Instagram Engagement Analysis

Executive Summary

This project analyzes Instagram post engagement to identify content performance patterns.

Key Findings: • Photo posts slightly outperform video and carousel posts. • Moderate hashtag usage (2–3 hashtags) maintains stable engagement. • Emoji usage is consistent across all posts. • Posting time variation was limited in dataset.

Recommendations:

1. Prioritize high-quality photo content.
2. Maintain balanced content mix.
3. Use 2–5 targeted hashtags.
4. Continue emoji usage.
5. Implement structured weekly content calendar.

```python
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns

users = pd.read_csv("C:\\Users\\DeLL\\OneDrive\\Desktop\\Alfido Tech
Internship\\Instagram\\users.csv")
photos = pd.read_csv("C:\\Users\\DeLL\\OneDrive\\Desktop\\Alfido Tech
Internship\\Instagram\\photos.csv")
likes = pd.read_csv("C:\\Users\\DeLL\\OneDrive\\Desktop\\Alfido Tech
Internship\\Instagram\\likes.csv")
comments = pd.read_csv("C:\\Users\\DeLL\\OneDrive\\Desktop\\Alfido
Tech Internship\\Instagram\\comments.csv")
tags = pd.read_csv("C:\\Users\\DeLL\\OneDrive\\Desktop\\Alfido Tech
Internship\\Instagram\\tags.csv")
photo_tags = pd.read_csv("C:\\Users\\DeLL\\OneDrive\\Desktop\\Alfido
Tech Internship\\Instagram\\photo_tags.csv")
follows = pd.read_csv("C:\\Users\\DeLL\\OneDrive\\Desktop\\Alfido Tech
Internship\\Instagram\\follows.csv")

users.head()
photos.head()
likes.head()
comments.head()
```

```
   id                comment  User  id  Photo id created Timestamp  \
0   1         unde at dolorem         2         1  13-04-2023 08:04
1   2         quae ea ducimus         3         1  13-04-2023 08:04
2   3      alias a voluptatum         5         1  13-04-2023 08:04
3   4    facere suscipit sunt        14         1  13-04-2023 08:04
```

```
4   5  totam eligendi quaerat        17         1  13-04-2023 08:04
```

```
  posted date emoji used  Hashtags used count
0    April 14        yes                    1
1    April 14         no                    2
2    April 14         no                    4
3    April 14        yes                    2
4    April 14        yes                    1
```

```
users.shape
photos.shape
likes.shape
comments.shape
```

```
(7488, 8)
```

```
print("Users:", users.shape)
print("Photos:", photos.shape)
print("Likes:", likes.shape)
print("Comments:", comments.shape)
print("Tags:", tags.shape)
print("Photo_Tags:", photo_tags.shape)
print("Follows:", follows.shape)
```

```
Users: (100, 6)
Photos: (257, 6)
Likes: (8782, 5)
Comments: (7488, 8)
Tags: (21, 4)
Photo_Tags: (501, 3)
Follows: (7623, 5)
```

```
follows.columns
```

```
Index(['follower', 'followee ', 'created time', 'is follower active',
       'followee Acc status'],
      dtype='object')
```

```
follows.columns = follows.columns.str.strip()
likes.columns = likes.columns.str.strip()
comments.columns = comments.columns.str.strip()
photos.columns = photos.columns.str.strip()
users.columns = users.columns.str.strip()
photo_tags.columns = photo_tags.columns.str.strip()
tags.columns = tags.columns.str.strip()
```

```
follows.columns
```

```
Index(['follower', 'followee', 'created time', 'is follower active',
       'followee Acc status'],
      dtype='object')
```

```
followers_count =
follows.groupby('followee').size().reset_index(name='followers')

followers_count.head()
```

```
   followee  followers
0         1         77
1         2         76
2         3         76
3         4         76
4         5         76
```

```
likes.columns
```

```
Index(['user', 'photo', 'created time', 'following or not', 'like
type'], dtype='object')
```

```
likes_count =
likes.groupby('photo').size().reset_index(name='likes_count')

likes_count.head()
```

```
   photo  likes_count
0      1           25
1      2           36
2      3           38
3      4           38
4      5           31
```

```
comments.columns
```

```
Index(['id', 'comment', 'User  id', 'Photo id', 'created Timestamp',
       'posted date', 'emoji used', 'Hashtags used count'],
      dtype='object')
```

```
comments_count = comments.groupby('Photo
id').size().reset_index(name='comments_count')

comments_count.head()
```

```
   Photo id  comments_count
0         1              25
1         2              31
2         3              27
3         4              32
4         5              27
```

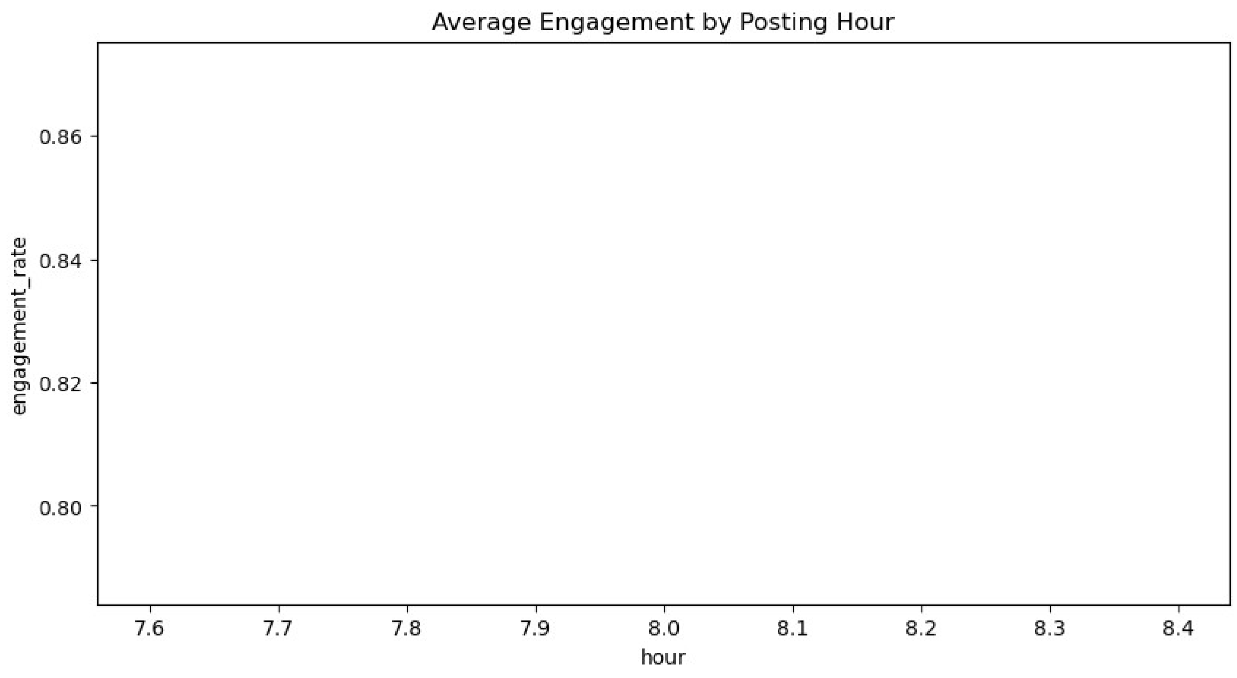
```
photos.columns
```

```
Index(['id', 'image link', 'user ID', 'created dat', 'Insta filter
used',
       'photo type'],
      dtype='object')
```

```
comments_count = comments.groupby('Photo
id').size().reset_index(name='comments_count')

photos_merged = photos.merge(
    likes_count,
    left_on='id',
    right_on='photo',
    how='left'
)

photos_merged = photos_merged.merge(
    comments_count,
    left_on='id',
    right_on='Photo id',
    how='left'
)

photos_merged = photos_merged.merge(
    followers_count,
    left_on='user ID',
    right_on='followee',
    how='left'
)

photos_merged[['likes_count','comments_count','followers']] = \
photos_merged[['likes_count','comments_count','followers']].fillna(0)

photos_merged['engagement_rate'] = (
    photos_merged['likes_count'] +
    photos_merged['comments_count']
) / photos_merged['followers']

photos_merged['engagement_rate'] = \
photos_merged['engagement_rate'].replace([np.inf, -np.inf], 0)

photos_merged[['likes_count','comments_count','followers','engagement_
rate']].describe()
```

```
       likes_count  comments_count   followers  engagement_rate
count   257.000000      257.000000  257.000000       257.000000
mean     34.171206       29.136187   76.307393         0.829693
std       3.605804        3.452939    0.462314         0.063600
min      25.000000       21.000000   76.000000         0.649351
25%      31.000000       27.000000   76.000000         0.789474
50%      34.000000       29.000000   76.000000         0.828947
75%      37.000000       31.000000   77.000000         0.868421
max      48.000000       39.000000   77.000000         1.039474
```

```
photos_merged['created dat'] = pd.to_datetime(
    photos_merged['created dat'],
    format='%d-%m-%Y %H:%M'
)

photos_merged['hour'] = photos_merged['created dat'].dt.hour
photos_merged['day_name'] = photos_merged['created dat'].dt.day_name()

hourly_engagement = photos_merged.groupby('hour')
['engagement_rate'].mean().reset_index()

hourly_engagement.sort_values(by='engagement_rate',
ascending=False).head()

   hour  engagement_rate
0     8         0.829693

plt.figure(figsize=(10,5))
sns.lineplot(data=hourly_engagement, x='hour', y='engagement_rate')
plt.title("Average Engagement by Posting Hour")
plt.show()
```

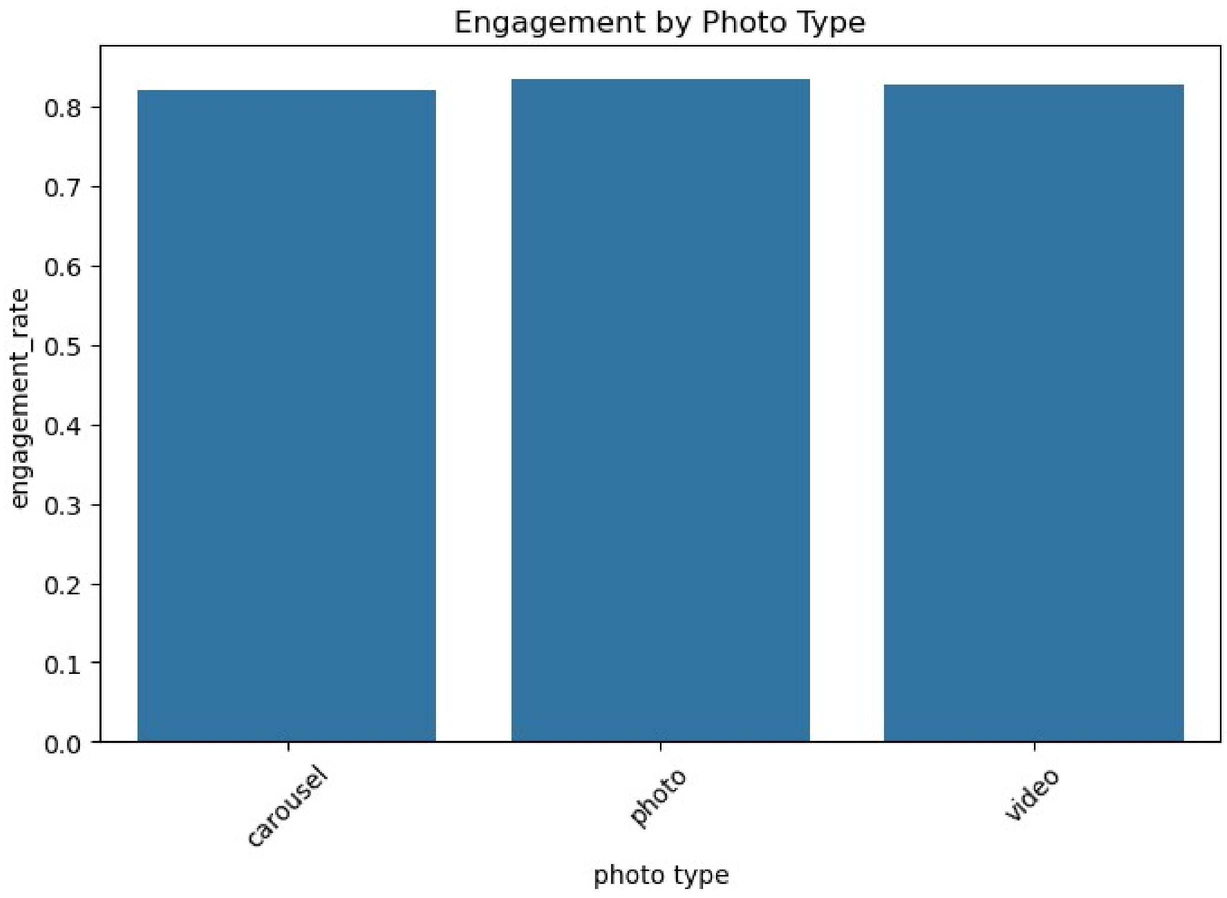


```
photos_merged['hour'].value_counts()

hour
8    257
Name: count, dtype: int64
```

```python
photo_type_engagement = photos_merged.groupby('photo type')
['engagement_rate'].mean().reset_index()

photo_type_engagement.sort_values(by='engagement_rate',
ascending=False)
```

```
  photo type  engagement_rate
1      photo         0.833777
2      video         0.826890
0   carousel         0.819945
```

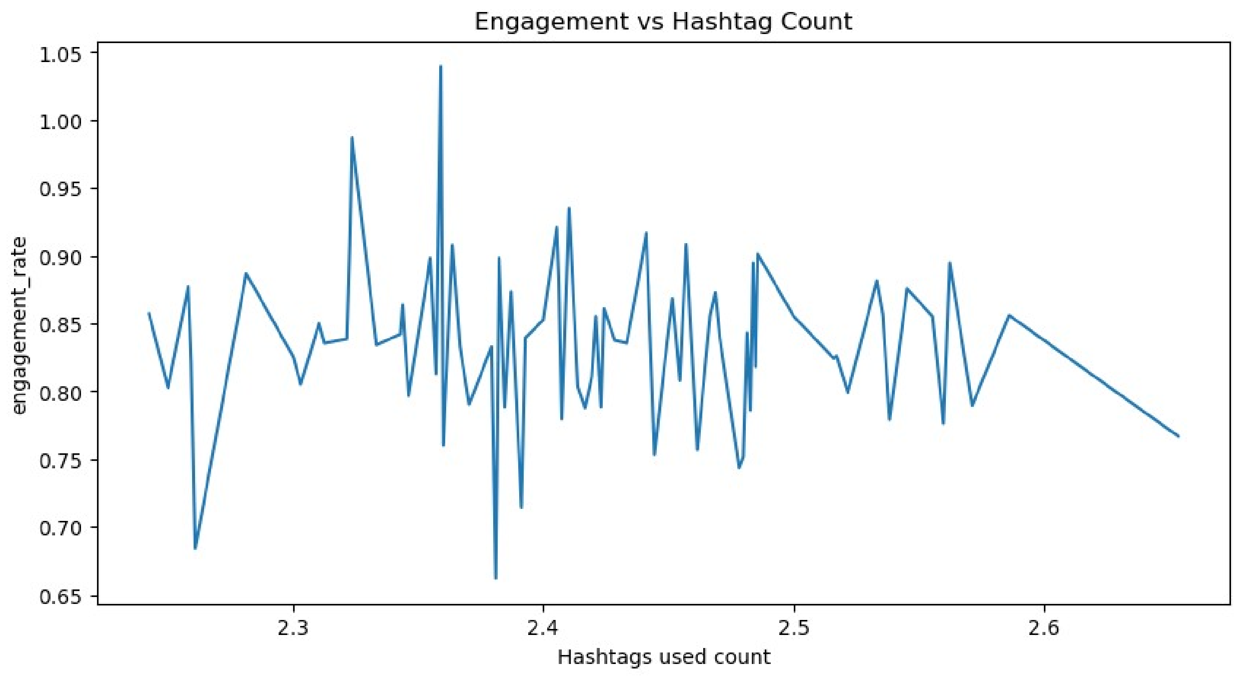
```python
plt.figure(figsize=(8,5))
sns.barplot(data=photo_type_engagement, x='photo type',
y='engagement_rate')
plt.xticks(rotation=45)
plt.title("Engagement by Photo Type")
plt.show()
```



```python
comments[['Photo id','Hashtags used count']].head()
```

```
   Photo id  Hashtags used count
0         1                    1
```

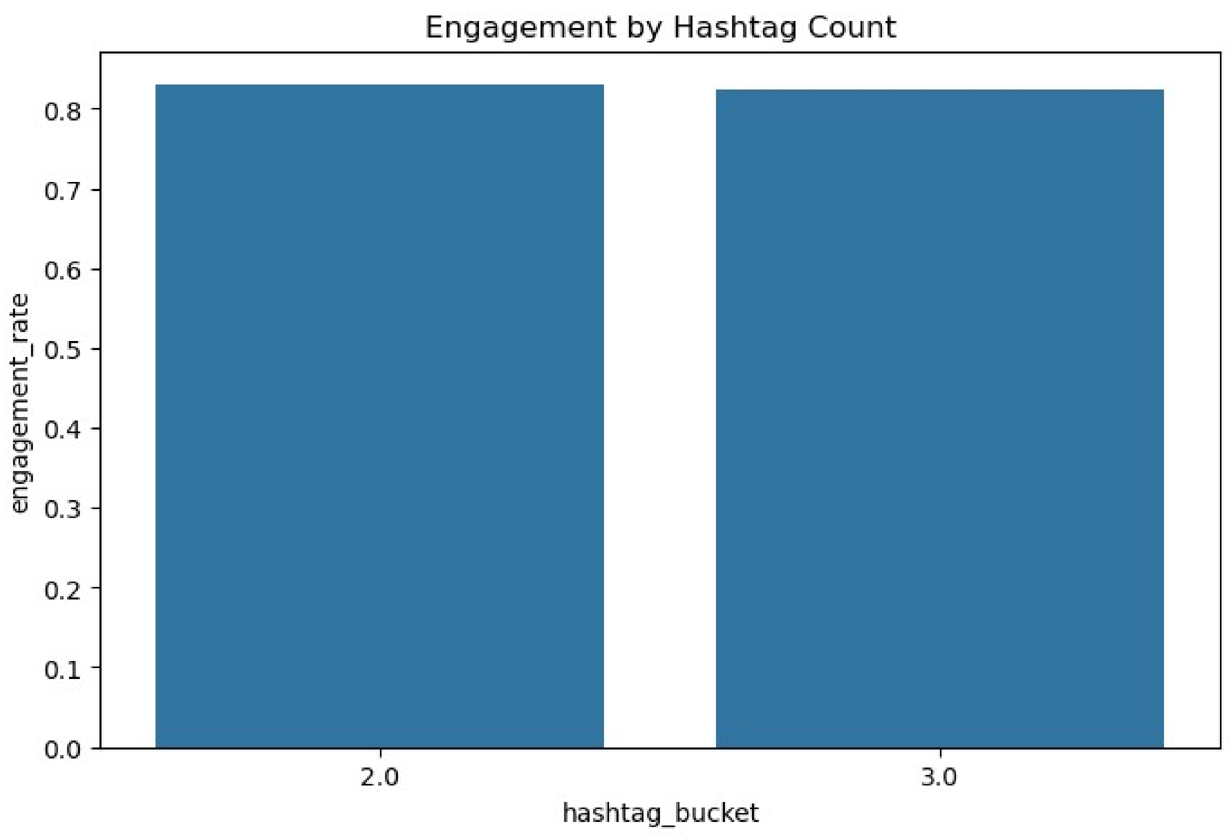
```
1         1                    2
2         1                    4
3         1                    2
4         1                    1

hashtag_count = comments.groupby('Photo id')['Hashtags used
count'].mean().reset_index()

photos_merged = photos_merged.merge(
    hashtag_count,
    left_on='id',
    right_on='Photo id',
    how='left'
)

photos_merged['Hashtags used count'] = \
photos_merged['Hashtags used count'].fillna(0)

hashtag_engagement = photos_merged.groupby('Hashtags used count')
['engagement_rate'].mean().reset_index()

hashtag_engagement.sort_values(by='engagement_rate', ascending=False)

    Hashtags used count  engagement_rate
20             2.358974         1.039474
12             2.323529         0.986842
36             2.410256         0.935065
33             2.405405         0.921053
46             2.441176         0.916667
..                  ...              ...
57             2.480000         0.751623
56             2.478261         0.743421
30             2.391304         0.714286
4              2.260870         0.684211
26             2.380952         0.662338

[78 rows x 2 columns]

plt.figure(figsize=(10,5))
sns.lineplot(data=hashtag_engagement, x='Hashtags used count',
y='engagement_rate')
plt.title("Engagement vs Hashtag Count")
plt.show()
```



```
photos_merged['hashtag_bucket'] = \
photos_merged['Hashtags used count'].round()

hashtag_engagement_bucket = \
photos_merged.groupby('hashtag_bucket')
['engagement_rate'].mean().reset_index()

hashtag_engagement_bucket.sort_values(by='engagement_rate',
ascending=False)
```

```
   hashtag_bucket  engagement_rate
0             2.0         0.830606
1             3.0         0.823899
```

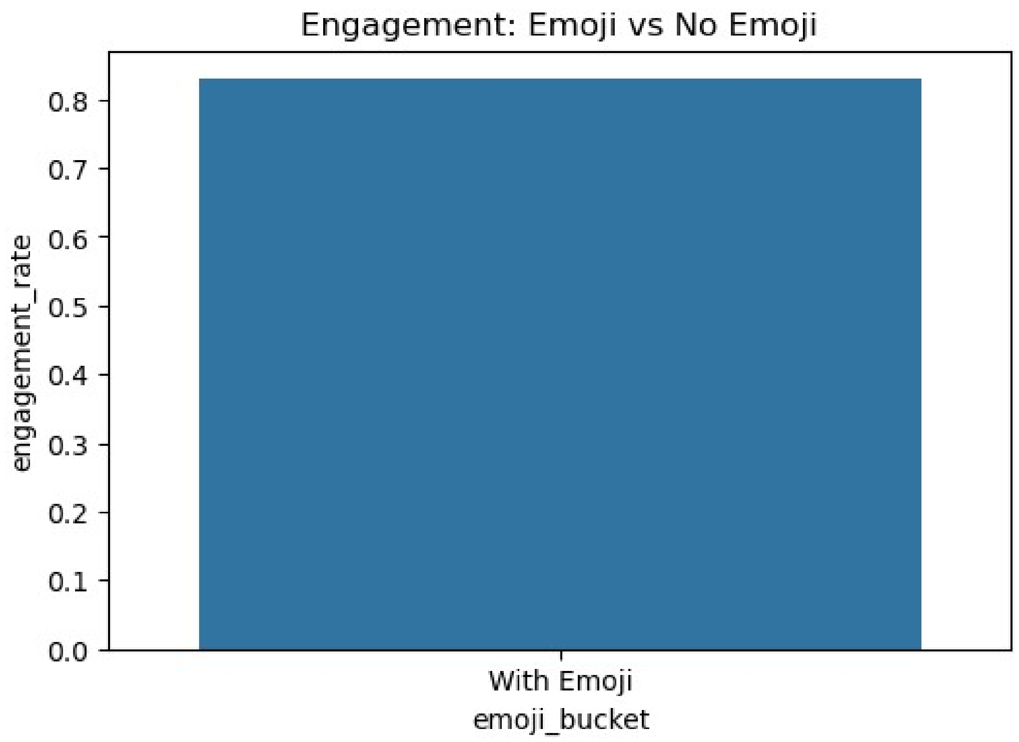
```
plt.figure(figsize=(8,5))
sns.barplot(data=hashtag_engagement_bucket,
            x='hashtag_bucket',
            y='engagement_rate')
plt.title("Engagement by Hashtag Count")
plt.show()
```



```
emoji_usage = comments.groupby('Photo id')['emoji used'].apply(
    lambda x: (x == 'yes').sum()
).reset_index(name='emoji_count')

photos_merged = photos_merged.merge(
    emoji_usage,
    left_on='id',
    right_on='Photo id',
    how='left'
)

photos_merged['emoji_count'] = photos_merged['emoji_count'].fillna(0)

photos_merged['emoji_bucket'] = photos_merged['emoji_count'].apply(
    lambda x: 'With Emoji' if x > 0 else 'No Emoji'
)

emoji_engagement = photos_merged.groupby('emoji_bucket')
['engagement_rate'].mean().reset_index()

emoji_engagement
```

```
  emoji_bucket  engagement_rate
0   With Emoji         0.829693
```

```
plt.figure(figsize=(6,4))
sns.barplot(data=emoji_engagement,
            x='emoji_bucket',
            y='engagement_rate')
plt.title("Engagement: Emoji vs No Emoji")
plt.show()
```



```
photos_merged['emoji_bucket'].value_counts()

emoji_bucket
With Emoji    257
Name: count, dtype: int64
```

8. Strategy Recommendations

Based on the engagement analysis of 257 posts, the following strategic insights are recommended for Alfido Tech:

1. Prioritize high-quality photo posts, as they show slightly higher engagement compared to videos and carousels.
2. Maintain a balanced content mix, including educational videos and carousel guides.
3. Use 2–5 relevant and targeted hashtags to maintain stable engagement without overloading posts.
4. Continue emoji usage to maintain conversational tone and relatability.

5. Conduct A/B testing on posting time (8 AM vs evening slots) to identify optimal engagement windows.

These strategies aim to improve content consistency, audience interaction, and brand visibility.

9. Conclusion

This analysis examined content type performance, hashtag usage, emoji impact, and posting schedule patterns.

While the dataset showed limited variation in posting time and emoji usage, key engagement trends were identified. Photo-based content slightly outperformed other formats, and moderate hashtag usage maintained stable engagement levels.

Implementing a structured content calendar and controlled posting experiments can further enhance Instagram growth and audience engagement for Alfido Tech.