. The relatively low standard deviation indicates some agreement among respondents. The skewness is -0.475, and the kurtosis is -0.232, suggesting that while there is an overall agreement, there are a few respondents with more pronounced disagreements, necessitating further exploration. This outcome suggests that there exists a positive perception of alignment between completed tasks and the predetermined standards, although some respondents might hold stronger contrary viewpoints.

Meeting quality thresholds of planned services: With an average score of 3.70 and a standard deviation of 1.01, respondents moderately agree that services meet the prescribed quality thresholds of the plans. The standard deviation reflects some variability in responses. The skewness is -0.175, while the kurtosis is -0.782, indicating a relatively normal distribution, albeit with some flattening due to less extreme responses. This result implies that there is a perception of satisfactory service quality, though the variability in responses suggests that there might be differing perspectives.

Increased project completion compared to prior plans: At a mean score of 3.74 and a standard deviation of 0.99, respondents tend to agree that there has been an escalation in project completion compared to previous plans. The standard deviation suggests moderate consensus. With a skewness of -0.437 and a kurtosis of -0.174, the data implies some non-uniformity in responses, warranting further exploration. This outcome signifies a belief in enhanced project completion rates, while the distribution suggests that various viewpoints might exist.

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High satisfaction level with plan success: Scoring an average of 3.58 with a standard deviation of 0.83, respondents moderately concur that there is a high level of satisfaction with the success of the plans. The standard deviation indicates variability in responses. The positive skewness (0.445) suggests strong agreement from some respondents, warranting deeper investigation. This finding indicates a positive perception of plan success satisfaction, potentially driven by the strong agreement from a subset of respondents. Diversification of delivered projects: With a mean of 3.63 and a standard deviation of 0.91, respondents moderately agree that there has been diversification in delivered projects. The standard deviation indicates moderate consensus. The skewness is -0.072, while the kurtosis is -0.797, suggesting a fairly normal distribution with some flattening. This result implies a perception of diversified project delivery, with responses spread across a range of viewpoints.

High efficiency of accomplished plan services: With an average score of 3.75 and a standard deviation of 1.01, respondents generally agree that the accomplished plan services exhibit high efficiency. The standard deviation indicates variability in responses. The skewness is -0.272, and the kurtosis is -0.453, suggesting a relatively normal distribution. This outcome indicates a perception of effective service delivery efficiency, with responses spanning a normal distribution.

Substantial return on investment from plan output evaluation: Scoring an average of 3.68 with a standard deviation of 0.91, respondents moderately agree that there has been a significant return on investment resulting from the evaluation of plan outputs. The standard deviation indicates variability in responses. The skewness is -0.238, and the kurtosis is -0.250, implying a relatively normal distribution. This finding suggests a favorable perception of substantial returns resulting from output evaluation efforts, with varying viewpoints.

The findings suggest a positive overall perception of the interrelation between resource-management roles and the achievement of strategic plans in the Nairobi County Assembly. However, the variability indicated by standard deviations, skewness, and kurtosis values implies the existence of diverse perspectives among the respondents. Further exploration and analysis of the responses are crucial to comprehending the underlying factors influencing these perceptions and identifying potential avenues for enhancement. The results of the current study are in agreement with findings from various literature sources. Asikhia and Mba (2021) emphasize the importance of well-formulated strategies for achieving organizational objectives, and the moderate agreement among respondents regarding plan completion within specified timeframes aligns with this concept. Similarly, the execution of tasks in alignment with set standards, as perceived by respondents, resonates with Dietrich's (2020) exploration of factors affecting strategic decision-making processes. The study's results also parallel the notion discussed by Wambugu and Waiganjo (2015) of barriers to strategy implementation, as indicated by the variability in responses and potential disagreements among participants.

Furthermore, the positive perception of enhanced project completion rates corresponds to the Cândido and Santos, (2015)'s emphasis on successful strategy implementation. The importance of clear responsibilities in strategy implementation, highlighted by Tawse and Tabesh (2021), is echoed in the study's findings regarding plan execution efficiency. Additionally, the concept of involving middle managers in strategy implementation (Tawse & Tabesh, 2021) aligns with the study's recognition of diverse perspectives among respondents. Overall, while the results show positive perceptions of the interrelation between resource-management roles and strategic plan achievement, the variability in responses underscores the need for further exploration, as suggested by various literature sources.

Table 2: Descriptive Statistics for Implementation of Strategic Plans

	N	Mean	Std. Dev.	Skewness		Kurtosis	
					Std. Error	Statistic	Std. Error
The plans have been completed on timely	91	3.69	1.00	-.239	.253	-.685	.500
Tasks have been completed according to the standards set	91	3.71	1.00	-.475	.253	-.232	.500
The quality of services meets the plan's set threshold	91	3.70	1.01	-.175	.253	-.782	.500
The number of projects completed has increase when compared to previous plans	91	3.74	0.99	-.437	.253	-.174	.500
Level of satisfaction of the plan's success is high	91	3.58	0.83	.445	.253	-.717	.500
Diversification of delivered projects	91	3.63	0.91	-.072	.253	-.797	.500
There is high efficiency of services that the plan has accomplished	91	3.75	1.01	-.272	.253	-.453	.500
The county has had a high return on investment from the monitoring and evaluation of the output set in the plan	91	3.68	0.91	-.238	.253	-.250	.500
Valid N (listwise)	91						

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Correlations

The study unveiled a strong positive correlation ($r = 0.847$, $p < 0.01$) between the coordination role of MCAs and the implementation of strategic plans. This underscores the importance of effective coordination in resource utilization and project alignment. A similar sentiment is echoed in the research by Kivuva (2018), emphasizing the necessity of coordinated efforts among county officials for efficient service delivery.

Table 3: Correlation between the roles of Members of County Assemblies (MCAs) and the Implementation of Strategic Plans

		Implementation of Strategic Plans
Coordination Role	Pearson Correlation	.847**
	Sig. (2-tailed)	.000
	N	91
Implementation of Strategic Plans	Pearson Correlation	1
	Sig. (2-tailed)	
	N	91

Regression Analysis

The model summary table provides key insights into the strength of the relationship between the coordination role and the attainment of strategic plans. The R value is .847, indicating a strong positive correlation between the two variables. The R Square value of .717 suggests that 71.7% of the variation in the attainment of strategic plans can be explained by the coordination role of members of the County Assembly. The adjusted R Square value of .714, very close to the R Square, confirms the model's stability and high explanatory power, while the standard error of .34834 indicates the average distance that the observed values fall from the regression line. This strong correlation implies that the coordination role is a significant contributor to the success of strategic plans.

Table 4: Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.847[a]	.717	.714	.34834

a. Predictors: (Constant), Coordination Role

The ANOVA table further supports the model's validity. The regression sum of squares is 27.419, significantly larger than the residual sum of squares (10.800), suggesting that the model explains much of the variation in the attainment of strategic plans. The F-statistic of 225.958 is considerably large, and the significance level of .000 indicates that the model is statistically significant at the 0.05 level. This means that there is a very low probability that the relationship between the coordination role and the attainment of strategic plans is due to chance. Hence, the coordination role is statistically significant in influencing the implementation of strategic plans in Nairobi County.

Table 5: ANOVA

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	27.419	1	27.419	225.958	.000[b]
	Residual	10.800	89	.121		
	Total	38.218	90			

a. Dependent Variable: Attainment of Strategic Plans
b. Predictors: (Constant), Coordination Role

The coefficients table provides insights into the specific impact of the coordination role on the attainment of strategic plans. The unstandardized coefficient (B) for the coordination role is .768, meaning that for every one-unit increase in the coordination role, there is a corresponding increase of .768 units in the attainment of strategic plans, holding all other factors constant. The standardized beta value of .847 confirms the strong positive relationship between the coordination role and strategic plan attainment. The t-value of 15.032 and the significance value of .000 indicate that the coordination role is a highly significant predictor of strategic plan success. The constant value (B = .930) represents the expected attainment of strategic plans when the coordination role is at zero, further emphasizing the substantial impact of the coordination role.

Table 6: Coefficients

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	.930	.191		4.872	.000
	Coordination Role	.768	.051	.847	15.032	.000

a. Dependent Variable: Attainment of Strategic Plans

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Hypotheses Testing

Based on the provided data and the p-value criterion of $p < 0.05$, the study analyzes the acceptance or rejection of each null hypothesis and discusses the implications of the results in the context of the Nairobi County Assembly (NCA) in Kenya.

H0: There is no significant relationship between the coordinating role and the implementation of strategic plans in the Nairobi County Assembly in Kenya.

The p-value associated with the coefficient for the "Coordination Role" is 0.000, which is less than 0.05. Thus, the study rejects the null hypothesis (H03). This suggests that there is a significant relationship between the coordinating role of MCAs and the implementation of strategic plans in the NCA. This indicates that MCAs involved in coordination activities play a significant role in contributing to the achievement of strategic plans.

Conclusions

The findings reveal varying perceptions among MCAs regarding coordination roles, encompassing stakeholder communication and resource allocation. A robust positive correlation underscores the pivotal role of effective coordination in resource allocation and project alignment, with a significant relationship established between MCAs' coordination roles and strategic plan implementation. These results underscore the need for enhanced coordination strategies to support successful plan implementation.

Recommendations

The varied levels of agreement among MCAs regarding coordination roles underline the importance of focused efforts by NCCG to coordinate stakeholder engagement effectively. The government should establish clear engagement structures, streamlining the process of stakeholder communication, involvement, and crisis management. Regular forums for stakeholders to interact with MCAs should be organized to foster a better understanding of plan-related activities. Moreover, expertise should be leveraged through involving stakeholders in resource allocation decisions. By strengthening coordination, NCCG can ensure alignment between stakeholders and strategic objectives, thereby enhancing the implementation of strategic plans.

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