report-1

March 18, 2025

[1]:
```
import pandas as pd
import numpy as np
import seaborn as sns
import matplotlib.pyplot as plt
```

[18]:
```
np.random.seed(42)
```

1. DATA LOADING & INITIAL OVERVIEW

[10]:
```
df = pd.read_csv('/content/student_data.csv')
```

[11]:
```
print("DATA INFO:")
print(df.info())
```

```
DATA INFO:
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 6607 entries, 0 to 6606
Data columns (total 20 columns):
 #   Column                      Non-Null Count  Dtype
---  ------                      --------------  -----
 0   Hours_Studied               6607 non-null   int64
 1   Attendance                  6607 non-null   int64
 2   Parental_Involvement        6607 non-null   object
 3   Access_to_Resources         6607 non-null   object
 4   Extracurricular_Activities  6607 non-null   object
 5   Sleep_Hours                 6607 non-null   int64
 6   Previous_Scores             6607 non-null   int64
 7   Motivation_Level            6607 non-null   object
 8   Internet_Access             6607 non-null   object
 9   Tutoring_Sessions           6607 non-null   int64
 10  Family_Income               6607 non-null   object
 11  Teacher_Quality             6529 non-null   object
 12  School_Type                 6607 non-null   object
 13  Peer_Influence              6607 non-null   object
 14  Physical_Activity           6607 non-null   int64
 15  Learning_Disabilities       6607 non-null   object
 16  Parental_Education_Level    6517 non-null   object
 17  Distance_from_Home          6540 non-null   object
```

```
 18  Gender                      6607 non-null   object
 19  Exam_Score                  6607 non-null   int64
dtypes: int64(7), object(13)
memory usage: 1.0+ MB
None
```

[12]:
```
print("\nSTATISTICAL DESCRIPTION:")
print(df.describe(include='all'))
```

```
STATISTICAL DESCRIPTION:
        Hours_Studied   Attendance Parental_Involvement Access_to_Resources  \
count     6607.000000  6607.000000                 6607                 6607
unique            NaN          NaN                    3                    3
top               NaN          NaN               Medium               Medium
freq              NaN          NaN                 3362                 3319
mean        19.975329    79.977448                  NaN                  NaN
std          5.990594    11.547475                  NaN                  NaN
min          1.000000    60.000000                  NaN                  NaN
25%         16.000000    70.000000                  NaN                  NaN
50%         20.000000    80.000000                  NaN                  NaN
75%         24.000000    90.000000                  NaN                  NaN
max         44.000000   100.000000                  NaN                  NaN

       Extracurricular_Activities  Sleep_Hours  Previous_Scores  \
count                        6607   6607.00000      6607.000000
unique                          2          NaN              NaN
top                           Yes          NaN              NaN
freq                         3938          NaN              NaN
mean                          NaN      7.02906        75.070531
std                           NaN      1.46812        14.399784
min                           NaN      4.00000        50.000000
25%                           NaN      6.00000        63.000000
50%                           NaN      7.00000        75.000000
75%                           NaN      8.00000        88.000000
max                           NaN     10.00000       100.000000

       Motivation_Level Internet_Access  Tutoring_Sessions Family_Income  \
count              6607            6607        6607.000000          6607
unique                3               2                NaN             3
top              Medium             Yes                NaN           Low
freq               3351            6108                NaN          2672
mean                NaN             NaN           1.493719           NaN
std                 NaN             NaN           1.230570           NaN
min                 NaN             NaN           0.000000           NaN
25%                 NaN             NaN           1.000000           NaN
50%                 NaN             NaN           1.000000           NaN
75%                 NaN             NaN           2.000000           NaN
```

```
max                  NaN             NaN           8.000000           NaN

       Teacher_Quality School_Type Peer_Influence  Physical_Activity  \
count             6529        6607            6607        6607.000000
unique               3           2               3                NaN
top             Medium      Public        Positive                NaN
freq              3925        4598            2638                NaN
mean               NaN         NaN             NaN           2.967610
std                NaN         NaN             NaN           1.031231
min                NaN         NaN             NaN           0.000000
25%                NaN         NaN             NaN           2.000000
50%                NaN         NaN             NaN           3.000000
75%                NaN         NaN             NaN           4.000000
max                NaN         NaN             NaN           6.000000

       Learning_Disabilities Parental_Education_Level Distance_from_Home  \
count                   6607                    6517               6540
unique                     2                       3                  3
top                       No             High School               Near
freq                    5912                    3223               3884
mean                     NaN                     NaN                NaN
std                      NaN                     NaN                NaN
min                      NaN                     NaN                NaN
25%                      NaN                     NaN                NaN
50%                      NaN                     NaN                NaN
75%                      NaN                     NaN                NaN
max                      NaN                     NaN                NaN

       Gender   Exam_Score
count    6607  6607.000000
unique      2          NaN
top      Male          NaN
freq     3814          NaN
mean      NaN    67.235659
std       NaN     3.890456
min       NaN    55.000000
25%       NaN    65.000000
50%       NaN    67.000000
75%       NaN    69.000000
max       NaN   101.000000
```

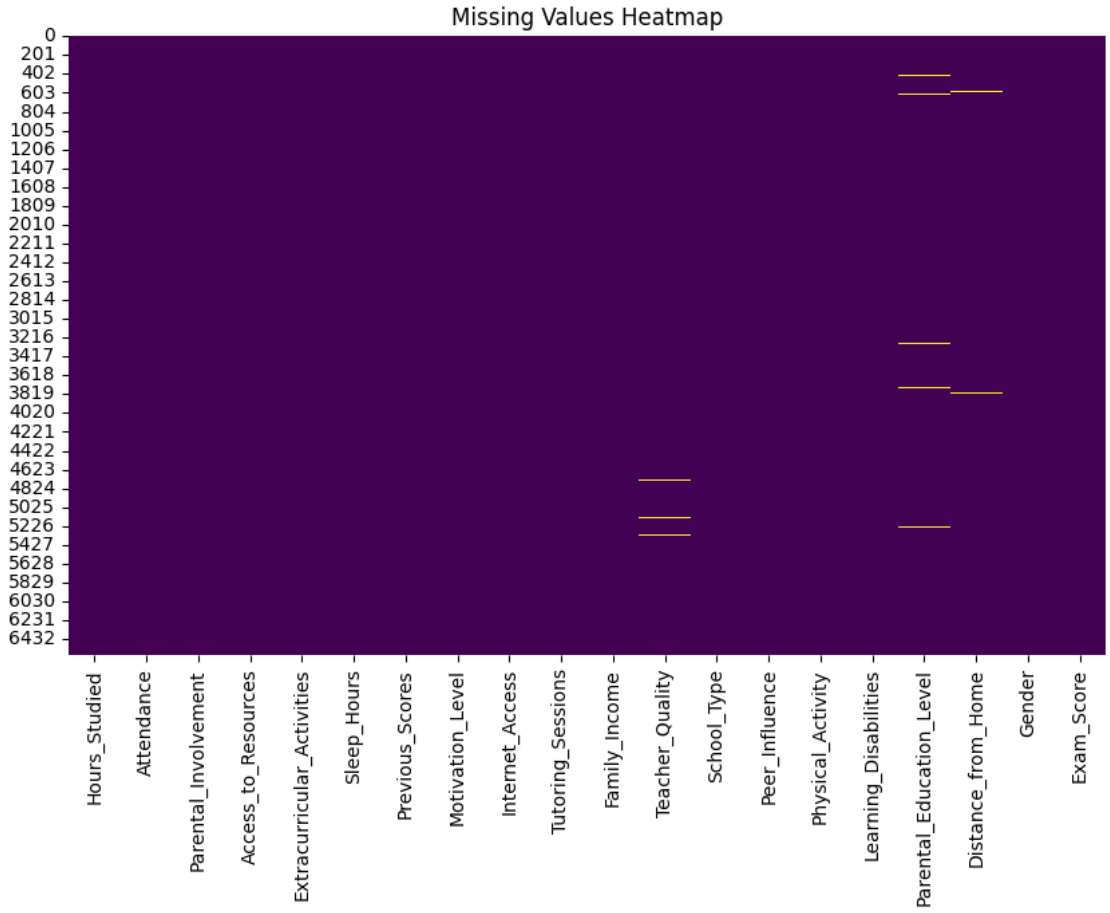
[17]:
```
print("\nMISSING VALUES PER COLUMN:")
print(df.isnull().sum())
```

```
MISSING VALUES PER COLUMN:
Hours_Studied                 0
Attendance                    0
```

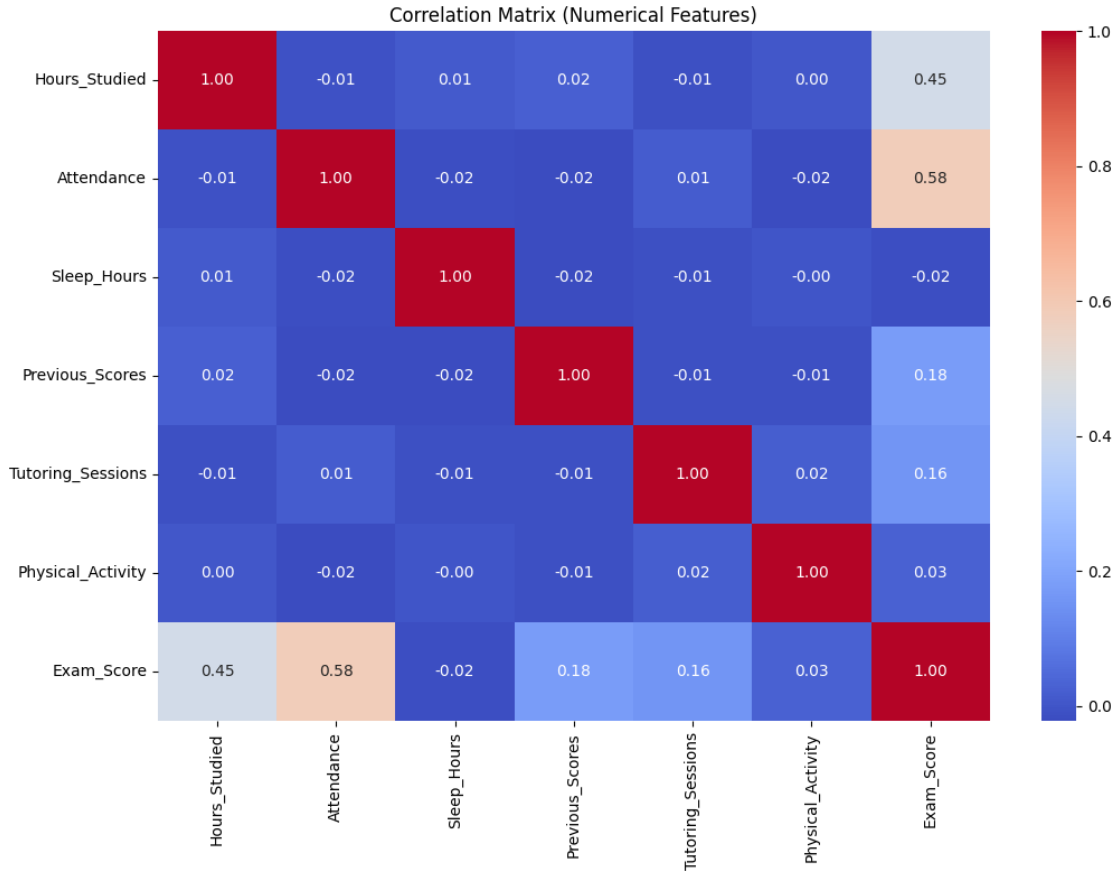
```
Parental_Involvement           0
Access_to_Resources            0
Extracurricular_Activities     0
Sleep_Hours                    0
Previous_Scores                0
Motivation_Level               0
Internet_Access                0
Tutoring_Sessions              0
Family_Income                  0
Teacher_Quality               78
School_Type                    0
Peer_Influence                 0
Physical_Activity              0
Learning_Disabilities          0
Parental_Education_Level      90
Distance_from_Home            67
Gender                         0
Exam_Score                     0
dtype: int64
```

2. EXPLORATORY DATA ANALYSIS (EDA) & VISUALIZATIONS

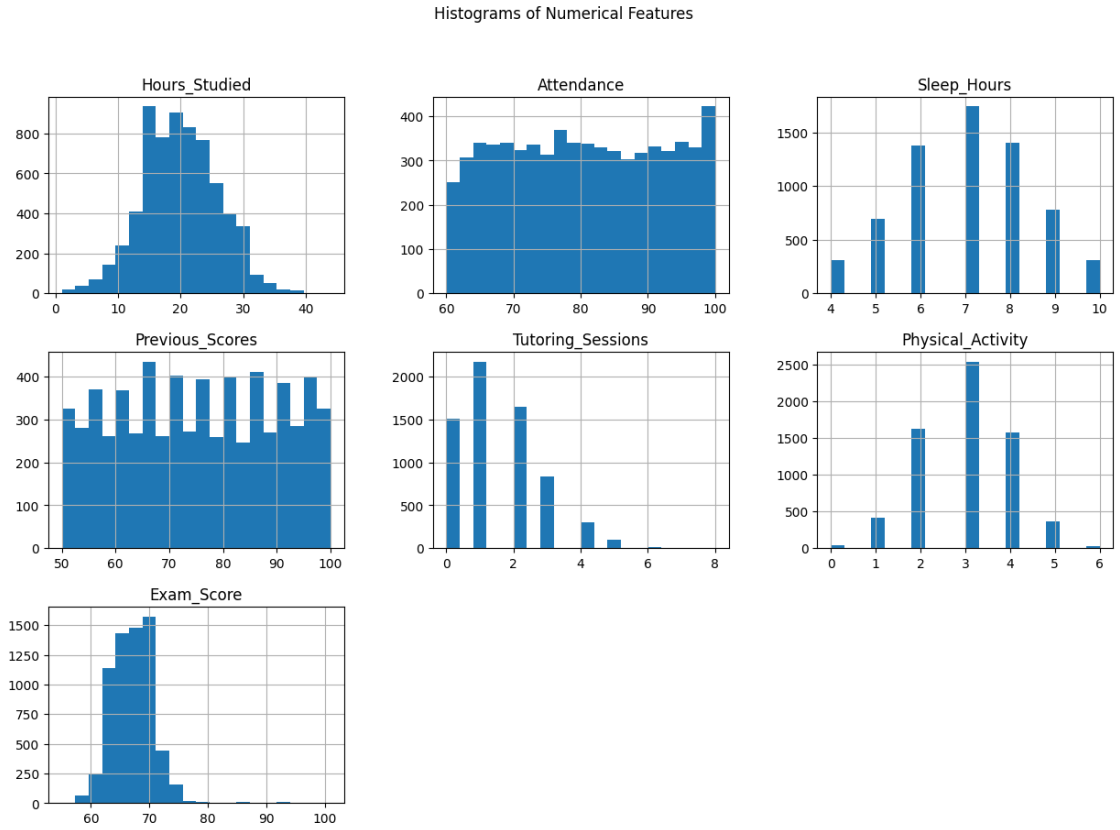
[19]:
```
# 2.1 Missing Values Heatmap
plt.figure(figsize=(10, 6))
sns.heatmap(df.isnull(), cmap='viridis', cbar=False)
plt.title('Missing Values Heatmap')
plt.show()
```



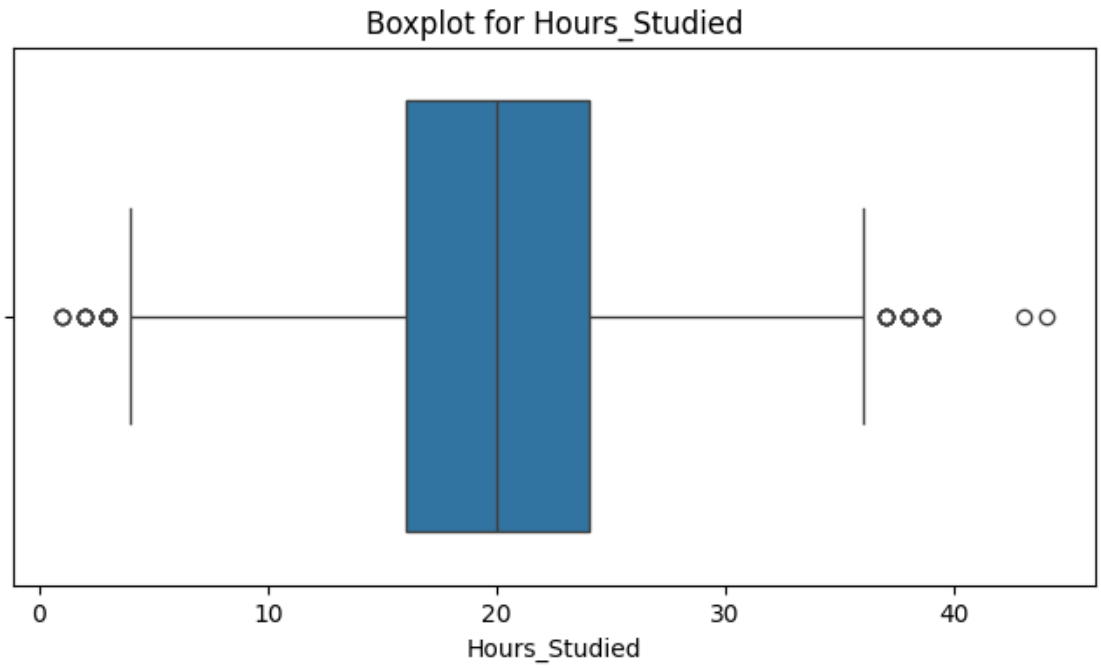
[20]:
```
# 2.2 Correlation Matrix (for numerical features)
numerical_cols = ['Hours_Studied', 'Attendance', 'Sleep_Hours',
                  'Previous_Scores', 'Tutoring_Sessions', 'Physical_Activity',␣
 ↪'Exam_Score']
plt.figure(figsize=(12, 8))
sns.heatmap(df[numerical_cols].corr(), annot=True, cmap='coolwarm', fmt='.2f')
plt.title('Correlation Matrix (Numerical Features)')
plt.show()
```

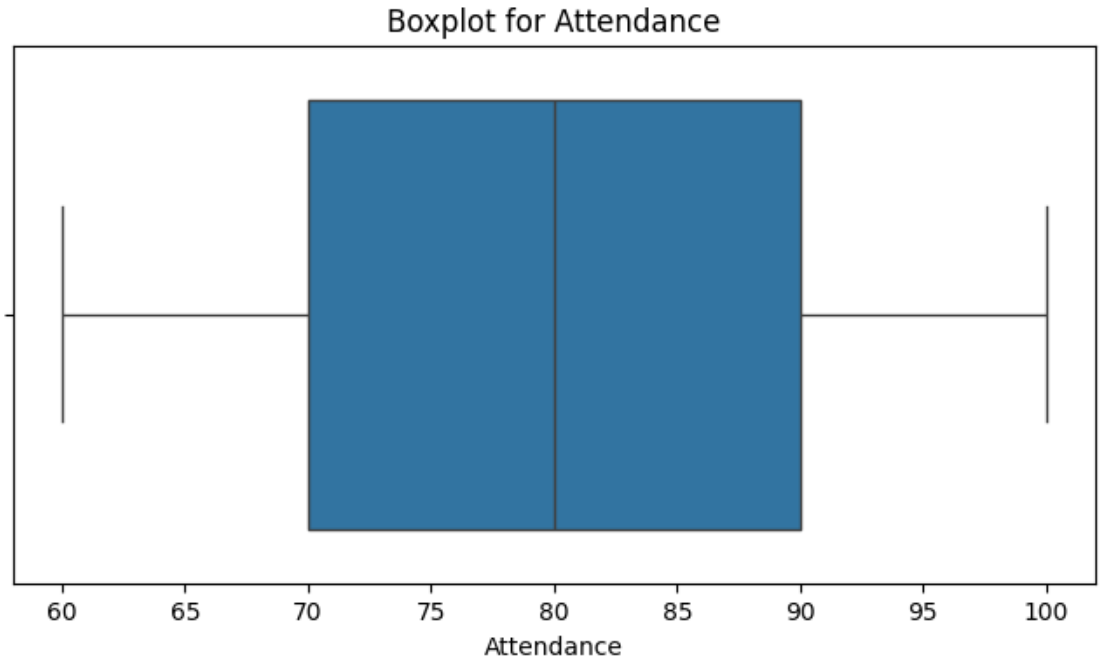


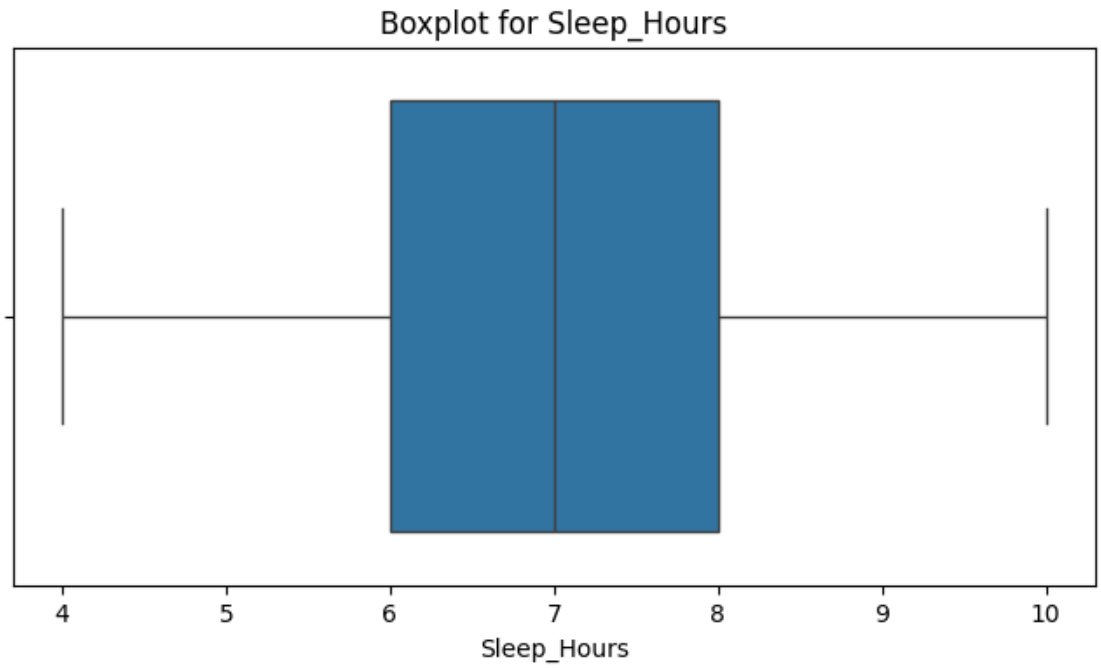
[21]:
```
# 2.3 Histograms for Numerical Features
df[numerical_cols].hist(bins=20, figsize=(15, 10))
plt.suptitle('Histograms of Numerical Features')
plt.show()
```

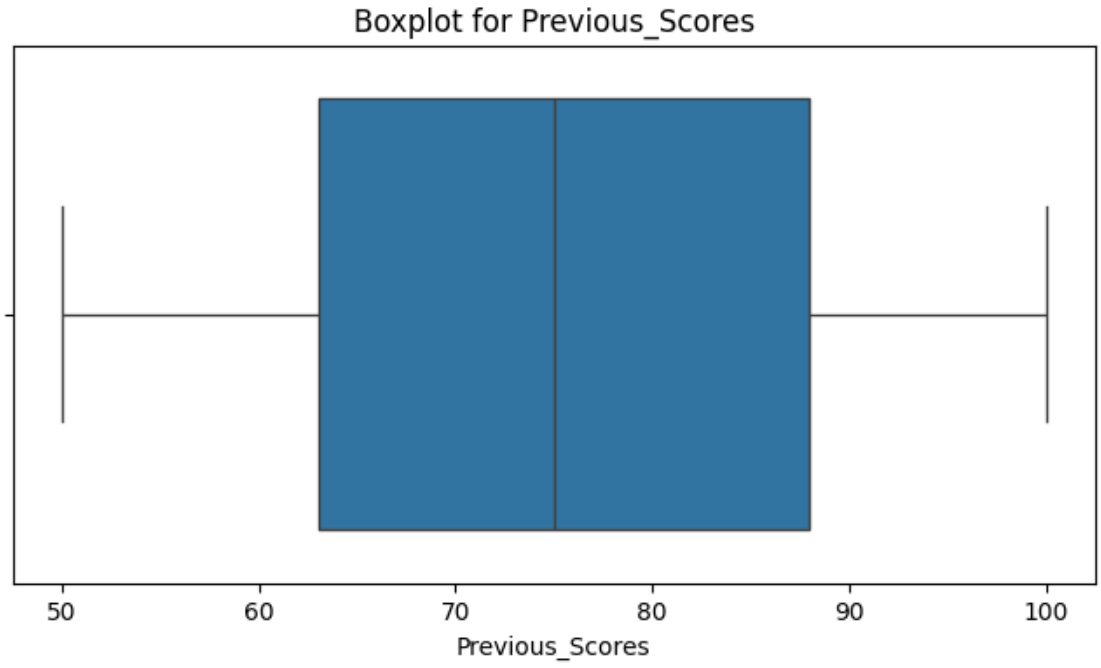


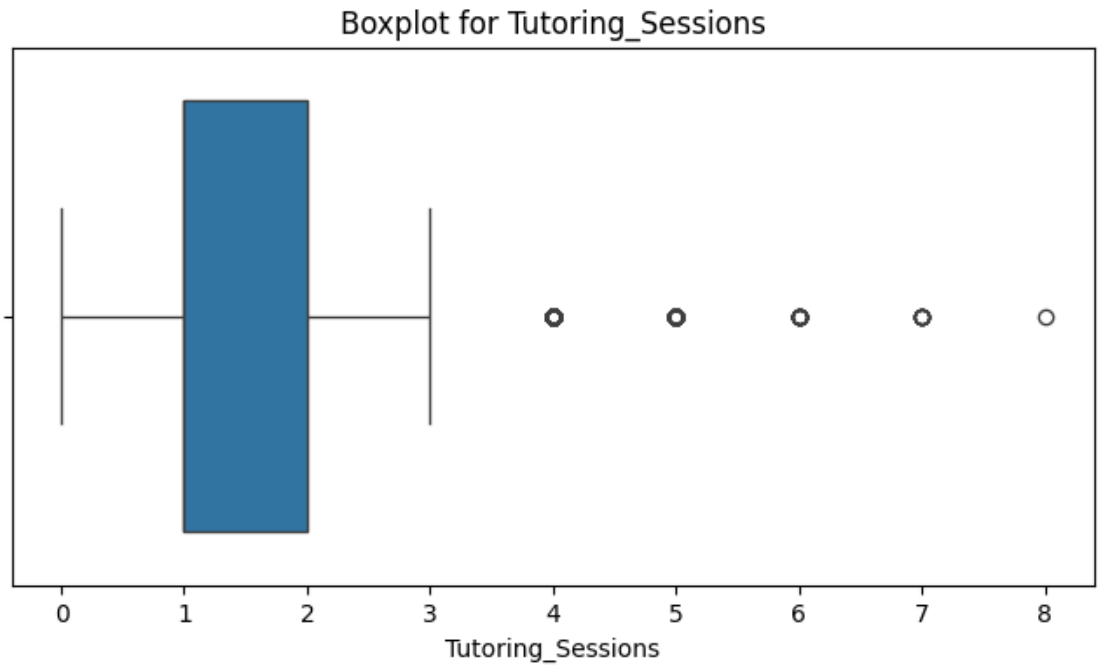
[22]:
```
# 2.4 Boxplots for Numerical Features
for col in numerical_cols:
    plt.figure(figsize=(8, 4))
    sns.boxplot(x=df[col])
    plt.title(f'Boxplot for {col}')
    plt.show()
```

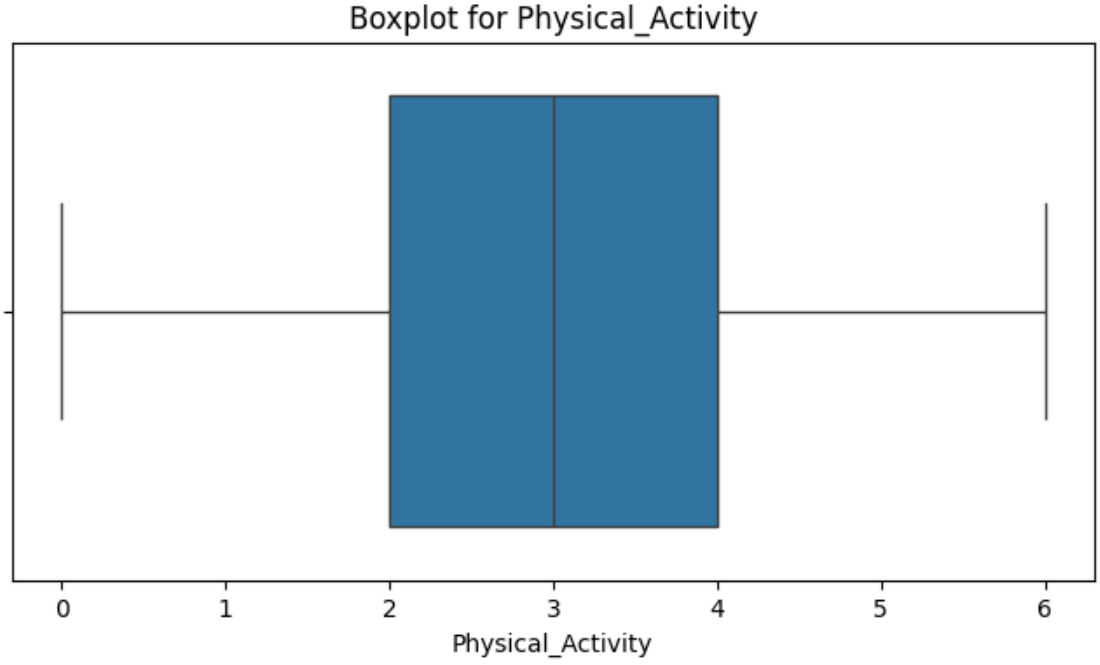

Boxplot for Hours_Studied
0
10
20
30
40
Hours_Studied

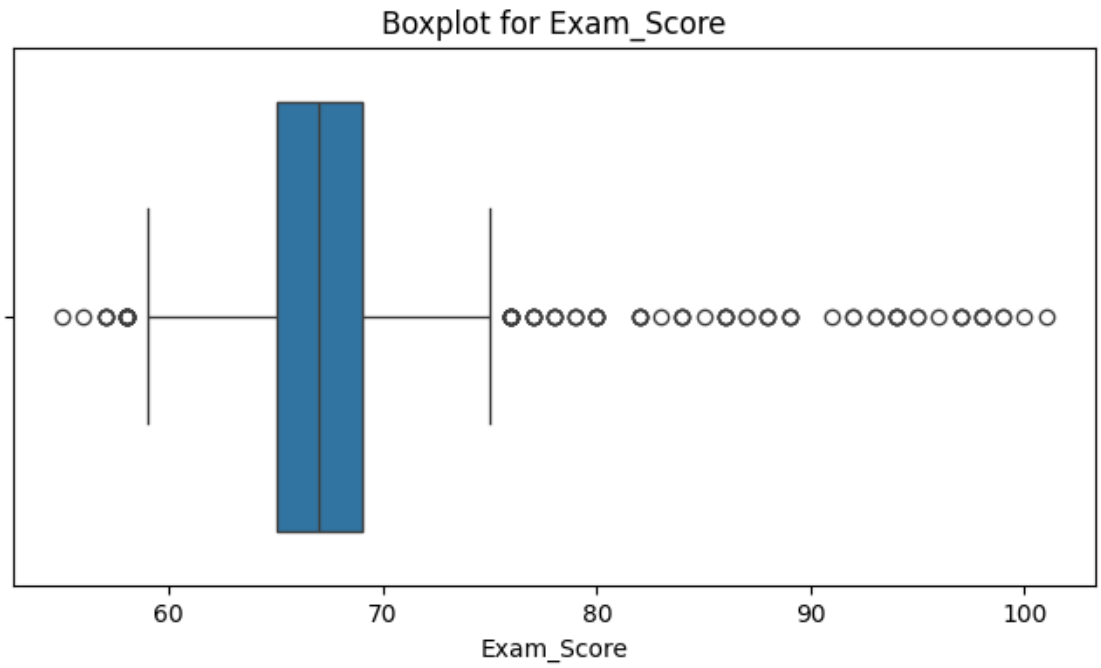

Boxplot for Attendance
60
65
70
75
80
85
90
95
100
Attendance


Boxplot for Sleep_Hours
4
5
6
7
8
9
10
Sleep_Hours

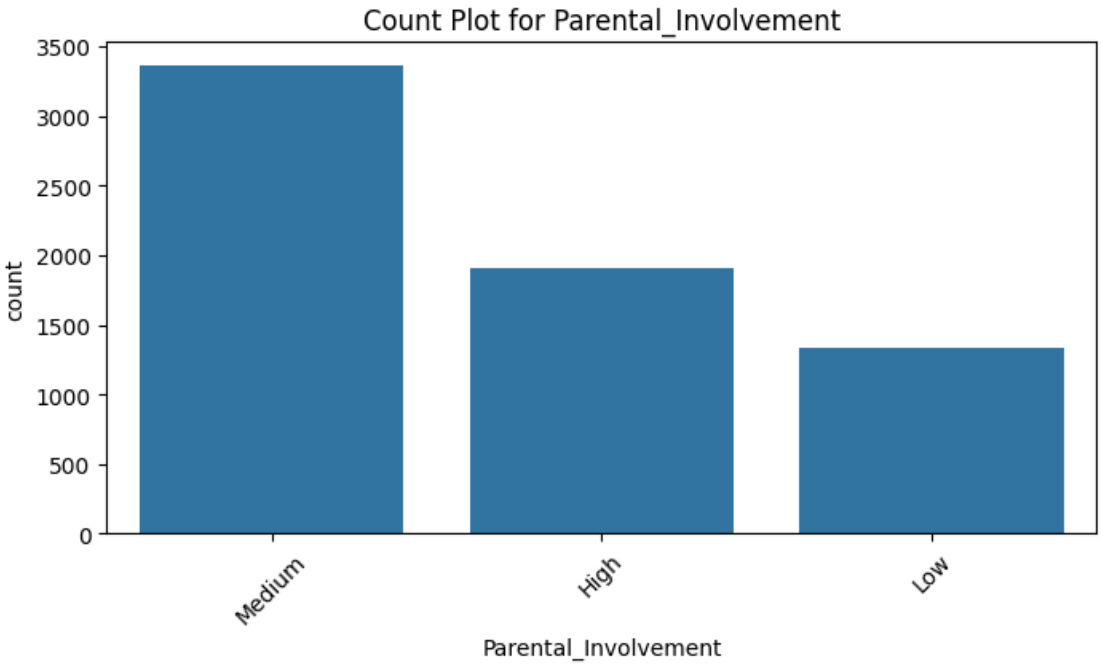

Boxplot for Previous_Scores
50
60
70
80
90
100
Previous_Scores

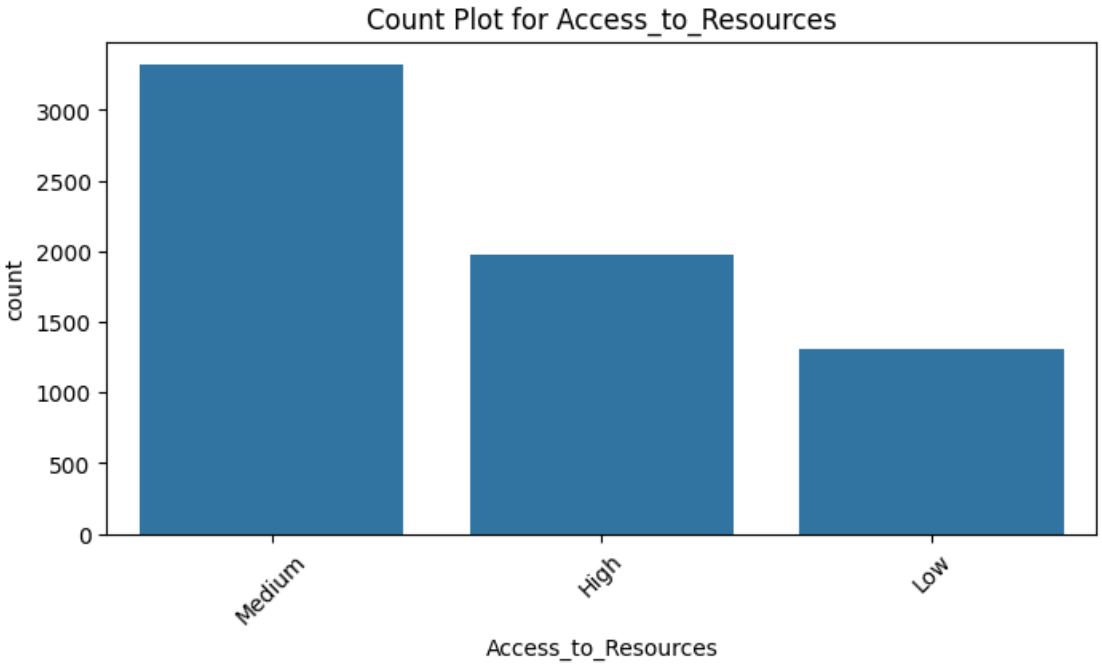

Boxplot for Tutoring_Sessions
0
1
2
3
4
5
6
7
8
Tutoring_Sessions

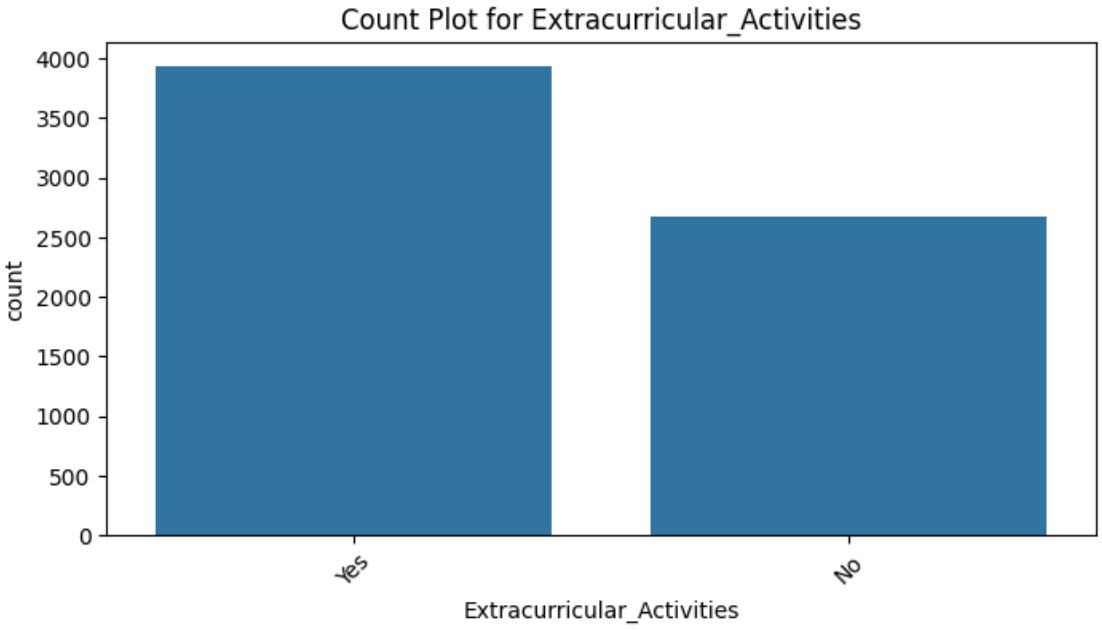

Boxplot for Physical_Activity
0
1
2
3
4
5
6
Physical_Activity

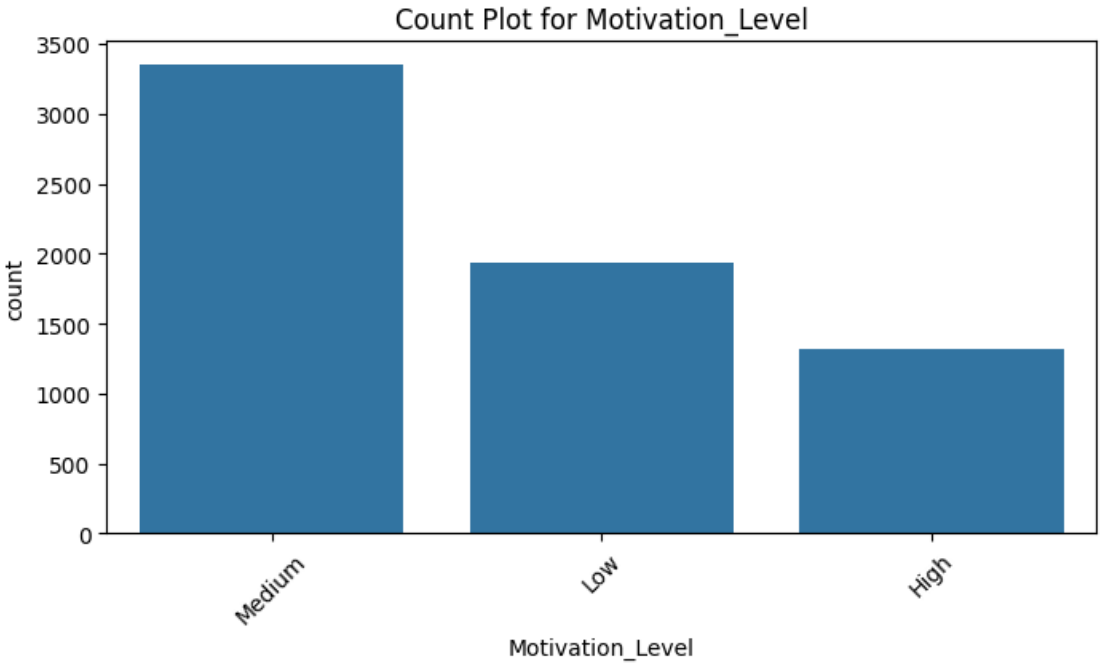


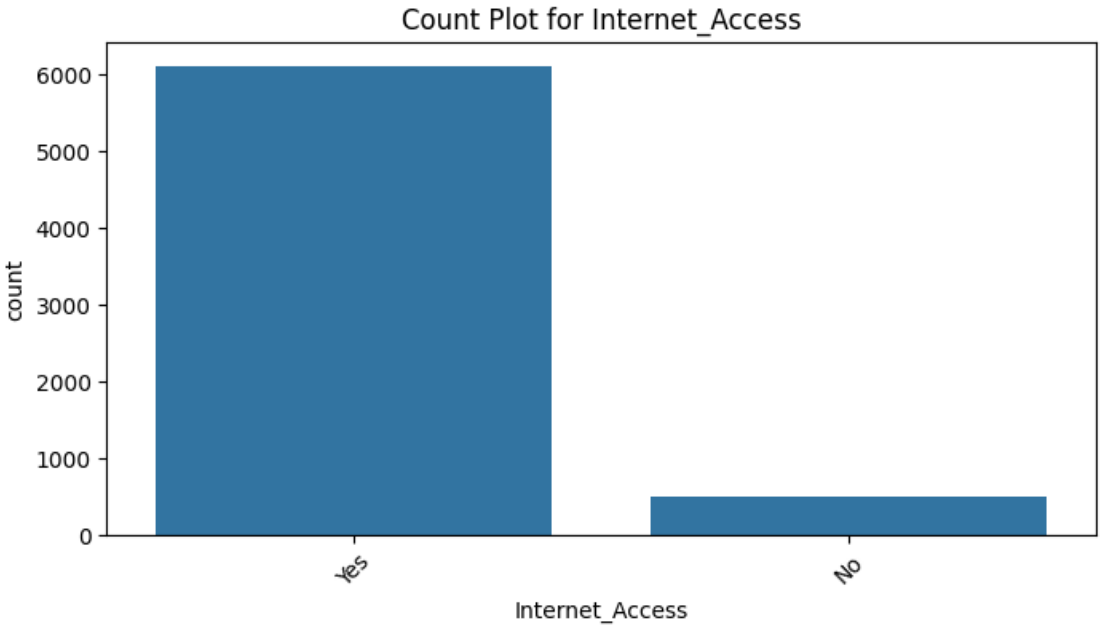
[23]:
```
# 2.5 Count Plots for Categorical Features
categorical_cols = ['Parental_Involvement', 'Access_to_Resources',␣
 ↪'Extracurricular_Activities',
                    'Motivation_Level', 'Internet_Access', 'Family_Income',␣
 ↪'Teacher_Quality',
                    'School_Type', 'Peer_Influence', 'Learning_Disabilities',
                    'Parental_Education_Level', 'Distance_from_Home', 'Gender']
for col in categorical_cols:
    plt.figure(figsize=(8, 4))
    sns.countplot(data=df, x=col, order=df[col].value_counts().index)
    plt.title(f'Count Plot for {col}')
    plt.xticks(rotation=45)
    plt.show()
```

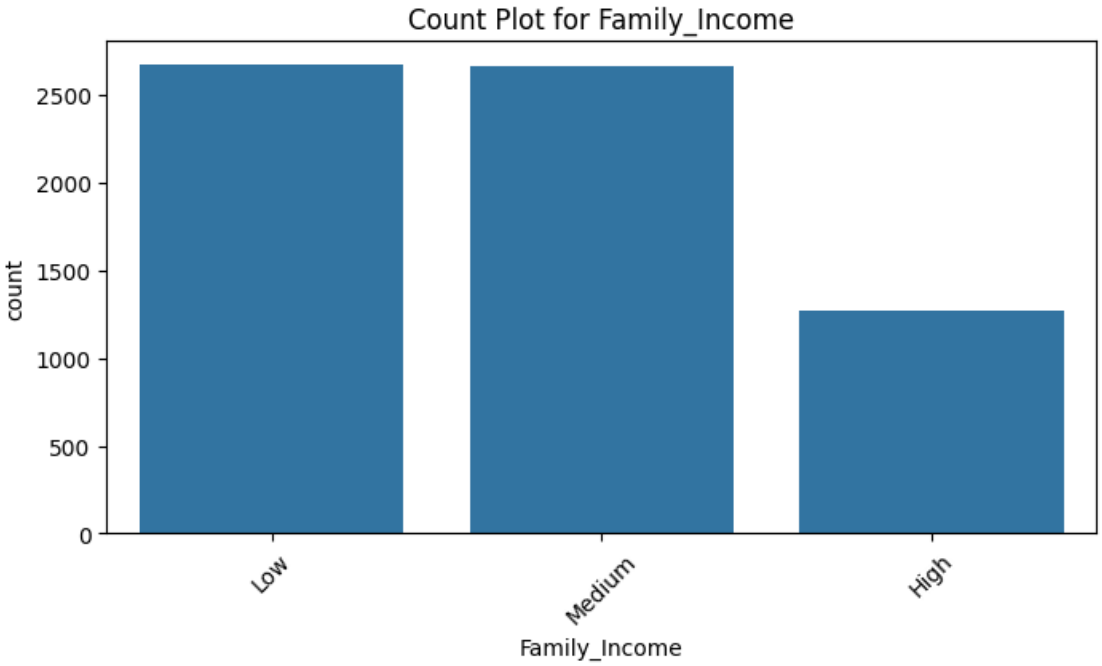

Count Plot for Parental_Involvement
3500
3000
2500
2000
1500
1000
500
0
count
Medium
High
Low
Parental_Involvement

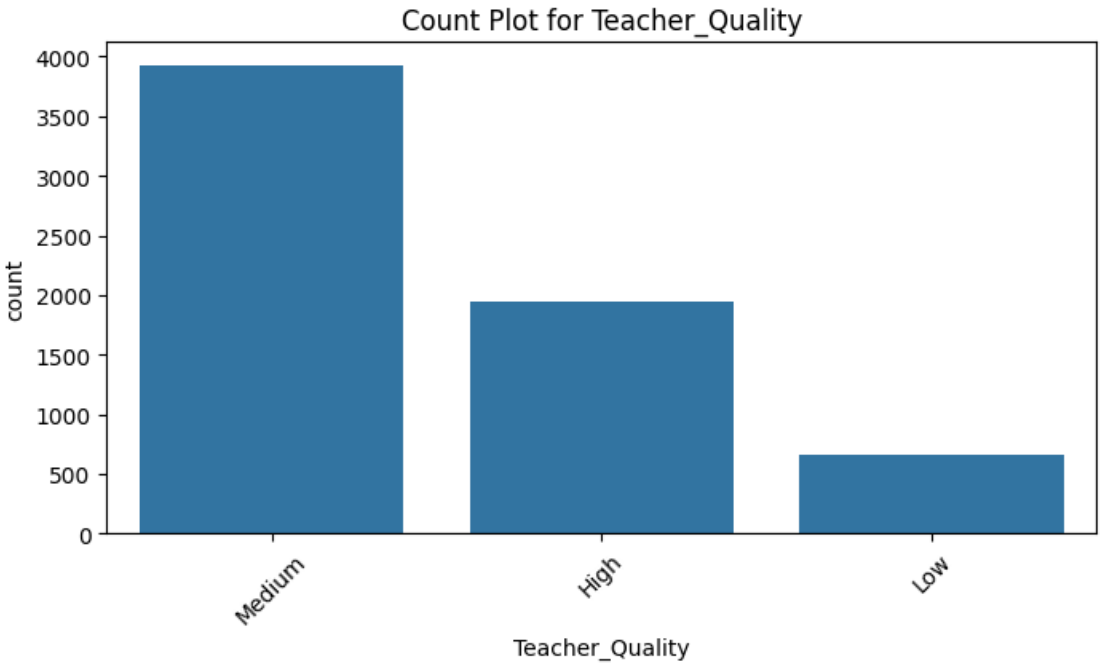

Count Plot for Access_to_Resources
3000
2500
2000
1500
1000
500
0
count
Medium
High
Low
Access_to_Resources

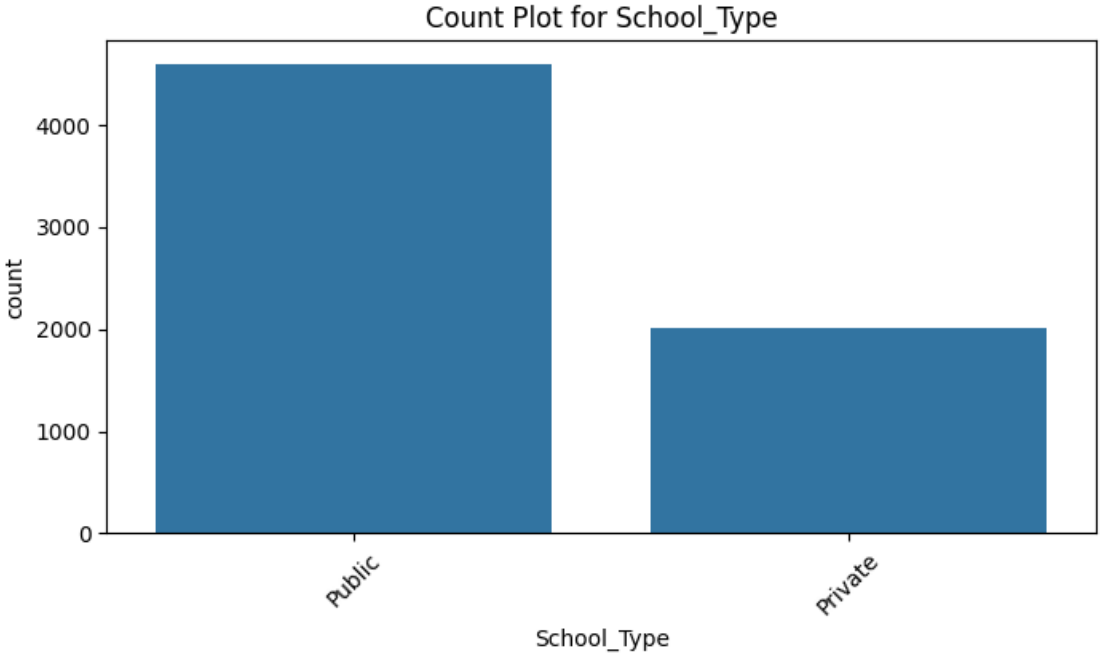

Count Plot for Extracurricular_Activities
count
4000
3500
3000
2500
2000
1500
1000
500
0
Yes
No
Extracurricular_Activities

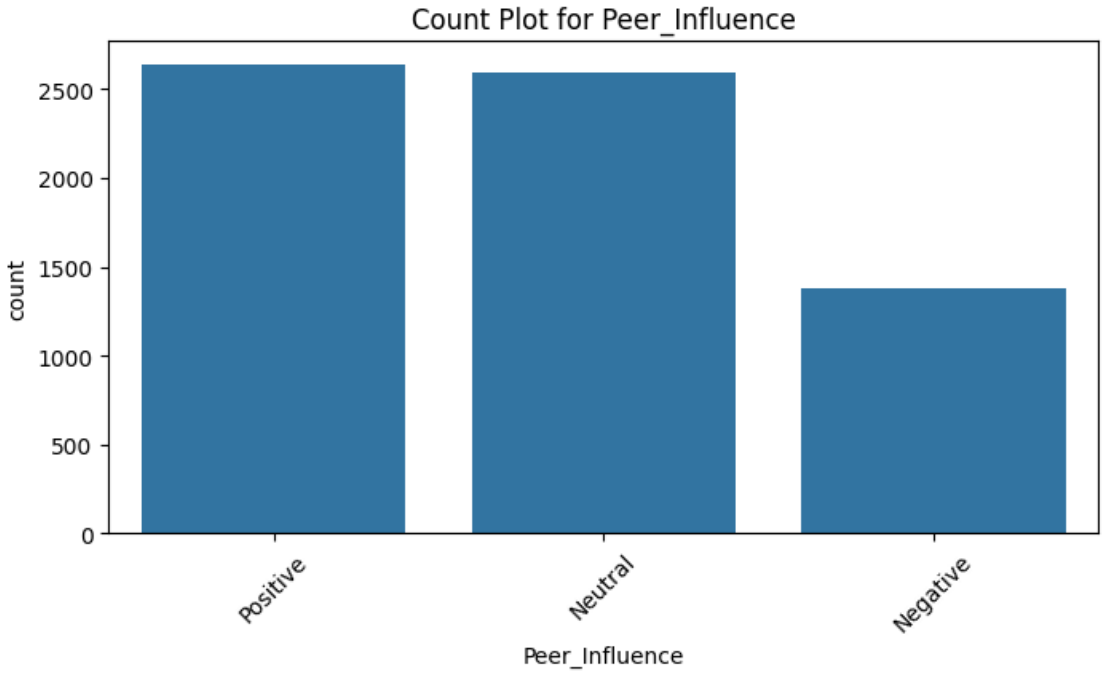

Count Plot for Motivation_Level
count
3500
3000
2500
2000
1500
1000
500
0
Medium
Low
High
Motivation_Level

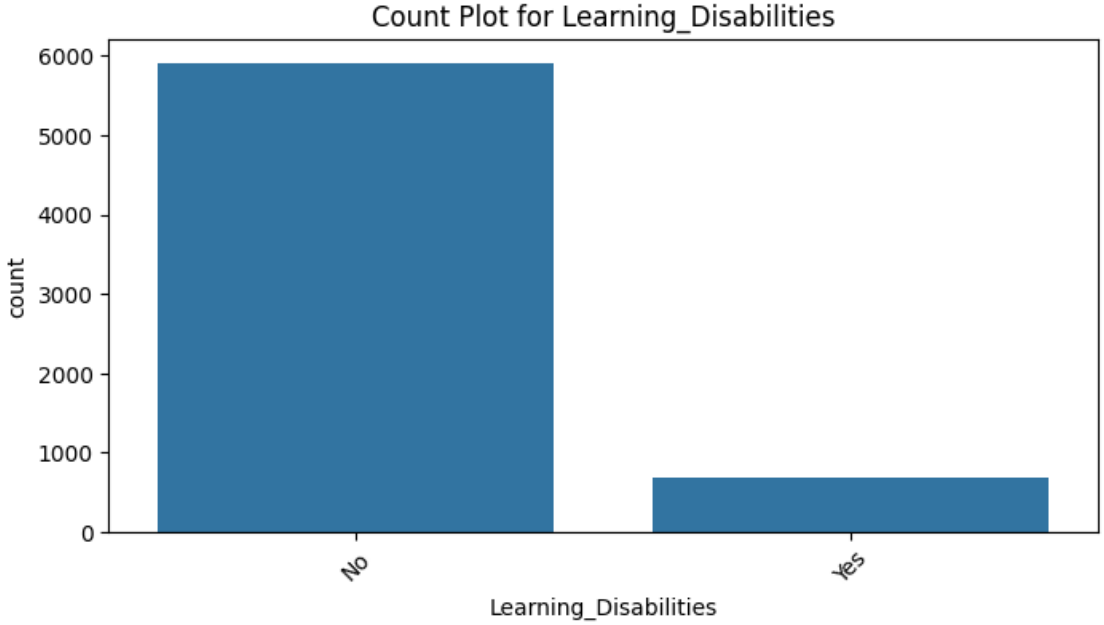

Count Plot for Internet_Access
count
6000
5000
4000
3000
2000
1000
0
Yes
No
Internet_Access

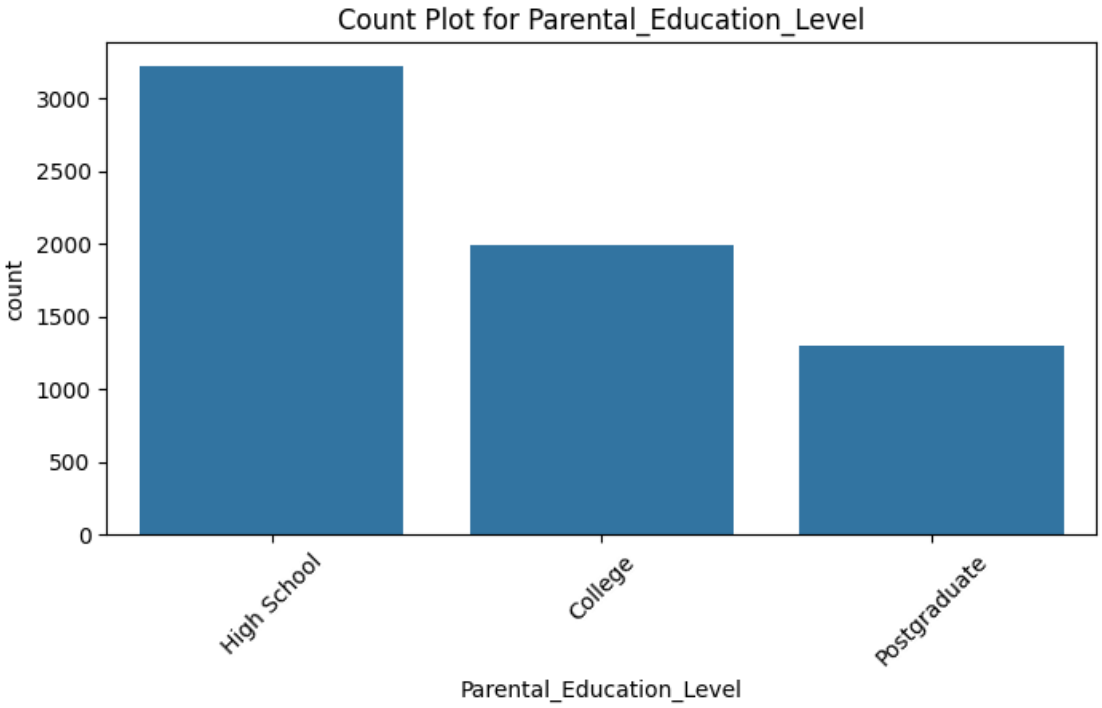

Count Plot for Family_Income
count
2500
2000
1500
1000
500
0
Low
Medium
High
Family_Income

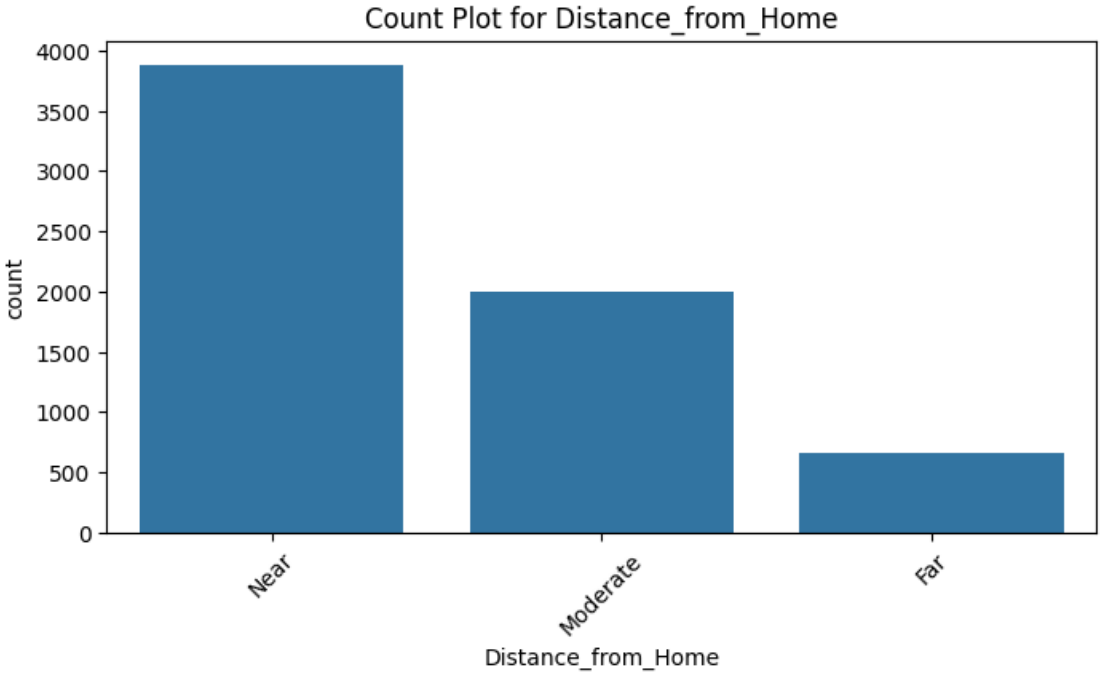

Count Plot for Teacher_Quality
count
4000
3500
3000
2500
2000
1500
1000
500
0
Medium
High
Low
Teacher_Quality

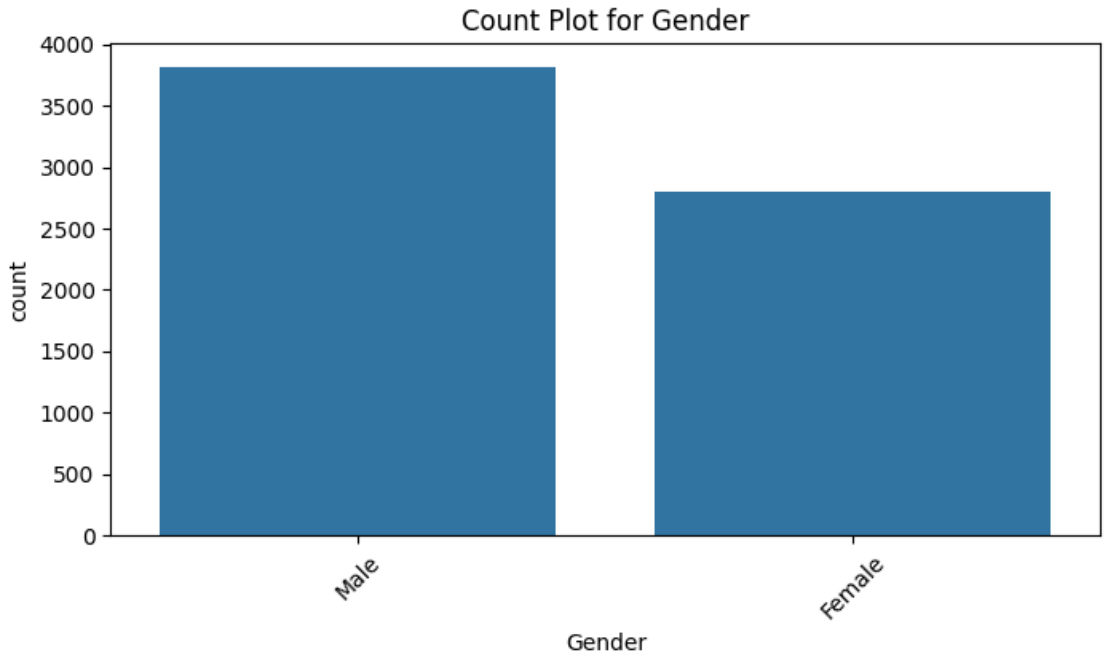

Count Plot for School_Type
count
4000
3000
2000
1000
0
Public
Private
School_Type


Count Plot for Peer_Influence
count
2500
2000
1500
1000
500
0
Positive
Neutral
Negative
Peer_Influence

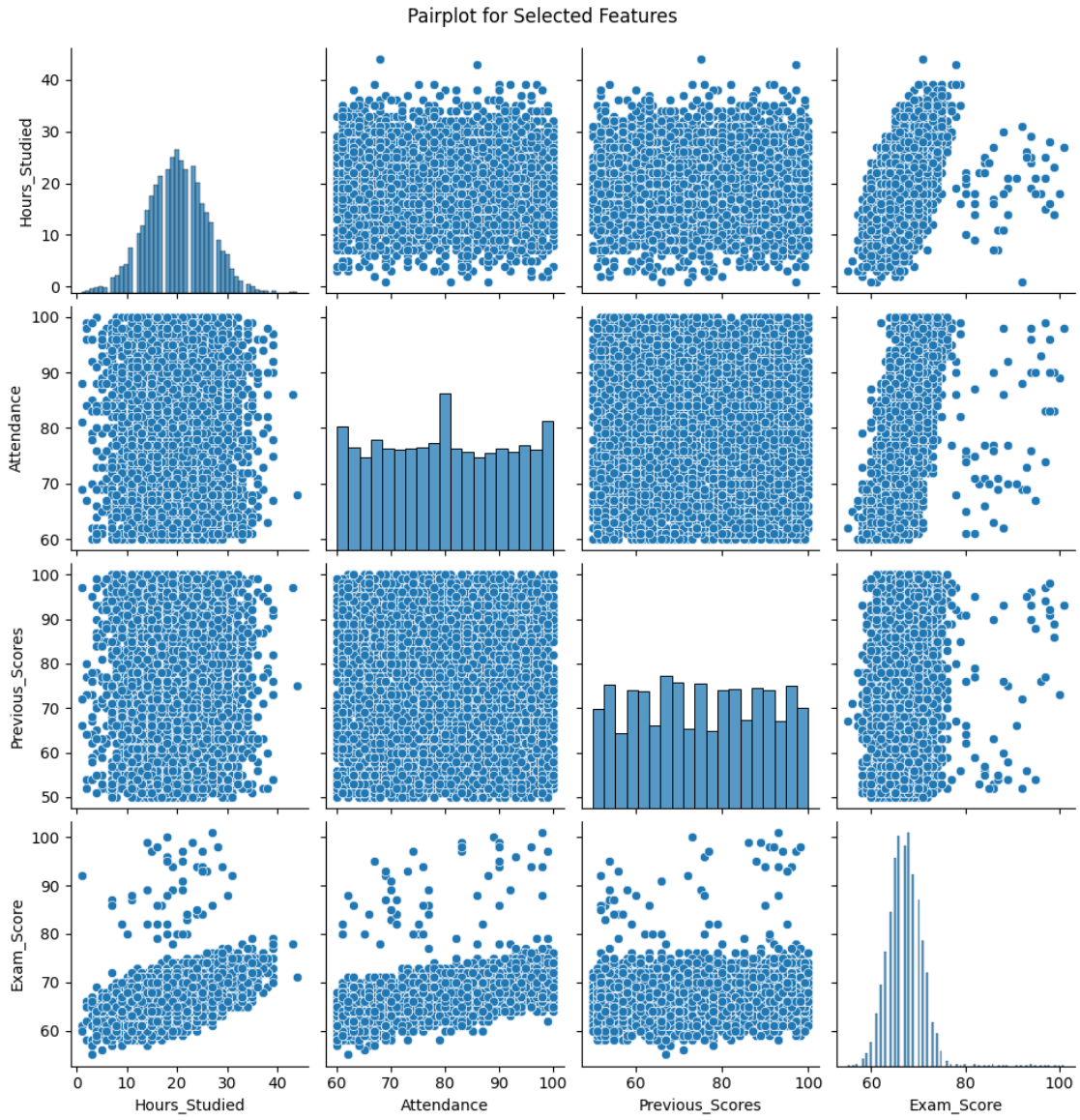

Count Plot for Learning_Disabilities
count
6000
5000
4000
3000
2000
1000
0
No
Yes
Learning_Disabilities


Count Plot for Parental_Education_Level
count
3000
2500
2000
1500
1000
500
0
High School
College
Postgraduate
Parental_Education_Level


Count Plot for Distance_from_Home
count
4000
3500
3000
2500
2000
1500
1000
500
0
Near
Moderate
Far
Distance_from_Home



[24]:
```
# 2.6 Pairplot (subset of features for clarity)
subset_cols = ['Hours_Studied', 'Attendance', 'Previous_Scores', 'Exam_Score']
sns.pairplot(df[subset_cols])
plt.suptitle('Pairplot for Selected Features', y=1.02)
plt.show()
```



0.0.1 3. DATA PREPROCESSING

[26]:
```
# Fix missing values without inplace=True
for col in df.columns:
    if df[col].dtype == 'object':
        df[col] = df[col].fillna(df[col].mode()[0])
    else:
        df[col] = df[col].fillna(df[col].median())

# Define mapping dictionaries for ordinal features:
mapping_dicts = {
    'Parental_Involvement': {'Low': 0, 'Medium': 1, 'High': 2},
```

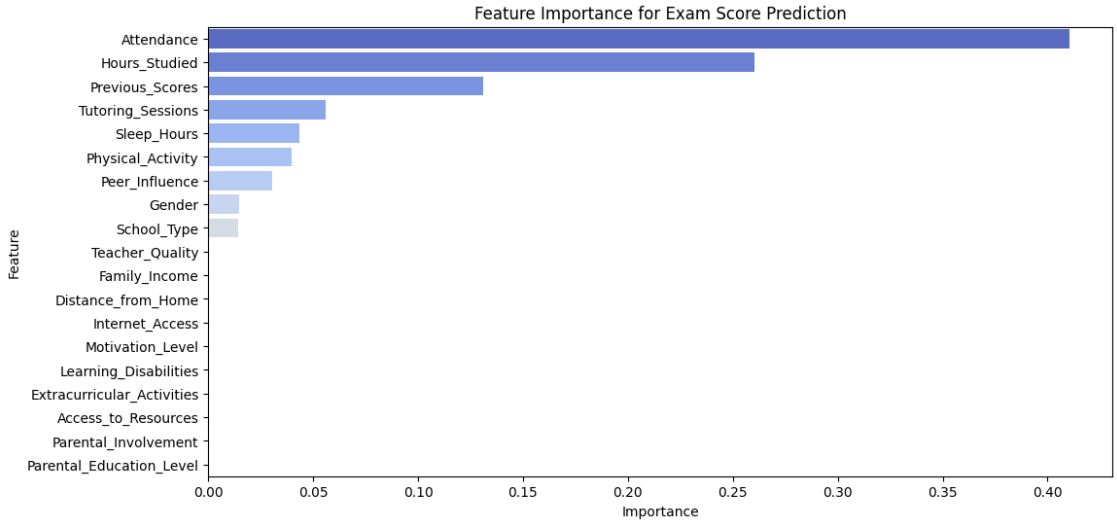
```
    'Access_to_Resources': {'Low': 0, 'Medium': 1, 'High': 2},
    'Motivation_Level': {'Low': 0, 'Medium': 1, 'High': 2},
    'Family_Income': {'Low': 0, 'Medium': 1, 'High': 2},
    'Teacher_Quality': {'Low': 0, 'Medium': 1, 'High': 2},
    'Parental_Education_Level': {'High School': 0, 'College': 1, 'Postgraduate':
 ↪ 2},
    'Distance_from_Home': {'Near': 0, 'Moderate': 1, 'Far': 2}
}
for col, mapping in mapping_dicts.items():
    if col in df.columns:
        df[col] = df[col].map(mapping)

# Map binary features
binary_mapping = {'Yes': 1, 'No': 0}
binary_cols = ['Extracurricular_Activities', 'Internet_Access',␣
 ↪'Learning_Disabilities']
for col in binary_cols:
    if col in df.columns:
        df[col] = df[col].map(binary_mapping)

# For Gender and School_Type (nominal), use LabelEncoder
from sklearn.preprocessing import LabelEncoder
le = LabelEncoder()
df['Gender'] = le.fit_transform(df['Gender'])
df['School_Type'] = le.fit_transform(df['School_Type'])

# Normalize numerical features using StandardScaler
from sklearn.preprocessing import StandardScaler
scaler = StandardScaler()
df[numerical_cols] = scaler.fit_transform(df[numerical_cols])
```

[28]:
```
# Convert non-numeric columns to numeric using Label Encoding or proper mapping
from sklearn.preprocessing import LabelEncoder

# Apply Label Encoding to non-numeric columns
le = LabelEncoder()
for col in X.columns:
    if X[col].dtype == 'object':
        X[col] = le.fit_transform(X[col])

# Train-test split
from sklearn.model_selection import train_test_split
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2,␣
 ↪random_state=42)

# Train Random Forest Regressor
from sklearn.ensemble import RandomForestRegressor
```

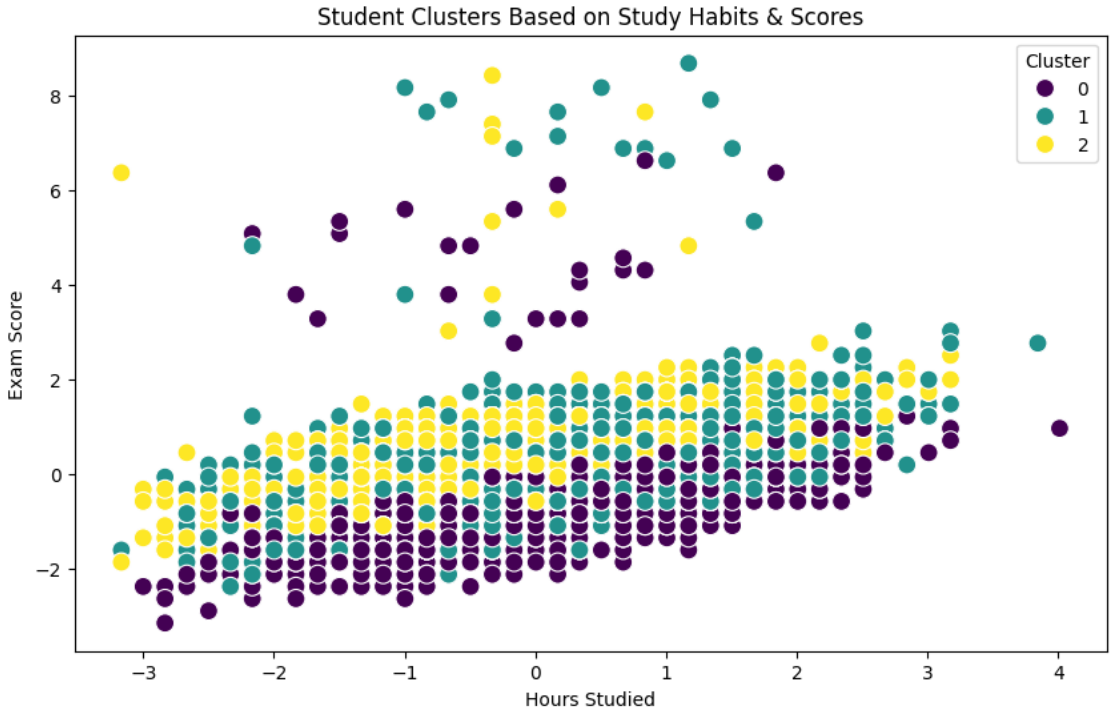
```
rf_model = RandomForestRegressor(n_estimators=100, random_state=42)
rf_model.fit(X_train, y_train)

# Make predictions
y_pred = rf_model.predict(X_test)

# Evaluate the model
from sklearn.metrics import mean_absolute_error, mean_squared_error, r2_score
print("Regression Model Evaluation:")
print("MAE:", mean_absolute_error(y_test, y_pred))
print("MSE:", mean_squared_error(y_test, y_pred))
print("R2 Score:", r2_score(y_test, y_pred))

# Visualize Feature Importance
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns

importances = rf_model.feature_importances_
features = X.columns
sorted_indices = np.argsort(importances)[::-1]

plt.figure(figsize=(12, 6))
sns.barplot(x=importances[sorted_indices], y=features[sorted_indices],␣
 ↪palette='coolwarm')
plt.title('Feature Importance for Exam Score Prediction')
plt.xlabel('Importance')
plt.ylabel('Feature')
plt.show()
```

```
Regression Model Evaluation:
MAE: 0.36610804440674277
MSE: 0.3992196714922818
R2 Score: 0.5725856264764716
```

```
<ipython-input-28-8af86d708512>:39: FutureWarning:

Passing `palette` without assigning `hue` is deprecated and will be removed in
v0.14.0. Assign the `y` variable to `hue` and set `legend=False` for the same
effect.

  sns.barplot(x=importances[sorted_indices], y=features[sorted_indices],
palette='coolwarm')
```



[40]:
```
from sklearn.impute import SimpleImputer
from sklearn.cluster import KMeans

# Define clustering features
clustering_features = ['Hours_Studied', 'Motivation_Level', 'Attendance',␣
 ↪'Previous_Scores']

# Fill columns with only NaNs with 0 (or another default value)
df[clustering_features] = df[clustering_features].fillna(0)

# Handle missing values by filling with the mean of each column (optional)
imputer = SimpleImputer(strategy='mean')
df[clustering_features] = pd.DataFrame(imputer.
 ↪fit_transform(df[clustering_features]), columns=clustering_features)

# Apply KMeans clustering
kmeans = KMeans(n_clusters=3, random_state=42, n_init=10)
df['Cluster'] = kmeans.fit_predict(df[clustering_features])

# Visualize clusters
plt.figure(figsize=(10, 6))
sns.scatterplot(x=df['Hours_Studied'], y=df['Exam_Score'], hue=df['Cluster'],␣
 ↪palette='viridis', s=100)
plt.title('Student Clusters Based on Study Habits & Scores')
plt.xlabel('Hours Studied')
plt.ylabel('Exam Score')
plt.show()
```



[43]:
```python
def generate_recommendation(row, df):
    """
    Generates a detailed recommendation based on every feature in the student␣
 ↪data.
    This function uses the original (non-normalized, non-encoded) values.
    """
    recs = []

    # Hours Studied
    if row['Hours_Studied'] < df['Hours_Studied'].median():
        recs.append("Increase study hours to build a stronger knowledge base.")
    else:
        recs.append("Study hours are satisfactory; continue your routine.")

    # Attendance
    if row['Attendance'] < df['Attendance'].median():
        recs.append("Improve attendance to avoid missing key lessons.")
    else:
        recs.append("Your attendance is commendable.")

    # Parental Involvement
    if row['Parental_Involvement'] == 'Low':
        recs.append("Enhance parental involvement for better academic support.")
    elif row['Parental_Involvement'] == 'Medium':
```

```
        recs.append("Consider discussing progress with parents to boost␣
↪involvement.")
    else:
        recs.append("Parental involvement is excellent; keep it up.")

    # Access to Resources
    if row['Access_to_Resources'] == 'Low':
        recs.append("Work on improving access to study materials and resources.
↪")
    elif row['Access_to_Resources'] == 'Medium':
        recs.append("Better resource access may help improve learning outcomes.
↪")
    else:
        recs.append("Access to resources is strong; leverage them further.")

    # Extracurricular Activities
    if row['Extracurricular_Activities'] == 'No':
        recs.append("Consider joining extracurricular activities to boost␣
↪overall development.")
    else:
        recs.append("Extracurricular engagement is a positive aspect of your␣
↪profile.")

    # Sleep Hours
    if row['Sleep_Hours'] < 7:
        recs.append("Increase sleep hours for improved concentration and energy.
↪")
    else:
        recs.append("Your sleep schedule is on track.")

    # Previous Scores
    if row['Previous_Scores'] < df['Previous_Scores'].median():
        recs.append("Review previous scores and identify areas needing␣
↪improvement.")
    else:
        recs.append("Maintain your strong performance from past scores.")

    # Motivation Level
    if row['Motivation_Level'] == 'Low':
        recs.append("Boost your motivation through goal-setting and counseling.
↪")
    elif row['Motivation_Level'] == 'Medium':
        recs.append("Explore techniques to further enhance your motivation.")
    else:
        recs.append("Your motivation is a strength; keep the momentum.")
```

```
    # Internet Access
    if row['Internet_Access'] == 'No':
        recs.append("Ensure reliable internet access to utilize online␣
↪resources.")
    else:
        recs.append("Internet access is sufficient for your learning needs.")

    # Tutoring Sessions
    if row['Tutoring_Sessions'] == 0:
        recs.append("Consider scheduling tutoring sessions to address␣
↪challenging topics.")
    else:
        recs.append("Tutoring sessions are being effectively utilized.")

    # Family Income
    if row['Family_Income'] == 'Low':
        recs.append("Explore free resources and scholarship opportunities to␣
↪supplement your studies.")
    else:
        recs.append("Your financial context supports access to additional␣
↪learning materials.")

    # Teacher Quality
    if row['Teacher_Quality'] == 'Low':
        recs.append("Supplement classroom learning with external tutoring due␣
↪to teacher quality concerns.")
    elif row['Teacher_Quality'] == 'Medium':
        recs.append("Consider extra help to reinforce lessons taught in class.")
    else:
        recs.append("Teacher quality is strong; maximize the benefits of␣
↪classroom instruction.")

    # School Type
    recs.append(f"Being in a {row['School_Type']} school can offer unique␣
↪advantages-leverage them accordingly.")

    # Peer Influence
    if row['Peer_Influence'] == 'Negative':
        recs.append("Work on improving peer influence by joining positive study␣
↪groups.")
    elif row['Peer_Influence'] == 'Neutral':
        recs.append("Engage with peers to build a supportive academic network.")
    else:
        recs.append("Positive peer influence is an asset; maintain your network.
↪")
```

```
    # Physical Activity
    if row['Physical_Activity'] < 3:  # assuming a scale where <3 indicates low␣
↪activity
        recs.append("Increase physical activity to boost concentration and␣
↪health.")
    else:
        recs.append("Your level of physical activity supports overall␣
↪well-being.")

    # Learning Disabilities
    if row['Learning_Disabilities'] == 'Yes':
        recs.append("Utilize special education resources and strategies to␣
↪address learning disabilities.")
    else:
        recs.append("No learning disabilities detected.")

    # Parental Education Level
    recs.append(f"Your parental education level␣
↪({row['Parental_Education_Level']}) may influence home support-discuss␣
↪strategies with your family.")

    # Distance from Home
    if row['Distance_from_Home'] in ['Moderate', 'Far']:
        recs.append("Consider time management techniques to overcome challenges␣
↪due to longer commute.")
    else:
        recs.append("Proximity to school is an advantage for regular attendance.
↪")

    # Gender
    recs.append(f"Your gender ({row['Gender']}) can be factored into tailored␣
↪guidance if needed.")

    return "\n".join(recs)
```

[48]:
```
def main_pipeline():
    # --- EDA and Preprocessing already executed above ---
    # (See sections 1-4)

    # Regression & Clustering evaluations have been printed and visualized.

    # Generate personalized recommendations for the first 10 students using the␣
↪original (non-processed) data.
    original_df = pd.read_csv('student_data.csv')

    # Impute missing values for original_df using updated Pandas syntax
```

```
    for col in original_df.columns:
        if original_df[col].dtype == 'object':
            original_df[col] = original_df[col].fillna(original_df[col].
↪mode()[0])
        else:
            original_df[col] = original_df[col].fillna(original_df[col].
↪median())

    print("\nPERSONALIZED LEARNING RECOMMENDATIONS (First 10 Students):")
    for i in range(10):
        print(f"\n--- Student {i+1} ---")
        print(generate_recommendation(original_df.iloc[i], original_df))

    # --- Example: Predict Exam Score and Generate Recommendation for a New␣
↪Student ---
    def predict_and_recommend(new_student):
        """
        Accepts a dictionary 'new_student' with the original (non-processed)␣
↪feature values.
        Returns the predicted exam score (from the regression model), the␣
↪cluster-based recommendation,
        and a detailed personalized recommendation based on every feature.
        """
        # Generate detailed recommendation based on original values
        recommendation = generate_recommendation(new_student, original_df)

        # Preprocess new_student for prediction:
        new_df = pd.DataFrame([new_student])

        # Fill missing values
        for col in new_df.columns:
            if new_df[col].dtype == 'object':
                new_df[col] = new_df[col].fillna(original_df[col].mode()[0])
            else:
                new_df[col] = new_df[col].fillna(original_df[col].median())

        # Map ordinal features
        for col, mapping in mapping_dicts.items():
            if col in new_df.columns:
                new_df[col] = new_df[col].map(mapping)

        # Map binary features
        for col in binary_cols:
            if col in new_df.columns:
                new_df[col] = new_df[col].map(binary_mapping)

        # --- Handle unseen labels for 'Gender' and 'School_Type' ---
```

```
        # Convert to lowercase to ensure consistency
        new_df['Gender'] = new_df['Gender'].str.lower()
        new_df['School_Type'] = new_df['School_Type'].str.lower()

        # Handle unseen labels: add new labels dynamically
        for col in ['Gender', 'School_Type', 'Peer_Influence']:
            if not set(new_df[col]).issubset(le.classes_):
                le.classes_ = np.append(le.classes_, new_df[col].unique())
            new_df[col] = le.transform(new_df[col])

        # --- Exclude non-numeric columns from scaling ---
        categorical_cols = ['Gender', 'School_Type', 'Peer_Influence']  # Don't␣
↪scale these
        cols_to_scale = [col for col in numerical_cols if col not in␣
↪categorical_cols]

        # Scale only numerical features (using the same scaler as before)
        new_df[cols_to_scale] = scaler.transform(new_df[cols_to_scale])

        # Predict exam score using the regression model
        predicted_score = rf_model.predict(new_df.
↪drop(columns=['Exam_Score']))[0]

        # Predict cluster using selected clustering features
        predicted_cluster = kmeans.predict(new_df[clustering_features])[0]
        if predicted_cluster == 0:
            cluster_recommendation = "High Performer: Consider advanced␣
↪coursework and mentorship."
        elif predicted_cluster == 1:
            cluster_recommendation = "Moderate Performer: Focus on structured␣
↪study plans and additional tutoring."
        else:
            cluster_recommendation = "Low Performer: Increase parental␣
↪involvement, improve sleep habits, and seek structured coaching."

        return (f"Predicted Exam Score: {predicted_score:.2f}\n"
                f"Cluster Recommendation: {cluster_recommendation}\n\n"
                f"Detailed Personalized Recommendation:\n{recommendation}")

    # Example new student data (original values)
    new_student = {
        'Hours_Studied': 5,
        'Attendance': 90,
        'Parental_Involvement': 'Low',
        'Access_to_Resources': 'High',
        'Extracurricular_Activities': 'No',
```

```
        'Sleep_Hours': 6,
        'Previous_Scores': 65,
        'Motivation_Level': 'Low',
        'Internet_Access': 'Yes',
        'Tutoring_Sessions': 0,
        'Family_Income': 'Low',
        'Teacher_Quality': 'Low',
        'School_Type': 'Public',
        'Peer_Influence': 'Negative',
        'Physical_Activity': 2,
        'Learning_Disabilities': 'No',
        'Parental_Education_Level': 'High School',
        'Distance_from_Home': 'Near',
        'Gender': 'Male',
        'Exam_Score': 0  # Placeholder (target is not used in prediction)
    }

    print("\nNEW STUDENT PREDICTION & RECOMMENDATION:")
    print(predict_and_recommend(new_student))

if __name__ == '__main__':
    main_pipeline()
```

```
PERSONALIZED LEARNING RECOMMENDATIONS (First 10 Students):

--- Student 1 ---
Study hours are satisfactory; continue your routine.
Your attendance is commendable.
Enhance parental involvement for better academic support.
Access to resources is strong; leverage them further.
Consider joining extracurricular activities to boost overall development.
Your sleep schedule is on track.
Review previous scores and identify areas needing improvement.
Boost your motivation through goal-setting and counseling.
Internet access is sufficient for your learning needs.
Consider scheduling tutoring sessions to address challenging topics.
Explore free resources and scholarship opportunities to supplement your studies.
Consider extra help to reinforce lessons taught in class.
Being in a Public school can offer unique advantages-leverage them accordingly.
Positive peer influence is an asset; maintain your network.
Your level of physical activity supports overall well-being.
No learning disabilities detected.
Your parental education level (High School) may influence home support-discuss
strategies with your family.
Proximity to school is an advantage for regular attendance.
Your gender (Male) can be factored into tailored guidance if needed.
```

```
--- Student 2 ---
Increase study hours to build a stronger knowledge base.
Improve attendance to avoid missing key lessons.
Enhance parental involvement for better academic support.
Better resource access may help improve learning outcomes.
Consider joining extracurricular activities to boost overall development.
Your sleep schedule is on track.
Review previous scores and identify areas needing improvement.
Boost your motivation through goal-setting and counseling.
Internet access is sufficient for your learning needs.
Tutoring sessions are being effectively utilized.
Your financial context supports access to additional learning materials.
Consider extra help to reinforce lessons taught in class.
Being in a Public school can offer unique advantages-leverage them accordingly.
Work on improving peer influence by joining positive study groups.
Your level of physical activity supports overall well-being.
No learning disabilities detected.
Your parental education level (College) may influence home support-discuss
strategies with your family.
Consider time management techniques to overcome challenges due to longer
commute.
Your gender (Female) can be factored into tailored guidance if needed.

--- Student 3 ---
Study hours are satisfactory; continue your routine.
Your attendance is commendable.
Consider discussing progress with parents to boost involvement.
Better resource access may help improve learning outcomes.
Extracurricular engagement is a positive aspect of your profile.
Your sleep schedule is on track.
Maintain your strong performance from past scores.
Explore techniques to further enhance your motivation.
Internet access is sufficient for your learning needs.
Tutoring sessions are being effectively utilized.
Your financial context supports access to additional learning materials.
Consider extra help to reinforce lessons taught in class.
Being in a Public school can offer unique advantages-leverage them accordingly.
Engage with peers to build a supportive academic network.
Your level of physical activity supports overall well-being.
No learning disabilities detected.
Your parental education level (Postgraduate) may influence home support-discuss
strategies with your family.
Proximity to school is an advantage for regular attendance.
Your gender (Male) can be factored into tailored guidance if needed.

--- Student 4 ---
Study hours are satisfactory; continue your routine.
```

```
Your attendance is commendable.
Enhance parental involvement for better academic support.
Better resource access may help improve learning outcomes.
Extracurricular engagement is a positive aspect of your profile.
Your sleep schedule is on track.
Maintain your strong performance from past scores.
Explore techniques to further enhance your motivation.
Internet access is sufficient for your learning needs.
Tutoring sessions are being effectively utilized.
Your financial context supports access to additional learning materials.
Consider extra help to reinforce lessons taught in class.
Being in a Public school can offer unique advantages-leverage them accordingly.
Work on improving peer influence by joining positive study groups.
Your level of physical activity supports overall well-being.
No learning disabilities detected.
Your parental education level (High School) may influence home support-discuss
strategies with your family.
Consider time management techniques to overcome challenges due to longer
commute.
Your gender (Male) can be factored into tailored guidance if needed.

--- Student 5 ---
Increase study hours to build a stronger knowledge base.
Your attendance is commendable.
Consider discussing progress with parents to boost involvement.
Better resource access may help improve learning outcomes.
Extracurricular engagement is a positive aspect of your profile.
Increase sleep hours for improved concentration and energy.
Review previous scores and identify areas needing improvement.
Explore techniques to further enhance your motivation.
Internet access is sufficient for your learning needs.
Tutoring sessions are being effectively utilized.
Your financial context supports access to additional learning materials.
Teacher quality is strong; maximize the benefits of classroom instruction.
Being in a Public school can offer unique advantages-leverage them accordingly.
Engage with peers to build a supportive academic network.
Your level of physical activity supports overall well-being.
No learning disabilities detected.
Your parental education level (College) may influence home support-discuss
strategies with your family.
Proximity to school is an advantage for regular attendance.
Your gender (Female) can be factored into tailored guidance if needed.

--- Student 6 ---
Increase study hours to build a stronger knowledge base.
Your attendance is commendable.
Consider discussing progress with parents to boost involvement.
Better resource access may help improve learning outcomes.
```

```
Extracurricular engagement is a positive aspect of your profile.
Your sleep schedule is on track.
Maintain your strong performance from past scores.
Explore techniques to further enhance your motivation.
Internet access is sufficient for your learning needs.
Tutoring sessions are being effectively utilized.
Your financial context supports access to additional learning materials.
Consider extra help to reinforce lessons taught in class.
Being in a Public school can offer unique advantages-leverage them accordingly.
Positive peer influence is an asset; maintain your network.
Your level of physical activity supports overall well-being.
No learning disabilities detected.
Your parental education level (Postgraduate) may influence home support-discuss
strategies with your family.
Proximity to school is an advantage for regular attendance.
Your gender (Male) can be factored into tailored guidance if needed.

--- Student 7 ---
Study hours are satisfactory; continue your routine.
Your attendance is commendable.
Consider discussing progress with parents to boost involvement.
Work on improving access to study materials and resources.
Extracurricular engagement is a positive aspect of your profile.
Your sleep schedule is on track.
Review previous scores and identify areas needing improvement.
Boost your motivation through goal-setting and counseling.
Internet access is sufficient for your learning needs.
Tutoring sessions are being effectively utilized.
Explore free resources and scholarship opportunities to supplement your studies.
Consider extra help to reinforce lessons taught in class.
Being in a Private school can offer unique advantages-leverage them accordingly.
Engage with peers to build a supportive academic network.
Increase physical activity to boost concentration and health.
No learning disabilities detected.
Your parental education level (High School) may influence home support-discuss
strategies with your family.
Consider time management techniques to overcome challenges due to longer
commute.
Your gender (Male) can be factored into tailored guidance if needed.

--- Student 8 ---
Study hours are satisfactory; continue your routine.
Improve attendance to avoid missing key lessons.
Enhance parental involvement for better academic support.
Access to resources is strong; leverage them further.
Extracurricular engagement is a positive aspect of your profile.
Increase sleep hours for improved concentration and energy.
Review previous scores and identify areas needing improvement.
```

Explore techniques to further enhance your motivation.
Internet access is sufficient for your learning needs.
Tutoring sessions are being effectively utilized.
Your financial context supports access to additional learning materials.
Teacher quality is strong; maximize the benefits of classroom instruction.
Being in a Public school can offer unique advantages-leverage them accordingly.
Work on improving peer influence by joining positive study groups.
Increase physical activity to boost concentration and health.
No learning disabilities detected.
Your parental education level (High School) may influence home support-discuss strategies with your family.
Consider time management techniques to overcome challenges due to longer commute.
Your gender (Male) can be factored into tailored guidance if needed.

--- Student 9 ---
Increase study hours to build a stronger knowledge base.
Your attendance is commendable.
Consider discussing progress with parents to boost involvement.
Access to resources is strong; leverage them further.
Consider joining extracurricular activities to boost overall development.
Increase sleep hours for improved concentration and energy.
Maintain your strong performance from past scores.
Your motivation is a strength; keep the momentum.
Internet access is sufficient for your learning needs.
Consider scheduling tutoring sessions to address challenging topics.
Your financial context supports access to additional learning materials.
Supplement classroom learning with external tutoring due to teacher quality concerns.
Being in a Private school can offer unique advantages-leverage them accordingly.
Engage with peers to build a supportive academic network.
Increase physical activity to boost concentration and health.
No learning disabilities detected.
Your parental education level (College) may influence home support-discuss strategies with your family.
Proximity to school is an advantage for regular attendance.
Your gender (Male) can be factored into tailored guidance if needed.

--- Student 10 ---
Study hours are satisfactory; continue your routine.
Your attendance is commendable.
Consider discussing progress with parents to boost involvement.
Better resource access may help improve learning outcomes.
Extracurricular engagement is a positive aspect of your profile.
Your sleep schedule is on track.
Review previous scores and identify areas needing improvement.
Explore techniques to further enhance your motivation.
Internet access is sufficient for your learning needs.

Consider scheduling tutoring sessions to address challenging topics.
Your financial context supports access to additional learning materials.
Teacher quality is strong; maximize the benefits of classroom instruction.
Being in a Public school can offer unique advantages-leverage them accordingly.
Positive peer influence is an asset; maintain your network.
Your level of physical activity supports overall well-being.
No learning disabilities detected.
Your parental education level (High School) may influence home support-discuss strategies with your family.
Consider time management techniques to overcome challenges due to longer commute.
Your gender (Male) can be factored into tailored guidance if needed.

NEW STUDENT PREDICTION & RECOMMENDATION:
Predicted Exam Score: 2.77
Cluster Recommendation: Moderate Performer: Focus on structured study plans and additional tutoring.

Detailed Personalized Recommendation:
Increase study hours to build a stronger knowledge base.
Your attendance is commendable.
Enhance parental involvement for better academic support.
Access to resources is strong; leverage them further.
Consider joining extracurricular activities to boost overall development.
Increase sleep hours for improved concentration and energy.
Review previous scores and identify areas needing improvement.
Boost your motivation through goal-setting and counseling.
Internet access is sufficient for your learning needs.
Consider scheduling tutoring sessions to address challenging topics.
Explore free resources and scholarship opportunities to supplement your studies.
Supplement classroom learning with external tutoring due to teacher quality concerns.
Being in a Public school can offer unique advantages-leverage them accordingly.
Work on improving peer influence by joining positive study groups.
Increase physical activity to boost concentration and health.
No learning disabilities detected.
Your parental education level (High School) may influence home support-discuss strategies with your family.
Proximity to school is an advantage for regular attendance.
Your gender (Male) can be factored into tailored guidance if needed.