An Investigation to Assess the Effectiveness of ESOL Teaching in Secondary School in Pakistan ¶

Import Required Libraries

In [49]:
```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
from sklearn.preprocessing import LabelEncoder
from sklearn.model_selection import train_test_split
from sklearn.ensemble import RandomForestClassifier
from sklearn.metrics import accuracy_score, confusion_matrix
from scipy.stats import ttest_ind
print("All libraries successfully imported")
```

```
All libraries successfully imported
```

Reading the Dataset

In [50]:
```
# Load the dataset
file_path = "C:\\Users\\n\\Downloads\\ESOL_Teaching_Survey_Data.csv"
data = pd.read_csv(file_path)

# Display the first few rows
data.head()
```

Out[50]:

age	role	school_affiliation	experience	teaching_effectiveness	teaching_methods
30-39 years	ESOL Teacher	SOAR STEM school	1-3 years	3	Communicative Language Teaching (CLT);Technolo...
20-29 years	Subject Teacher (non-ESOL)	SOAR STEM school	Less than 1 year	4	Direct Instruction;Communicative Language Teac...
30-39 years	ESOL Teacher	Lahore grammar school	1-3 years	4	Direct Instruction;Collaborative Learning;Task...
20-29 years	ESOL Teacher	Lahore grammar school	1-3 years	4	Collaborative Learning;Task-based Learning;Com...
20-29 years	School Administrator	SOAR STEM school	1-3 years	3	Direct Instruction;

columns

In [51]:
```
# Display the last few rows
data.tail()
```

Out[51]:

	gender	age	role	school_affiliation	experience	teaching_effectiveness	teaching_metho
23	Female	Under 20 years	Subject Teacher (non-ESOL)	Lahore grammar school	1-3 years	5	Collaborat Learni
24	Female	30-39 years	Subject Teacher (non-ESOL)	Lahore grammar school	1-3 years	4	Direct Instructi
25	Female	40-49 years	Subject Teacher (non-ESOL)	Lahore grammar school	1-3 years	5	Communicat Language Teach (CL
26	Female	20-29 years	Subject Teacher (non-ESOL)	Lahore grammar school	7-10 years	5	Collaborat Learni
27	Female	20-29 years	Subject Teacher (non-ESOL)	Lahore grammar school	1-3 years	3	Collaborat Learni

5 rows × 21 columns

Data Cleaning and Transformation

In [52]:
```
# Check for missing values
print(data.isnull().sum())

# Fill missing values (for example, we can fill missing 'experience' with the m
data['experience'].fillna(data['experience'].mode()[0], inplace=True)

# Drop rows with too many missing values
data.dropna(thresh=5, inplace=True)  # Drops rows where more than 5 columns are
```

```
gender                          0
age                             0
role                            0
school_affiliation              0
experience                      0
teaching_effectiveness          0
teaching_methods                0
primary_language_use            0
tech_impact                     0
biggest_challenge               0
proficiency_improvement         0
performance_other_subjects      0
preparation_higher_ed           0
student_participation           0
teacher_preparedness            0
professional_development        0
admin_support                   0
curriculum_alignment            0
resources_used                  0
resource_accessibility          0
teaching_improvements           0
dtype: int64
```

Encoding categorical variables

In [53]:
```
#Some of the columns have categorical data, like gender, school_affiliation, e
# Label encoding categorical variables
label_encoder = LabelEncoder()

# List of columns to encode
categorical_columns = ['gender', 'role', 'school_affiliation', 'primary_langua

for col in categorical_columns:
    data[col] = label_encoder.fit_transform(data[col])

print(data.head())
```

```
   gender          age  role  school_affiliation         experience  \
0       1  30-39 years     1                   1          1-3 years
1       0  20-29 years     5                   1   Less than 1 year
2       0  30-39 years     1                   0          1-3 years
3       1  20-29 years     1                   0          1-3 years
4       1  20-29 years     4                   1          1-3 years

   teaching_effectiveness                                  teaching_methods
\
0                       3  Communicative Language Teaching (CLT);Technolo...
1                       4  Direct Instruction;Communicative Language Teac...
2                       4  Direct Instruction;Collaborative Learning;Task...
3                       4  Collaborative Learning;Task-based Learning;Com...
4                       3                                Direct Instruction;

   primary_language_use  tech_impact  biggest_challenge  ...  \
0                     1            4                  2  ...
1                     1            4                  3  ...
2                     0            4                  2  ...
3                     1            4                  3  ...
4                     1            4                  4  ...

   performance_other_subjects preparation_higher_ed student_participation  \
0                        Good               Neutral                51-75%
1                        Good       To Some Extent                51-75%
2                        Good       To Some Extent                51-75%
3                        Good    To a Great Extent                51-75%
4                        Good               Neutral                26-50%

  teacher_preparedness                           professional_development  \
0                    4  Workshops/Seminars;Online Courses; Peer Collab...
1                    3                                Workshops/Seminars;
2                    4  Workshops/Seminars;Online Courses; Peer Collab...
3                    4  Workshops/Seminars; Peer Collaboration; Mentor...
4                    4           Workshops/Seminars; Peer Collaboration;

    admin_support curriculum_alignment  \
0       Satisfied                   4
1       Satisfied                   3
2  Very satisfied                   4
3       Satisfied                   3
4         Neutral                   4

                                    resources_used resource_accessibility  \
0                     Textbooks;Online Resources;              Accessible
1                Textbooks;Audio-Visual Materials;              Accessible
2                     Textbooks;Online Resources;                 Neutral
3  Textbooks;Audio-Visual Materials;Language Labs;              Accessible
4                                  Textbooks;                 Accessible

                            teaching_improvements
0  In my opinion, institutions' support and avail...
1  More interactive workshops for teachers. Activ...
2  Frequent Incorporation of audio visual techniq...
3  In order to enhance the effectiveness of ESOL ...
4  By giving opportunities to students to explore...
```

```
[5 rows x 21 columns]
```

Handling multi-select fields

In [54]:
```
#For columns like teaching_methods, which have multiple values separated by ser

# Split multi-select columns
teaching_methods = data['teaching_methods'].str.get_dummies(sep=';')

# Add the columns to the original dataset
data = pd.concat([data, teaching_methods], axis=1)

# Drop the original 'teaching_methods' column
data.drop('teaching_methods', axis=1, inplace=True)
```

Descriptive Statistics

In [55]:
```
# Descriptive statistics for numerical columns
print(data.describe())

# Descriptive statistics for categorical columns
print(data[categorical_columns].describe(include='all'))
```

	gender	role	school_affiliation	teaching_effectiveness
count	28.000000	28.000000	28.000000	28.000000
mean	0.928571	3.571429	0.214286	4.000000
std	0.262265	1.874361	0.417855	0.720082
min	0.000000	0.000000	0.000000	3.000000
25%	1.000000	1.000000	0.000000	3.750000
50%	1.000000	5.000000	0.000000	4.000000
75%	1.000000	5.000000	0.000000	4.250000
max	1.000000	5.000000	1.000000	5.000000

	primary_language_use	tech_impact	biggest_challenge
count	28.00000	28.000000	28.000000
mean	0.50000	4.214286	2.107143
std	0.57735	0.738223	1.227442
min	0.00000	2.000000	0.000000
25%	0.00000	4.000000	1.000000
50%	0.00000	4.000000	2.000000
75%	1.00000	5.000000	3.000000
max	2.00000	5.000000	4.000000

	proficiency_improvement	teacher_preparedness	curriculum_alignment
count	28.000000	28.000000	28.000000
mean	1.142857	4.000000	3.821429
std	0.705234	0.860663	0.904866
min	0.000000	2.000000	2.000000
25%	1.000000	3.000000	3.000000
50%	1.000000	4.000000	4.000000
75%	2.000000	5.000000	4.250000
max	2.000000	5.000000	5.000000

	Collaborative Learning	Communicative Language Teaching (CLT)
count	28.000000	28.000000
mean	0.464286	0.357143
std	0.507875	0.487950
min	0.000000	0.000000
25%	0.000000	0.000000
50%	0.000000	0.000000
75%	1.000000	1.000000
max	1.000000	1.000000

	Direct Instruction	Task-based Learning
count	28.000000	28.000000
mean	0.321429	0.464286
std	0.475595	0.507875
min	0.000000	0.000000
25%	0.000000	0.000000
50%	0.000000	0.000000
75%	1.000000	1.000000
max	1.000000	1.000000

	Technology Integration (e.g., apps, online tools)
count	28.000000
mean	0.250000
std	0.440959
min	0.000000
25%	0.000000
50%	0.000000

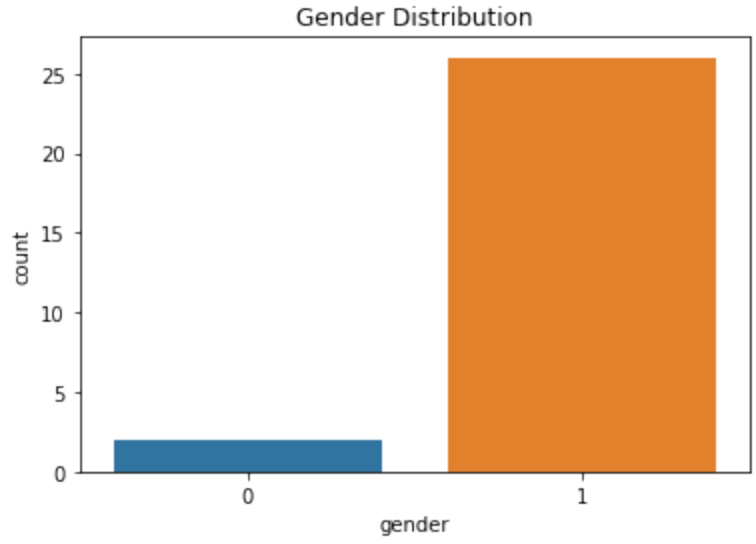
```
75%                                                0.250000
max                                                1.000000
          gender       role  school_affiliation  primary_language_use  \
count  28.000000  28.000000           28.000000              28.00000
mean    0.928571   3.571429            0.214286               0.50000
std     0.262265   1.874361            0.417855               0.57735
min     0.000000   0.000000            0.000000               0.00000
25%     1.000000   1.000000            0.000000               0.00000
50%     1.000000   5.000000            0.000000               0.00000
75%     1.000000   5.000000            0.000000               1.00000
max     1.000000   5.000000            1.000000               2.00000

       biggest_challenge  proficiency_improvement
count          28.000000                28.000000
mean            2.107143                 1.142857
std             1.227442                 0.705234
min             0.000000                 0.000000
25%             1.000000                 1.000000
50%             2.000000                 1.000000
75%             3.000000                 2.000000
max             4.000000                 2.000000
```

Data Visualization

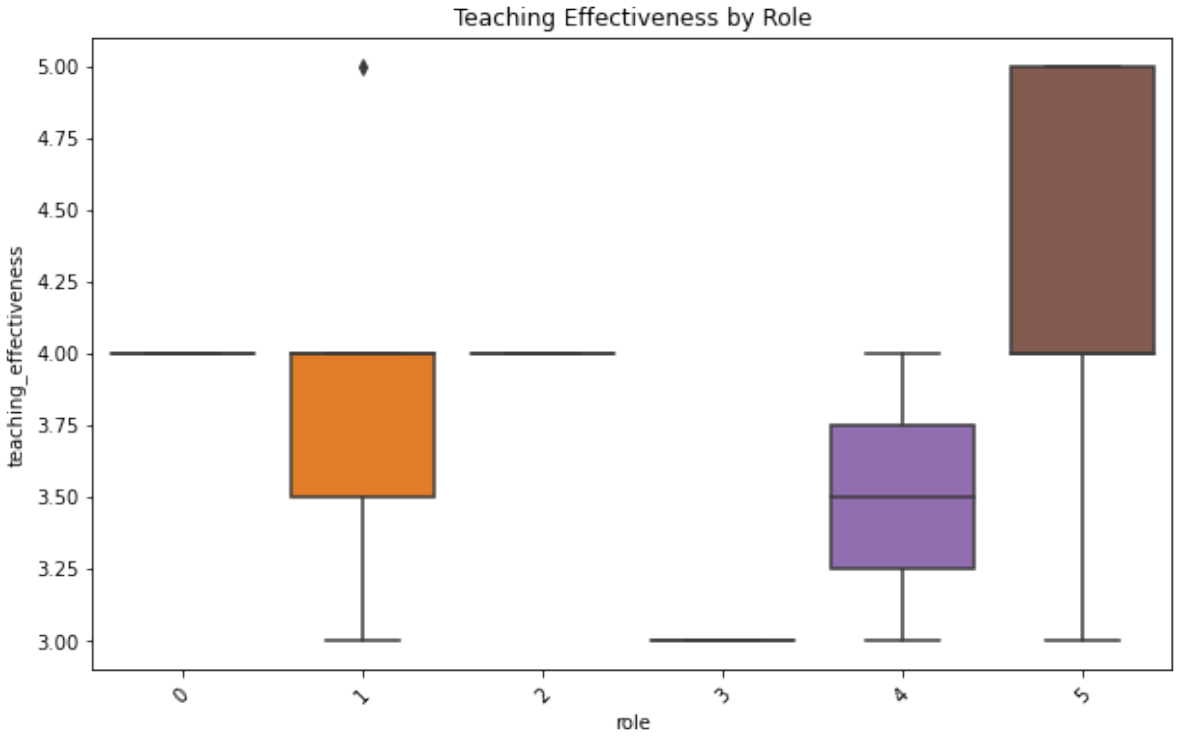
1) Gender Distribution

In [56]:
```
# Gender distribution
sns.countplot(x='gender', data=data)
plt.title('Gender Distribution')
plt.show()
```



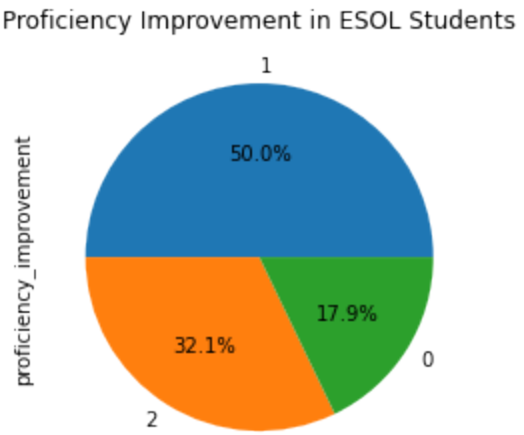
2) Teaching Effectiveness by Role

In [57]:
```
# Teaching effectiveness by role
plt.figure(figsize=(10, 6))
sns.boxplot(x='role', y='teaching_effectiveness', data=data)
plt.title('Teaching Effectiveness by Role')
plt.xticks(rotation=45)
plt.show()
```



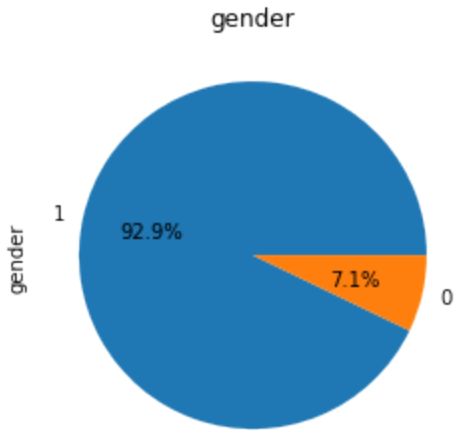
3). Pie chart for proficiency improvement

In [58]:
```
# Pie chart for proficiency improvement
data['proficiency_improvement'].value_counts().plot.pie(autopct='%1.1f%%')
plt.title('Proficiency Improvement in ESOL Students')
plt.show()
```



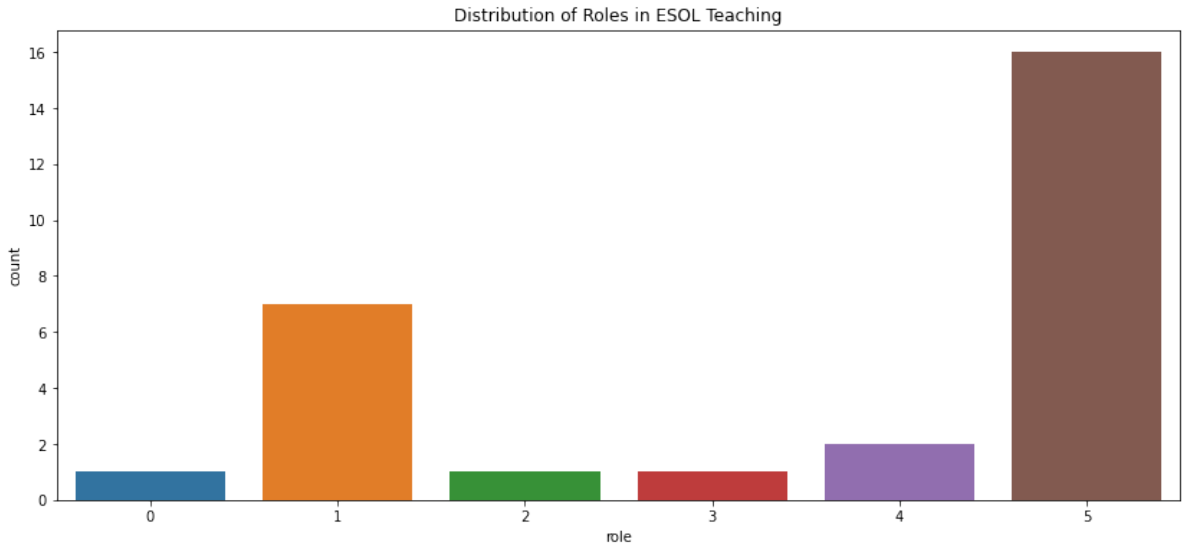
4). Pie chart for gender distribution

In [75]:
```
# Pie chart for proficiency improvement
data['gender'].value_counts().plot.pie(autopct='%1.1f%%')
plt.title('Gender distribution')
plt.show()
```



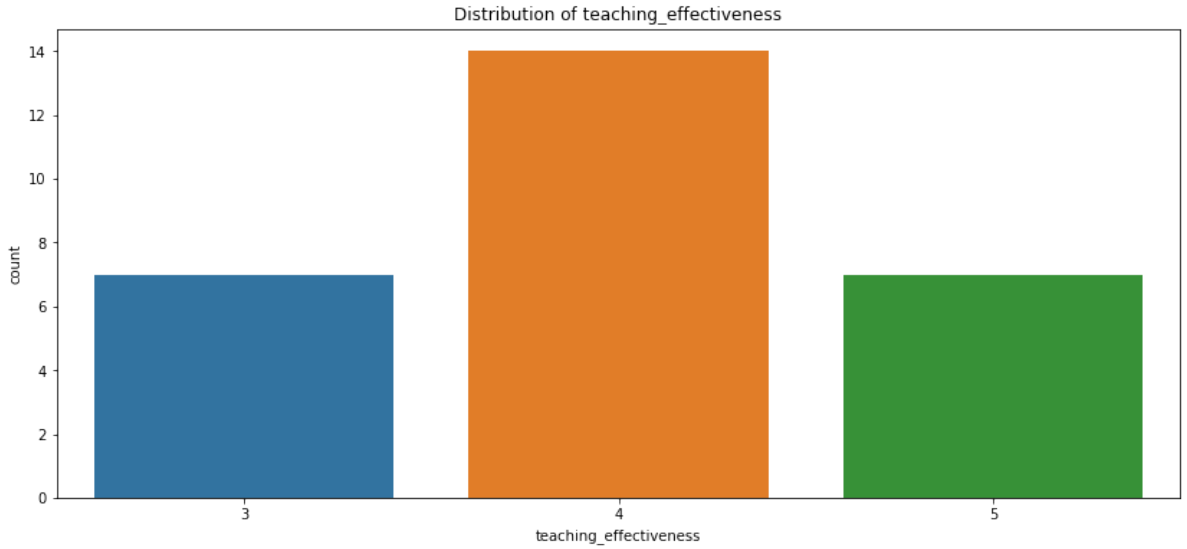
4) Bar chart for distribution of roles

In [59]:
```
plt.figure(figsize=(14, 6))
sns.countplot(x='role', data=data)
plt.title('Distribution of Roles in ESOL Teaching')
plt.show()
```



5). The histogram for teaching effectiveness

In [76]:
```
plt.figure(figsize=(14, 6))
sns.countplot(x='teaching_effectiveness', data=data)
plt.title('Distribution of teaching_effectiveness')
plt.show()
```



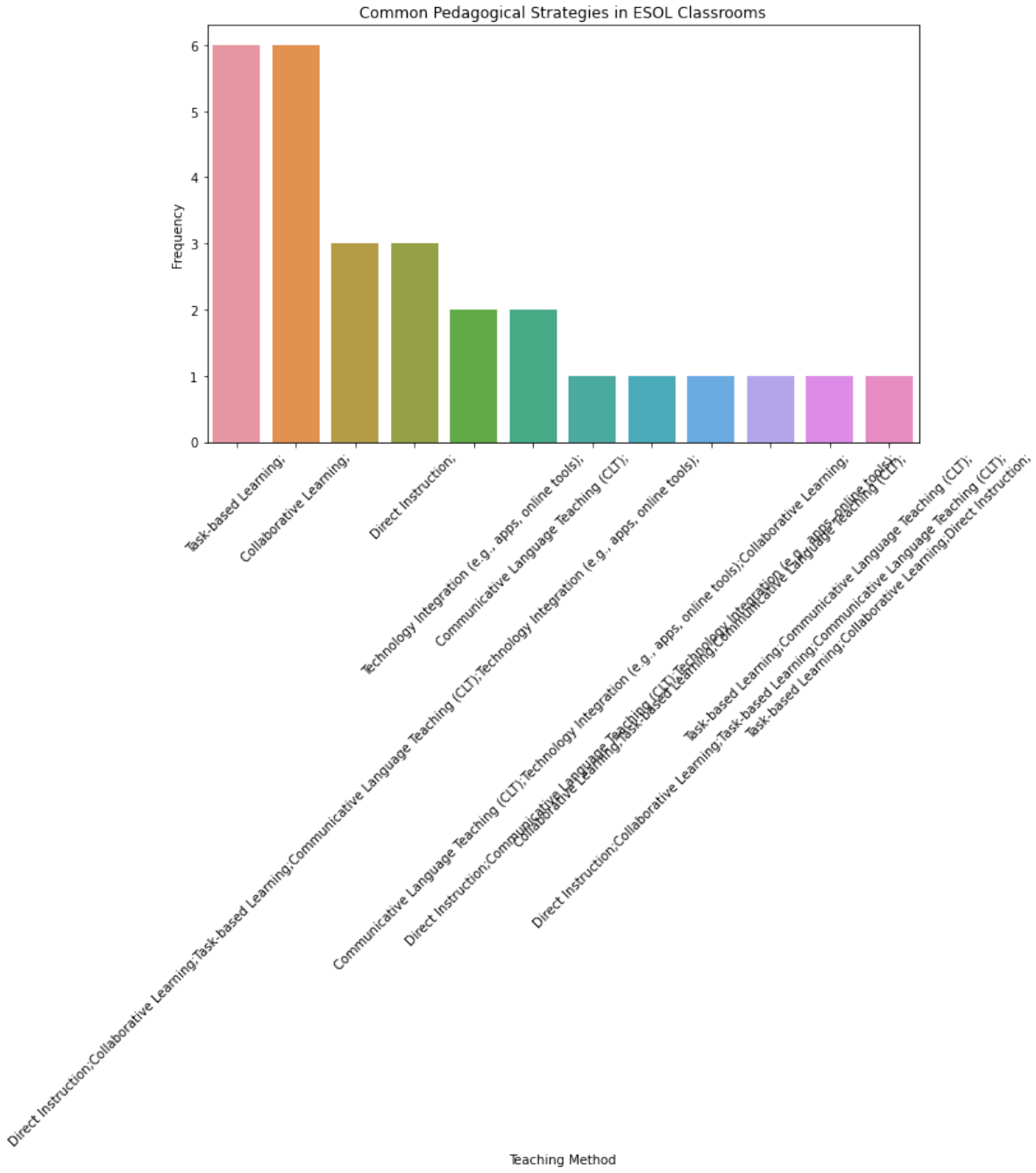
Analysis of Teaching Methods (RQ a):

In [73]:
```
# Load data (make sure to use your actual file path)
esol_data = pd.read_csv('C:\\Users\\n\\Downloads\\ESOL_Teaching_Survey_Data.csv

# Step 1: Analyze Teaching Methods (Research Question a)
teaching_methods = esol_data['teaching_methods'].value_counts()
print(teaching_methods)

plt.figure(figsize=(10, 6))
sns.barplot(x=teaching_methods.index, y=teaching_methods.values)
plt.title('Common Pedagogical Strategies in ESOL Classrooms')
plt.ylabel('Frequency')
plt.xlabel('Teaching Method')
plt.xticks(rotation=45)
plt.show()
```

```
Task-based Learning;
6
Collaborative Learning;
6
Direct Instruction;Collaborative Learning;Task-based Learning;Communicative L
anguage Teaching (CLT);Technology Integration (e.g., apps, online tools);
3
Direct Instruction;
3
Technology Integration (e.g., apps, online tools);
2
Communicative Language Teaching (CLT);
2
Communicative Language Teaching (CLT);Technology Integration (e.g., apps, onl
ine tools);Collaborative Learning;
1
Direct Instruction;Communicative Language Teaching (CLT);Technology Integrati
on (e.g., apps, online tools);
1
Collaborative Learning;Task-based Learning;Communicative Language Teaching (C
LT);
1
Direct Instruction;Collaborative Learning;Task-based Learning;Communicative L
anguage Teaching (CLT);
1
Task-based Learning;Communicative Language Teaching (CLT);
1
Task-based Learning;Collaborative Learning;Direct Instruction;
1
Name: teaching_methods, dtype: int64
```


Common Pedagogical Strategies in ESOL Classrooms
Frequency
0
1
2
3
4
5
6
Task-based Learning;
Collaborative Learning;
Direct Instruction;
Technology Integration (e.g., apps, online tools);
Communicative Language Teaching (CLT);
Communicative Language Teaching (CLT);Technology Integration (e.g., apps, online tools);
Direct Instruction;Collaborative Learning;Task-based Learning;Communicative Language Teaching (CLT);Technology Integration (e.g., apps, online tools);
Communicative Language Teaching (CLT);Technology Integration (e.g., apps, online tools);Collaborative Learning;
Direct Instruction;Communicative Language Teaching (CLT);Technology Integration (e.g., apps, online tools);
Collaborative Learning;Task-based Learning;Communicative Language Teaching (CLT);
Task-based Learning;Communicative Language Teaching (CLT);
Direct Instruction;Collaborative Learning;Task-based Learning;Communicative Language Teaching (CLT);
Task-based Learning;Collaborative Learning;Direct Instruction;
Teaching Method

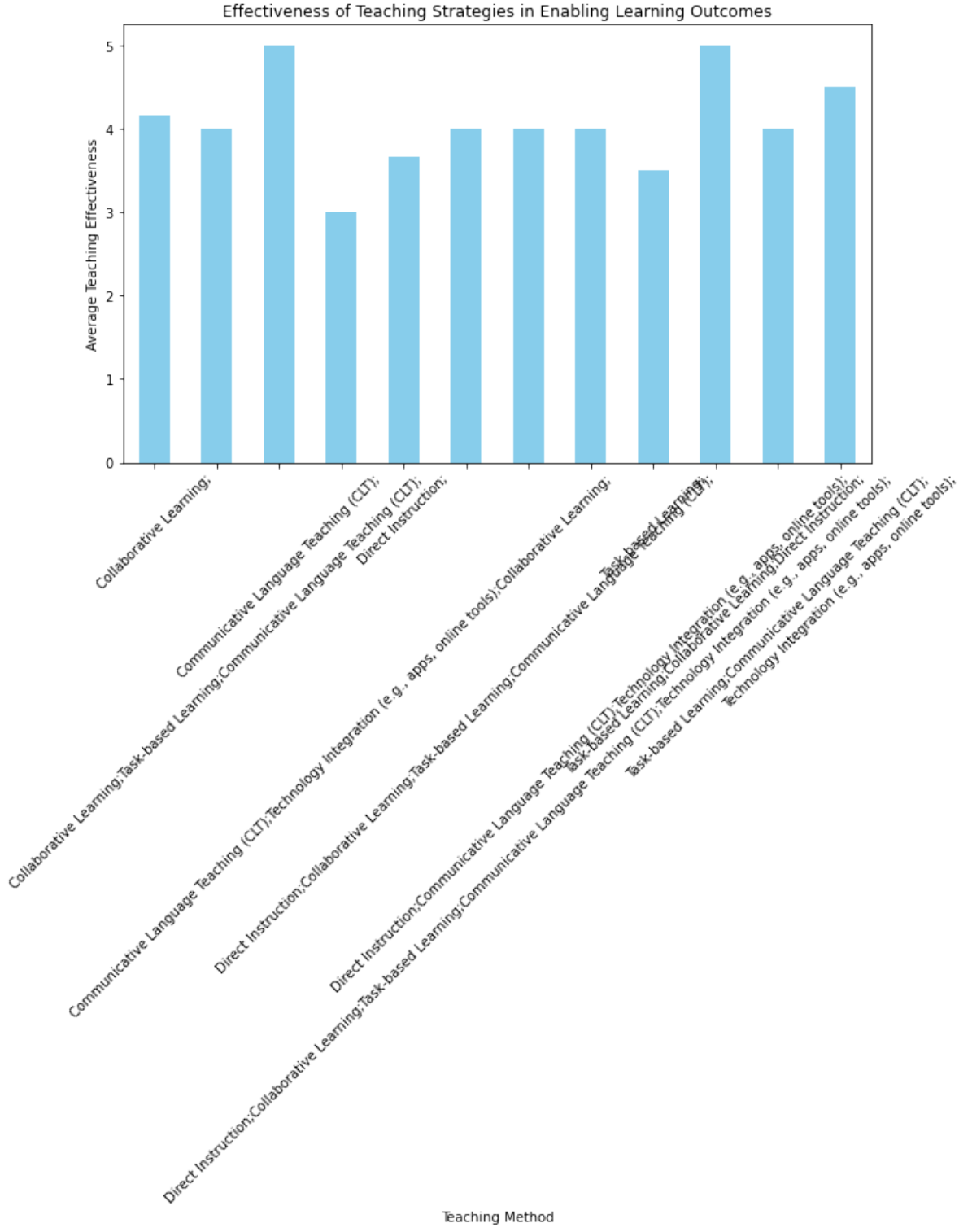
Assessment of Teaching Effectiveness (RQ b)

In [69]:
```
# Step 2: Assess Effectiveness of Teaching Methods (Research Question b)
# Group by teaching method and calculate average teaching effectiveness
outcomes_by_method = esol_data.groupby('teaching_methods')['teaching_effectiver

print("Average Teaching Effectiveness by Teaching Method:")
print(outcomes_by_method)

# Visualize outcomes by teaching method
plt.figure(figsize=(10, 6))
outcomes_by_method.plot(kind='bar', color='skyblue')
plt.title('Effectiveness of Teaching Strategies in Enabling Learning Outcomes'
plt.ylabel('Average Teaching Effectiveness')
plt.xlabel('Teaching Method')
plt.xticks(rotation=45)
plt.show()
```

```
Average Teaching Effectiveness by Teaching Method:
teaching_methods
Collaborative Learning;
4.166667
Collaborative Learning;Task-based Learning;Communicative Language Teaching (C
LT);
4.000000
Communicative Language Teaching (CLT);
5.000000
Communicative Language Teaching (CLT);Technology Integration (e.g., apps, onl
ine tools);Collaborative Learning;
3.000000
Direct Instruction;
3.666667
Direct Instruction;Collaborative Learning;Task-based Learning;Communicative L
anguage Teaching (CLT);
4.000000
Direct Instruction;Collaborative Learning;Task-based Learning;Communicative L
anguage Teaching (CLT);Technology Integration (e.g., apps, online tools);
4.000000
Direct Instruction;Communicative Language Teaching (CLT);Technology Integrati
on (e.g., apps, online tools);
4.000000
Task-based Learning;
3.500000
Task-based Learning;Collaborative Learning;Direct Instruction;
5.000000
Task-based Learning;Communicative Language Teaching (CLT);
4.000000
Technology Integration (e.g., apps, online tools);
4.500000
Name: teaching_effectiveness, dtype: float64
```


Effectiveness of Teaching Strategies in Enabling Learning Outcomes
Average Teaching Effectiveness
0
1
2
3
4
5
Collaborative Learning;
Communicative Language Teaching (CLT);
Direct Instruction;
Collaborative Learning,Task-based Learning,Communicative Language Teaching (CLT);
Communicative Language Teaching (CLT),Technology Integration (e.g., apps, online tools);Collaborative Learning;
Direct Instruction;Collaborative Learning,Task-based Learning,Communicative Language Teaching (CLT);
Direct Instruction;Communicative Language Teaching (CLT),Technology Integration (e.g., apps, online tools);
Direct Instruction;Collaborative Learning,Task-based Learning,Communicative Language Teaching (CLT);
Task-based Learning,Communicative Language Teaching (CLT),Technology Integration (e.g., apps, online tools);
Teaching Method

Statistical Testing (RQ c)

In [71]:
```
# Step 3: Statistical Test (e.g., T-test) to evaluate if differences in outcome
# Here you can compare two groups of teaching methods. This example compares tw
# You may need to modify this based on actual methods in your data.

# Example: Comparing "Direct Instruction" vs "Collaborative Learning"
direct_instruction = esol_data[esol_data['teaching_methods'].str.contains('Dir
collaborative_learning = esol_data[esol_data['teaching_methods'].str.contains(

# Perform t-test
t_stat, p_value = ttest_ind(direct_instruction, collaborative_learning, nan_po

print(f"T-statistic: {t_stat}, P-value: {p_value}")
if p_value < 0.05:
    print("There is a significant difference between Direct Instruction and Col
else:
    print("There is no significant difference between Direct Instruction and C
```

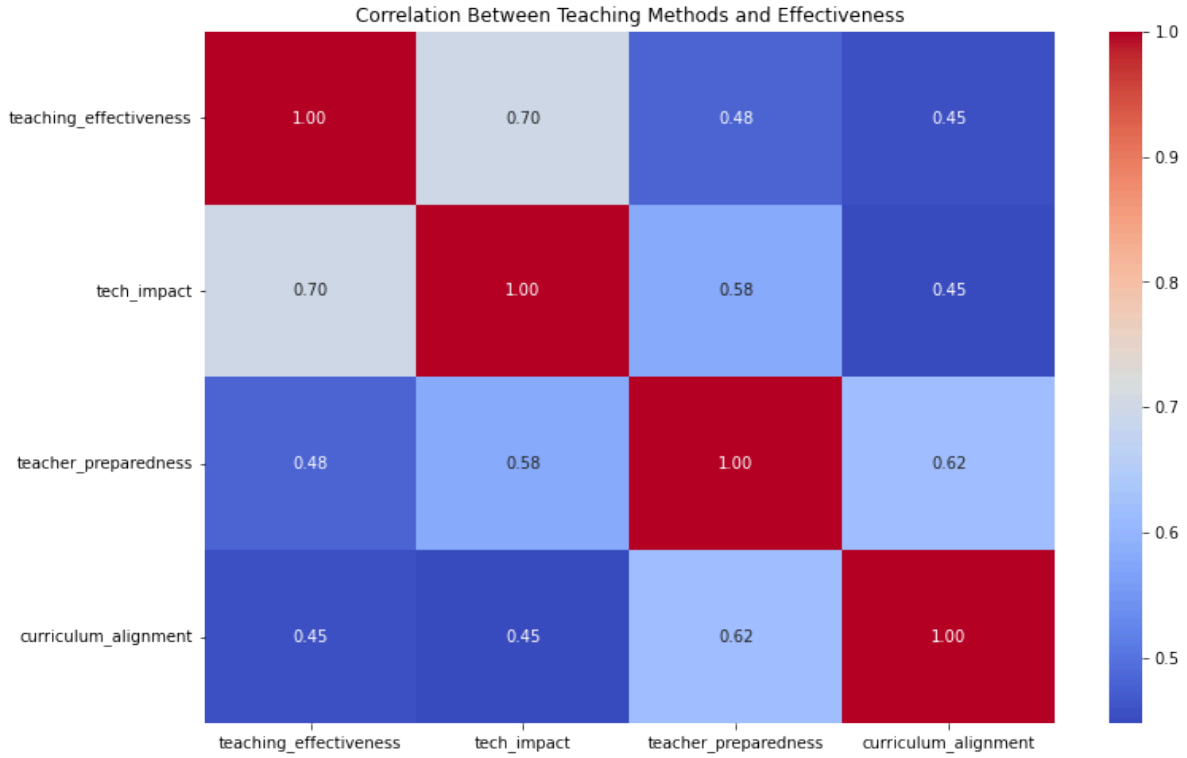
```
T-statistic: -0.2655803369236907, P-value: 0.793280745302779
There is no significant difference between Direct Instruction and Collaborati
ve Learning.
```

Correlation Analysis

In [72]:
```
# Step 4: Correlation analysis to see relationship with effectiveness
correlation_matrix = esol_data.corr()
print(correlation_matrix)
plt.figure(figsize=(12, 8))
sns.heatmap(correlation_matrix, annot=True, cmap='coolwarm', fmt='.2f')
plt.title('Correlation Between Teaching Methods and Effectiveness')
plt.show()
```

```
                        teaching_effectiveness  tech_impact  \
teaching_effectiveness                1.000000     0.696733
tech_impact                           0.696733     1.000000
teacher_preparedness                  0.478091     0.582929
curriculum_alignment                  0.454736     0.447522

                        teacher_preparedness  curriculum_alignment
teaching_effectiveness              0.478091              0.454736
tech_impact                         0.582929              0.447522
teacher_preparedness                1.000000              0.618247
curriculum_alignment                0.618247              1.000000
```



THE END