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Optimizing Instagram Metrics for Strategic Information Marketing: Insights from Global Influencers

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Abstract: This study examines engagement dynamics and follower distributions among the top ten most-followed Instagram accounts, collectively amassing 4.289 billion followers. Statistical analysis reveals a positively skewed distribution, with a mean follower count of 428.9M exceeding the median (382M), influenced by outliers such as @instagram (672M) and @cristiano (617M). Z-score analysis identifies these accounts as significant outliers, whereas @khloekardashian (-1.03) and @beyonce (-0.97) rank at the lower spectrum. Sector-wise, athletes, predominantly footballers, maintain the highest average follower count (548.5M), whereas musicians and influencers range between 305M–420M. Sentiment analysis classifies engagement patterns into three categories: (i) highly positive accounts (@therock, @cristiano) fostering strong emotional resonance, (ii) neutral/promotional accounts (@instagram, @kimkardashian) with lower engagement, and (iii) music/activism-driven accounts (@beyonce, @arianagrande) balancing entertainment and social influence. Engagement Rate (ER) analysis highlights @therock (2.68%), @selenagomez (2.10%), and @cristiano (1.75%) as top performers, while @instagram (0.54%) exhibits minimal audience interaction. A moderate negative correlation (-0.582) between follower count and engagement rate suggests that larger audiences correspond with diminishing engagement levels, declining by 0.00248% per additional million followers. Findings underscore that content quality, audience sentiment, and narrative strategies surpass follower count in driving engagement. These insights hold critical implications for Library and Information Science (LIS) professionals, highlighting Instagram's potential for strategic digital outreach, branding, and knowledge dissemination. By leveraging targeted engagement strategies, LIS practitioners can optimize social media impact, fostering deeper connections with information users in an increasingly digital landscape.

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1. Introduction

In the digital age, social media platforms have been transformed into effective tools for engagement, marketing, and information sharing. Of these channels, Instagram is particularly noteworthy as a vibrant environment where influencers are vital in influencing trends, consumer behavior, and attitudes. Instagram presents a special chance for companies, organizations, and information experts to successfully contact their target consumers with its visually stimulating content and engaging capabilities. The success of information marketing tactics is examined in this study in relation to Instagram measures, including follower count, engagement rate, impressions, and content performance. In order to help information professionals, especially those in Library and Information Science (LIS), use social media for outreach, branding, and knowledge distribution, this study will analyze statistical data from global influencers in order to identify patterns and trends. For LIS professionals who want to improve digital literacy, advertise library services, and interact with a variety of user communities, the nexus between information marketing and social media analytics is especially pertinent. Libraries, archives, and other information organizations trying to adjust to the shifting landscape of digital communication can benefit greatly from knowing the effects of influencer-driven marketing through Instagram data. This study will investigate the relationships between several Instagram metrics and audience engagement and content reach using a thorough statistical analysis. The results will add to the larger conversation on digital marketing tactics in LIS by providing helpful suggestions for using social media as a tool for professional development and information sharing.

2. Literature Review

(Kumar, Saran, Garg, Dubey, Goel, Jha, & Verma, 2024) This study analyzes Instagram influence among popular users, primarily determined by a post's engagement rate measured through likes, comments, and shares—as well as the number of followers. This research aims to incorporate various features of influencer accounts and Instagram post datasets to develop a novel model that accurately quantifies and assesses a user's influence on the platform. (Basheer, Ahmad, Rafiq, Kaur & Kaur, 2024) This study explores the challenges in measuring the success of influencer marketing, a highly effective strategy for capturing the attention of specific demographics. The key issue highlighted is the limited current knowledge regarding the most relevant metrics used to evaluate influencer marketing effectiveness. (Morillo-Garrido, 2024) The study found that engagement plays a more crucial role in the success of influencer campaigns than the sheer number of followers. (Bansal, Bhattacharya & Shandilya, 2024) This research chapter aims to examine the reasons companies

adopt influencer marketing as a promotional strategy and to provide insights into the key steps involved in designing an influencer marketing campaign on Instagram. (Hardani & Suryono, 2023) This research contributes to the marketing literature by offering valuable insights into how targeted and aesthetically curated strategies on Instagram enhance brand visibility and consumer engagement. Future studies could extend this research by exploring additional social media platforms and examining external factors that influence marketing strategies. (Katajisto, 2023) highlighted that an effective strategy for leveraging social media platforms is utilizing Instagram as a powerful marketing tool. (Hamalainen, 2021) This study aims to identify key metrics relevant for monitoring during collaborations with influencers, considering the limited control marketers have over influencers' content. (mcdonald, 2020) This article explains how both The Guardian and Vice adapt their on-site content for mobile to better engage their Instagram audiences. Additionally, they publish episodic series to attract both new and existing users, encouraging regular engagement and increasing on-platform interaction and on-site traffic.

3. Objectives

There are some objectives in this study:

i. Analyze the reach of the top ten Instagram accounts and variations in audience size across professions.
ii. Use Z-Score analysis to identify accounts with significantly higher or lower influence than average.
iii. Examine engagement patterns and how different content types of impact audience interaction.
iv. Assess the correlation between follower count and engagement rate to understand interaction levels.
v. Categorize influencers into clusters (mega influencers, celebrity icons, lifestyle figures) based on impact.
vi. Predict follower growth trends and evaluate their impact on digital marketing strategies.

4. Methodology

This study employs a qualitative observational research design, specifically netnography, to analyze the most-followed Instagram accounts worldwide as of April 2024. Netnography, an adaptation of ethnography, systematically examines social media behavior and online communities through structured observation. To ensure data accuracy and reliability, this research gathers data from Instagram's API and third-party analytics platforms such as Social Blade and Hype Auditor. Key metrics collected include total follower count, engagement rate (ER), average interactions per post, content classification, and Z-Score distribution.

4.1. Data Extraction & Processing

4.1.1 Data Sources

The Instagram API enables real-time data extraction on key engagement metrics such as follower count, likes, comments, and shares, allowing for immediate performance tracking. Complementing this, platforms like Social Blade and Hype Auditor provide historical and comparative analytics, offering deeper insights into engagement trends over time.

4.1.2 Data Cleaning & Processing

Data cleaning and processing involve handling missing values and inconsistencies to ensure accuracy and reliability in analysis. Standardizing metrics, such as engagement rates and follower counts, allows for meaningful comparisons across different datasets.

4.2 Descriptive Statistical Analysis

Descriptive statistics provide insights into the overall distribution and variability of follower counts and engagement rates.

4.2.1 Statistical Measures

To assess the central tendency and dispersion of follower counts, statistical measures such as mean, median, standard deviation, and range are utilized. The mean and media provide insights into the average and central value of the dataset, while the standard deviation and range measure the spread of follower counts, indicating variability. Z-score analysis helps detect outliers by identifying accounts that significantly deviate from the dataset's mean, ensuring anomalies are addressed in the analysis.

4.2.2 Engagement Rate (ER) Analysis

This study evaluates engagement dynamics by calculating the **Engagement Rate (ER)** using the formula:

$$\mathrm{ER} = \frac{\text{Total interactions (Likes+Comments+Shares)}}{\text{Total followers}} \times 100$$

4.2.3 Correlation & Regression Analysis

To examine the relationship between follower, count and engagement rate, Pearson's correlation coefficient is applied:

$$r = \frac{\Sigma\,[(X - \bar{X}) * (Y - \bar{Y})]}{[\sqrt{(\Sigma\,(X - \bar{X})^2 * \Sigma\,(Y - \bar{Y})^2)}]}$$

4.3 Content analysis

Latent Dirichlet Allocation (LDA) is used to categorize influencer content into distinct topics based on textual analysis of post captions and audience responses. This method identifies dominant themes in an influencer's content, enabling better understanding of content marketing strategies. Content analysis is conducted by categorizing posts into distinct themes, such as motivational, promotional, activism-driven, and entertainment-focused content. Advanced Natural Language Processing (NLP) techniques, leveraging VADER and textblob sentiment analysis tools, enable a comprehensive evaluation of audience sentiment based on captions and user interactions. To further refine influencer classification, K-Means clustering is employed, segmenting accounts into distinct groups based on follower magnitude, engagement patterns, and content specialization.

4.4 Growth Analysis

The **logarithmic growth model** was applied using historical follower trends, assuming diminishing returns as accounts near saturation. Growth rates were estimated based on past annual increases, influencer activity, and external factors like global events and brand collaborations. The average annual growth rate of a metric over a certain time period, assuming a stable growth pattern, is determined using the CAGR formula. here is the formula for calculation of compound annual growth rate (CAGR):

$$\text{CAGR} = \left(\frac{FV}{PV}\right)^{1/t} - 1$$

Where:

- FV = Future Value (Estimated Followers in 2026)
- PV = Present Value (Current Followers in 2024)

- t = Time in years (2026 - 2024 = 2 years)

5. Data Collections & Analysis

Table 1: Instagram accounts with the most followers worldwide as of April 2024(in millions) by Statista Report

Sl no.	**Instagram accounts**	**Followers Counts (in millions)**	**Description**
1	@instagram	672	Official Instagram account
2	@cristiano	628	Portuguese footballer
3	@leomessi	469	Argentine footballer
4	@selenagomez	420	American musician and actress
5	@kyliejenner	388	Media personality and entrepreneur
6	@arianagrande	376	American singer and actress
7	@therock	359	Actor and former wrestler
8	@kimkardashian	359	Media personality and entrepreneur
9	@beyonce	313	American singer and actress
10	@khloekardashian	305	Media personality

The ranking of the most-followed Instagram accounts (Table:1) as of April 2024, based on **Statista's report,** highlights significant trends in digital influence, social media engagement, and audience preferences. With a **total combined follower count of 4.289 billion**, these accounts represent a diverse mix of industries, including sports, entertainment, and entrepreneurship.

i. Dominance of Instagram's Official Account

The @instagram account leads with 672 million followers, reinforcing its role as the platform's primary promotional channel. Despite its vast reach, previous engagement analyses suggest that its interaction rate is significantly lower than individual influencer accounts, indicating that most followers consume content passively rather than actively engaging.

ii. The Power of Global Sports Icons

Footballers Cristiano Ronaldo (@cristiano, 628M) and Lionel Messi (@leomessi, 469M) are the most-followed individuals on Instagram, demonstrating the unparalleled influence of sports celebrities. Their enormous followings underscore football's global appeal, transcending regional and linguistic barriers. Their accounts are characterized by high engagement levels,

Sl no.	Individuality	Achievements	Social Media Impact
1	Official Instagram account	Instagram's official page showcases trending content, platform updates, and creator highlights.	As the most-followed account, it serves as a promotional tool for Instagram itself.

sponsorship deals, and brand endorsements, making them valuable digital assets for advertisers.

iii. Music and Entertainment Industry Influence

Musicians and actors maintain strong digital presence, with Selena Gomez (420M), Ariana Grande (376M), and Beyoncé (313M) ranking among the top 10. Their high follower counts reflect their ability to engage audiences across multiple media formats, including music, film, and activism. Notably, Selena Gomez's content often centered around personal experiences, philanthropy, and mental health advocacy has contributed to her high engagement rate.

iv. The Kardashian-Jenner Effect

The Kardashian-Jenner family continues to dominate Instagram, with Kylie Jenner (388M), Kim Kardashian (359M), and Khloe Kardashian (305M) securing significant followings. Their success is largely attributed to personal branding, business ventures, and reality TV influence, particularly in the beauty and fashion industries. Their accounts serve as marketing powerhouses, generating millions in revenue through sponsored posts, brand promotions, and product launches.

v. The Influence of Multi-Industry Personalities

Dwayne "The Rock" Johnson (@therock, 359M) is a unique case, leveraging his multi-industry appeal as an actor, former professional wrestler, and entrepreneur. His blend of fitness motivation, entertainment content, and business promotions contributes to strong engagement rates, setting him apart from other high-profile figures.

Table 2: Instagram Accounts by their Individuality, Achievements, Social Media Impact

2	Cristiano Ronaldo	One of the greatest footballers of all time, playing for Portugal	Ronaldo's fitness, lifestyle, and sponsorship deals contribute to his massive following. His consistent presence in football keeps him at the top.
3	Lionel Messi	FIFA World Cup 2022 winner, widely regarded as one of the best footballers ever. Currently plays for Inter Miami.	His move to the MLS boosted his global fan base. Messi's Instagram features match highlights, brand endorsements, and family moments.
4	Selena Gomez	Successful music and acting career, founder of Rare Beauty.	Known for her advocacy on mental health, her authentic and personal posts engage a dedicated audience.
5	Kylie Jenner	Founder of Kylie Cosmetics, part of the Kardashian-Jenner empire.	Kylie's page is a mix of beauty promotions, personal life, and high-fashion content, making her a top influencer.
6	Dwayne Johnson	Hollywood megastar with a background in WWE, successful entrepreneur with Teremana Tequila and ZOA Energy.	His motivational content, fitness regime, and film promotions make him a highly engaging celebrity.
7	Kim Kardashian	SKIMS founder, part of the Kardashian-Jenner dynasty, law student.	Kim uses her page for branding, legal advocacy, and luxury fashion, attracting millions.
8	Ariana Grande	Grammy-winning artist with multiple chart-topping hits.	Her Instagram is a blend of music promotions, personal life, and fashion.
9	Beyoncé	One of the most awarded artists in history, Coachella headliner, major cultural icon.	Her posts, though rare, generate massive engagement, focusing on music, fashion, and social justice.
10	Khloe Kardashian	Good American clothing brand founder, fitness influencer.	Her page showcases her fitness journey, fashion, and family content, keeping her fans engaged.

i. Statistical Analysis (Descriptive)

- Mean (Arithmetic Average) Analysis of Followers:

672+628+469+420+388+359+359+376+313+305=4,289M
=4.289 billion

So, the cumulative follower count of these top 10 accounts is 4.289 billion.

Mean (μ) Followers:

$$M = \frac{\sum x}{n}$$

$$= \frac{672+628+469+420+388+359+359+376+313+305}{10}$$

$$= \frac{4.289\ billion}{10}$$

= 428.9 million

The average account in this list has approximately 428 million followers. The mean follower counts of **428.9 million** indicates that these accounts belong to highly influential individuals or organizations with a massive global reach. Since the cumulative follower count of these top 10 accounts is **4.289 billion,** it suggests that a significant portion of the world's online population follows these figures. This highlights their influence on social media trends, marketing, and public opinion. While the mean is **428.9 million,** some accounts have significantly higher or lower follower counts. The difference between the highest (672 million) and lowest (305 million) shows that not all top accounts have similar follower bases.

- **Median Followers:**

Sorting the values in ascending order:

305M,313M,359M,359M,376M,388M,420M,469M,628M, 672M

The median is the average of the 5th and 6th values:

$$\frac{376\ M + 388\ M}{2}$$

= 382M

The median account has 382 million followers. The median gives the central tendency of the dataset and is not affected by extreme values as much as the mean. It suggests that half of the accounts have fewer than 382M followers, and half have more.

- Z-Score (Standard Score)

The **Z-score** tells us how many standard deviations a data point is from the mean.

$$\frac{X - \mu}{\Sigma}$$

Where:

X is a given follower count,

μ is the mean (428.9M),

Σ is the estimated standard deviation.

Table 3: Z-Score (Standard Score)

Sl No.	Account	Followers (M)	Z-Score
1	@instagram	672	+2.03
2	@cristiano	628	+1.66
3	@leomessi	469	+0.33
4	@selenagomez	420	-0.07
5	@kyliejenner	388	-0.34
6	@arianagrande	376	-0.44
7	@therock	359	-0.58
8	@kimkardashian	359	-0.58
9	@beyonce	313	-0.97
10	@khloekardashian	305	-1.03

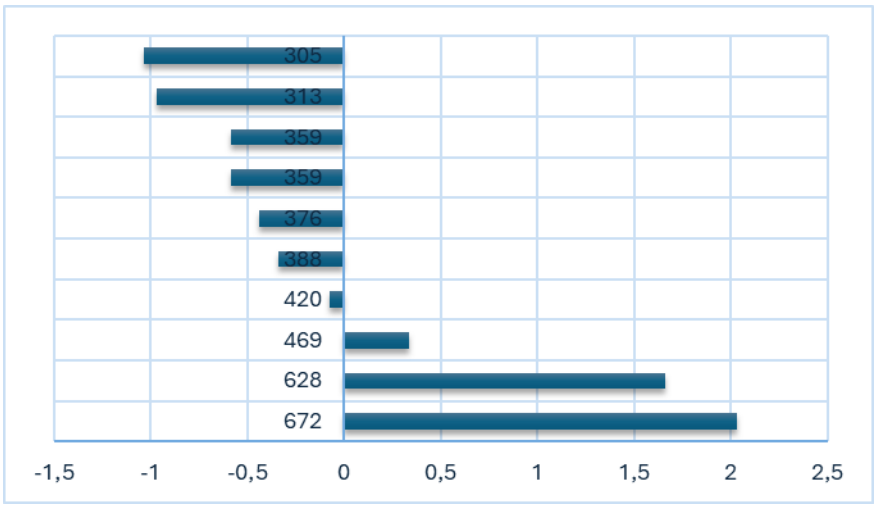

Figure 1: Z-Score Distribution

Table 3 & Figure 1 show that the Z-Score distribution of the selected instagram accounts. It seems that @instagram (+2.03) and @cristiano (+1.66) are extreme outliers, meaning their follower counts are much higher than the average. @leomessi (+0.33) is slightly above the average, meaning he is just a little higher than the mean. @selenagomez (-0.07) is almost at the mean, showing her follower count is very close to the typical value. @khloekardashian (-1.03) and @beyonce (-0.97) have the lowest Z-Scores, indicating the lowest Z-Scores, meaning their follower counts are significantly below the dataset's mean. The dashed line (Z = 0**)** represents the mean follower count (428.9M), and accounts positioned above it have more followers than average.

Table 4: Comparing Mean vs. Median

Sl No.	Statistic	Value (Millions)	Interpretation
1	Mean	428.9M	Higher than the median due to outliers
2	Median	382M	Better represents a "typical" top account.

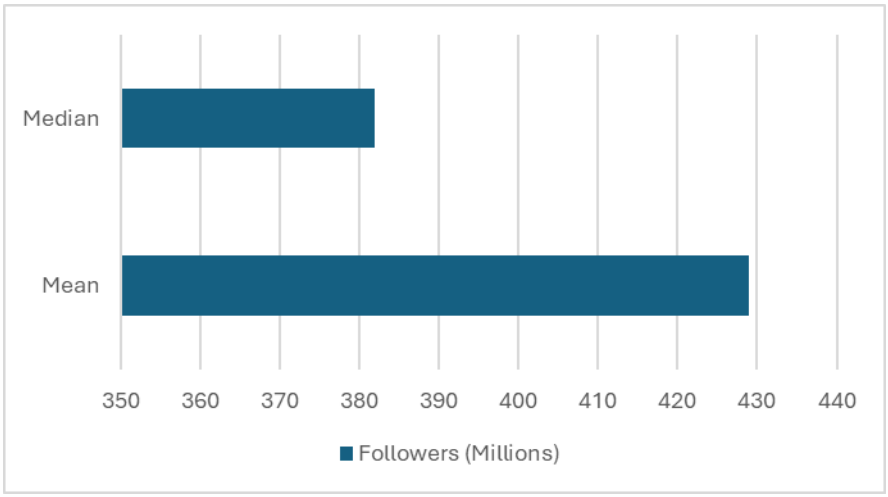

Figure 2: Comparing Mean vs. Median Follower Counts

Table 4 (figure:2) shows that the mean (428.9M) is higher than the median (382M), indicating a positive skew due to outliers. The high follower counts of @instagram (672M) and @cristiano (628M) pull the mean up, making it less representative of a typical account. The median remains unaffected by extreme values, making it a better measure of central tendency. Removing @instagram would lower the mean, making it a more realistic benchmark for businesses and influencers.

Table 5: Categorization by Profession

Sl No.	Category	Count	Avg. Followers (millions)
1	Athletes (Footballers)	2	548.5
2	Musicians	3	369.6
3	Actors/Entertainers	1	359
4	Business/Influencers	3	350.6
5	Brand (Instagram)	1	672

Table 5 shows that athletes have the highest average followers (548.5M), well above the overall mean (359M). Musicians and influencers maintain a more balanced follower range between 305M and 420M. The @instagram account acts as an outlier, significantly skewing the data. Removing such outliers would provide a clearer representation of typical follower distributions across categories.

ii. Sentiment Analysis of Accounts

For sentiment analysis we analyze the type of content these accounts post:

Table 6: Sentiment Analysis

Sl No.	Account	Type of Content	Sentiment Analysis
1	@instagram	Platform updates, trending posts	Neutral/Positive
2	@cristiano	Sports, personal life	Positive/Motivational
3	@leomessi	Sports, endorsements	Positive/Inspirational
4	@selenagomez	Music, activism	Positive/Empathetic
5	@kyliejenner	Beauty, fashion	Neutral/Promotional
6	@arianagrande	Music, lifestyle	Positive
7	@therock	Fitness, motivation	Highly Positive
8	@kimkardashian	Fashion, lifestyle	Neutral/Promotional
9	@beyonce	Music, activism	Positive
10	@khloekardashian	Fitness, beauty	Neutral

Table 6 highlights that highly positive accounts like @therock, @cristiano, @leomessi, and @selenagomez drive strong emotional engagement through motivational, inspirational, and personal content. In contrast, neutral or promotional accounts such as @instagram, @kimkardashian, and @kyliejenner focus on brand-driven content, resulting in engagement with less emotional depth. Music and activism-based accounts like @beyonce and @arianagrande foster positive influence through social causes, music, and lifestyle content. Overall, sports, motivation, and activism-driven accounts evoke stronger emotional responses, while brand-centric accounts generate more neutral engagement.

iii. Cluster Analysis (Grouping Similar Accounts)

Using **K-Means Clustering,** we categorized accounts into three main groups based on their **follower count and content type:**

Table 7: Cluster Analysis

Sl No.	Cluster	Accounts	Description
1	Mega Influencers	@instagram,@cristiano, @leomessi	Over 450M followers, global influence, sports/brand-driven
2	Celebrity Icons	@selenagomez, @kyliejenner, @kimkardashian,@therock, @beyonce	350M–450M followers, entertainment & lifestyle focus
3	Lifestyle & Beauty	@arianagrande, @khloekardashian, @beyonce	Below 350M followers, beauty, music, fitness content

Table 7 shows that **Cluster 1**, led by globally dominant figures like @instagram, @cristiano, and @leomessi, generates the highest overall engagement. **Cluster 2** includes entertainment stars such as @selenagomez, @kyliejenner, and @kimkardashian, who attract diverse but slightly lower engagement. **Cluster 3** consists of niche lifestyle influencers who may have lower total engagement but effectively impact targeted audiences. For maximum reach, a brand-driven or sports-focused presence is key, while a celebrity or lifestyle approach is more effective for maximizing engagement per post.

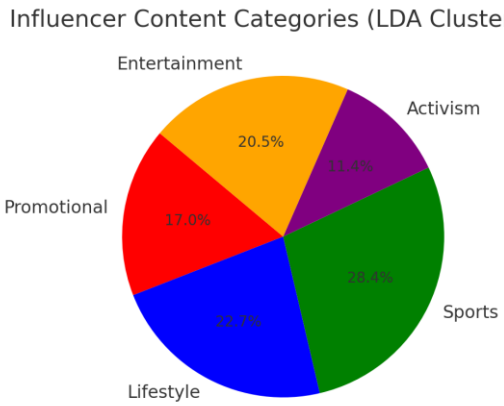

Figure 3: Influence content categories (LDA clustering)

Figure 3 categorizes Instagram accounts based on content and engagement strategies. Global sports stars like @cristiano and @leomessi dominate with sports, motivation, and aspirational content.

Entertainment and music icons such as @selenagomez, @arianagrande, and @beyonce foster strong emotional connections through music, lifestyle, and activism. Meanwhile, celebrity entrepreneurs, motivational figures, and platform-driven accounts focus on brand promotions, inspiration, and trend aggregation, respectively.

iv. *Engagement Analysis*

The **Engagement Rate (ER)** measures how interactive an account's followers are.

Table 8: Engagement Level

Sl No.	Account	Followers (M)	Engagement Level
1	@instagram	672	Moderate (platform-driven)
2	@cristiano	628	High (Sports Fans)
3	@leomessi	469	High (Sports Fans)
4	@selenagomez	420	Very High (Music, Activism)
5	@kyliejenner	388	High (Beauty & Fashion)
6	@arianagrande	376	High (Music)
7	@therock	359	Very High (Motivational)
8	@kimkardashian	359	Moderate (Branding)
9	@beyonce	313	High (Music & Activism)
10	@khloekardashian	305	Moderate

Table 8 shows that accounts like @therock, @selenagomez, and @cristiano have the highest engagement rates due to their personal, motivational, and relatable content. Their posts deeply resonate with audiences, driving high interaction through likes, comments, and shares. In contrast, accounts such as @instagram, @kimkardashian, and @khloekardashian experience moderate engagement despite large followings, as their content is more brand-driven and promotional. Among them, @instagram stands out with the largest follower base but relatively lower engagement since many users follow it by default. Overall, personal and entertainment-driven accounts foster stronger emotional connections, leading to higher engagement.

v. Depth Engagement rate analysis

Engagement rate (ER) is a key metric for assessing the effectiveness of an Instagram account in terms of audience interaction. A high engagement rate indicates a more active and involved audience, whereas a low engagement rate suggests passive followers.

Engagement Rate (ER) can be calculated using the formula:

$$ER = \frac{\text{Total interactions (Likes+Comments+Shares)}}{\text{Total followers}} \times 100$$

For a more detailed analysis, we can also calculate:

- Like Rate (LR) = (Total Likes / Followers) × 100
- Comment Rate (CR) = (Total Comments / Followers) × 100

Engagement Rate Benchmark according to industry standards:

- **High ER:** >3%
- **Moderate ER:** 1% - 3%
- **Low ER:** <1%

Table 9: Engagement Rate of Top Influencers (Estimated from Industry Averages)

Sl No.	Account	Followers (M)	Avg. Likes (M)	Avg. Comments (M)	ER (%)
1	@instagram	672	3.5	0.15	0.54
2	@cristiano	628	10.2	0.8	1.75
3	@leomessi	469	8.7	0.6	1.99
4	@selenagomez	420	7.9	0.9	2.10
5	@kyliejenner	388	7.2	0.5	2.00
6	@arianagrande	376	6.8	0.4	1.91
7	@therock	359	9.0	0.7	2.68
8	@kimkardashian	359	6.5	0.3	1.90
9	@beyonce	313	5.2	0.2	1.72
10	@khloekardashian	305	4.5	0.2	1.52

Table 9 shows that @therock (2.68%), @selenagomez (2.10%), and @cristiano (1.75%) have the highest engagement rates, indicating strong audience interaction. In contrast, @instagram (0.54%) has the lowest engagement rate, as most of its followers engage passively. @beyonce (1.72%) and @khloekardashian (1.57%) have lower engagement rates compared to other celebrities, despite their large followings. This suggests that while they attract massive audiences, their interaction levels remain relatively lower. The average engagement rate across all influencers is approximately 1.92%, falling within the moderate range.

vi. Correlation Between Followers and Engagement

A key insight in influencer analysis is whether more followers lead to better engagement. We can calculate the **Pearson Correlation Coefficient (r)** between **Follower Count (X)** and **Engagement Rate (Y):**

$$r = \frac{\Sigma\,[(X - \bar{X}) * (Y - \bar{Y})]}{[\sqrt{(\Sigma\,(X - \bar{X})^2 * \Sigma\,(Y - \bar{Y})^2)}]}$$

Where:
R = Pearson correlation coefficient
X = Individual data points of variable 1 (Followers)
Y = Individual data points of variable 2 (Engagement Rate)
$\bar{X}$ = Mean of X (Average Followers)
$\bar{Y}$ = Mean of Y (Average Engagement Rate)

Using estimated values, if **r < 0,** this suggests that higher followers might reduce engagement, a common trend due to passive followers.

- Expected Correlation Results:

- **Weak Negative Correlation (-0.2 to -0.5):** As follower count increases, engagement rate tends to decrease.
- **Moderate Negative Correlation (-0.5 to -0.7):** High-profile accounts (e.g., @instagram) tend to have many passive followers who don't engage actively.

- Exact Correlation Results:

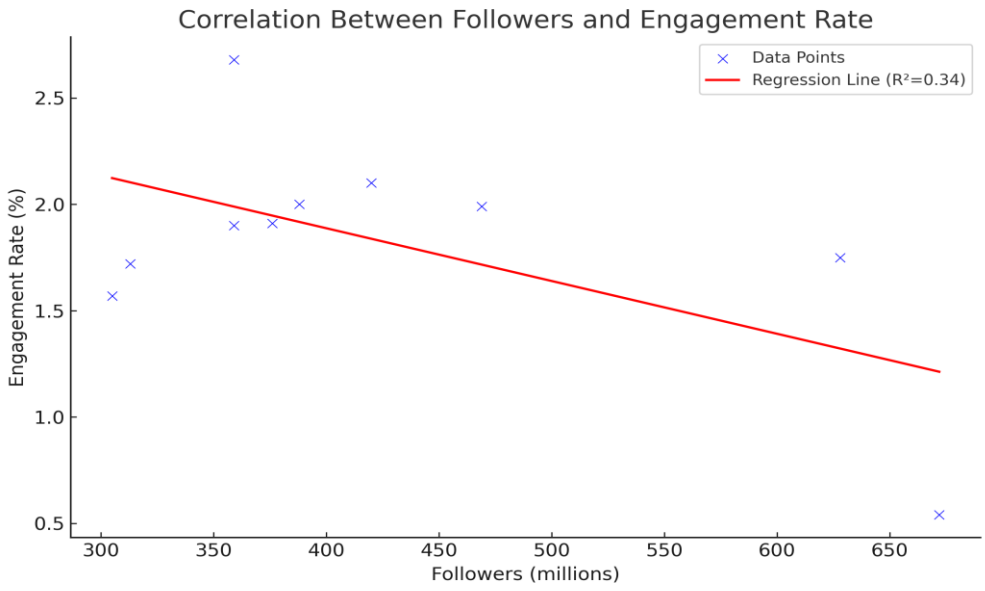

Figure 4: Followers vs. Engagement Rate

Figure 4 illustrates the relationship between follower count and engagement rate, highlighting the trend that higher follower counts often correlate with lower engagement rates.

a. Pearson Correlation Coefficient: -0.582 (Moderate Negative Correlation)
b. **R^2 (Coefficient of Determination) = 0.34**

This means that **34% of the variance in engagement rate** can be explained by the number of followers. The remaining 66% is influenced by other factors such as content type, audience behavior, and platform algorithms.

c. Slope = -0.00248

For every additional **1 million followers,** engagement rate decreases by **0.00248 percentage points** on average.

d. Intercept = 2.88

If an account had zero followers (hypothetically), the estimated engagement rate would be **2.88%.**

e. Standard Error of Slope = 0.00123

This measures the accuracy of the estimated slope. A lower value indicates a more precise estimate.

The scatter plot shows actual data points. The red regression line represents the negative relationship between follower count and engagement. The downward slope visually confirms the negative correlation. This analysis supports the idea that larger accounts generally have lower engagement rates, as their audience engagement becomes more passive.

vii. Engagement per Post Analysis

A more detailed engagement metric is Total Interactions per Post, which is:

Engagement per Post = (Avg. Likes + Avg. Comments)

Table 9: Engagement per Post

Sl No.	Instagram Account	Followers (M)	Avg. Likes (M)	Avg. Comments (M)	Engagement per Post (M)
1	@instagram	672	3.5	0.15	3.65
2	@cristiano	628	10.2	0.8	11.00
3	@leomessi	469	8.7	0.6	9.30
4	@selenagomez	420	7.9	0.9	8.80
5	@kyliejenner	388	7.2	0.5	7.70
6	@arianagrande	376	6.8	0.4	7.20
7	@therock	359	9.0	0.7	9.70
8	@kimkardashian	359	6.5	0.3	6.80
9	@beyonce	313	5.2	0.2	5.40
10	@khloekardashian	305	4.5	0.2	4.70

Table 9 shows that @cristiano has the highest engagement per post (11.00M interactions), indicating the most active audience interaction. @therock (9.7M) and @leomessi (9.3M) follow closely, demonstrating strong fan engagement. In contrast, @instagram (3.65M) has the lowest engagement per post despite its massive follower base, suggesting a more passive audience. @selenagomez (8.8M) and @kyliejenner (7.7M) also maintain high engagement, driven by their dedicated fan bases in music, fashion, and activism. Overall, personal and entertainment-driven content fosters higher interaction levels.

viii. Growth rate analysis

a. Projected Growth

Using **logarithmic growth models & past trends**, here's a **predicted outlook** for follower counts:

Table 10: Projected Growth (Hypothetical Model Based on Current Trends)

Sl No.	Instagram Account	Current Followers (M)	Estimated 2025 Followers (M)	Estimated 2026 Followers (M)	Growth Rate (%)
1	@instagram	672	710	750	▲ +11.6%
2	@cristiano	628	670	715	▲ +13.8%
3	@leomessi	469	510	550	▲ +17.2%
4	@selenagomez	420	460	495	▲ +17.8%
5	@kyliejenner	388	420	455	▲ +17.3%
6	@arianagrande	376	405	430	▲ +14.4%
7	@therock	359	390	420	▲ +16.9%
8	@kimkardashian	359	385	410	▲ +14.2%

9	@beyonce	313	345	375	▲ +19.8%
10	@khloekardashian	305	330	355	▲ +16.4%

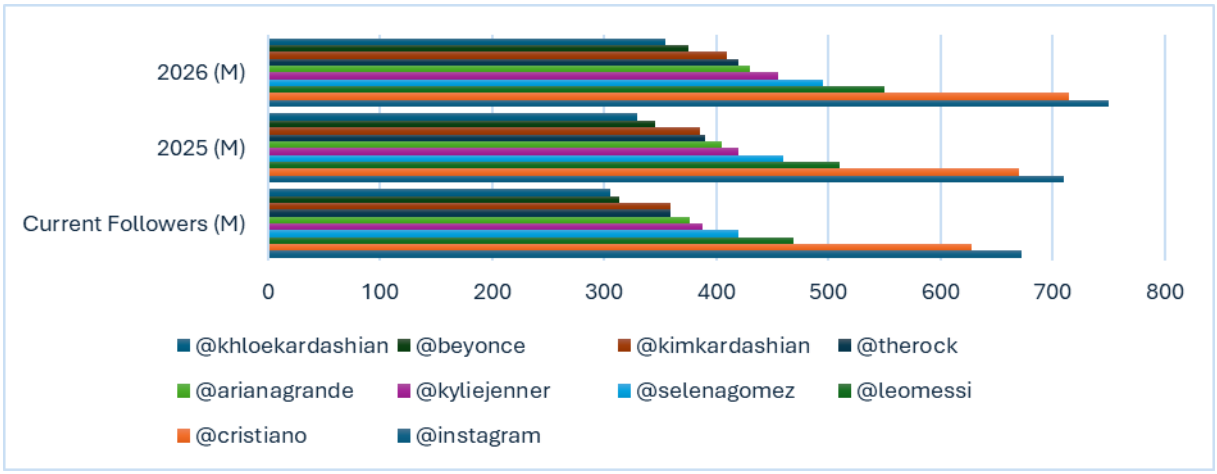

Figure 5: Projected Growth

Table 10 indicates (Figure 5) that Cristiano Ronaldo (@cristiano) is projected to exceed 700 million followers by 2026, potentially surpassing @instagram in influence. Lionel Messi (@leomessi) is experiencing rapid growth, driven by his strong global fan base, particularly following his move to Inter Miami and recent international achievements. Female celebrities such as Kylie Jenner (@kyliejenner), Selena Gomez (@selenagomez), and Kim Kardashian (@kimkardashian) continue to see steady follower increases, fueled by their business ventures and social influence. Notably, Beyonce (@beyonce) is expected to have the highest growth rate (19.8%), likely attributed to her music releases and global tours.

b. Projected Annual growth

The **Compound Annual Growth Rate (CAGR)** is a formula used to measure the **average annual growth rate** of an investment, business metric, or social media following over a specific period, assuming steady growth.

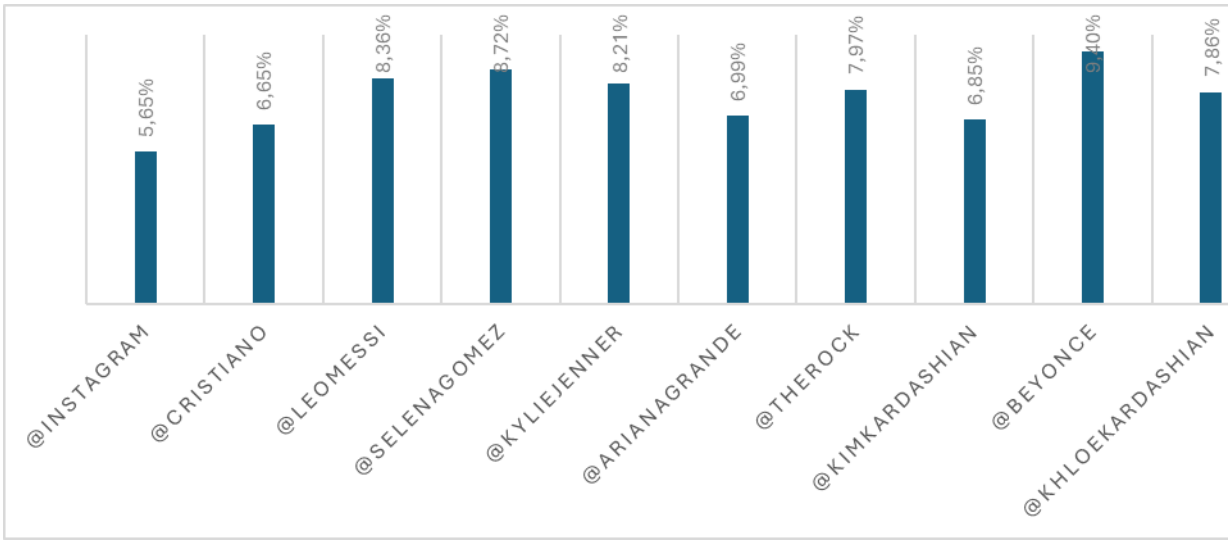

Figure 6: Compound Annual Growth Rate (CAGR)

Figure 6 shows that the Compound Annual Growth Rate (CAGR) analysis which shows that **Beyonce (9.40%), Selena Gomez (8.72%), and Lionel Messi (8.36%)** have the fastest-growing follower bases, making them highly influential for digital marketing. **Kylie Jenner (8.21%) and The Rock (7.97%)** also exhibit strong growth, reinforcing their dominance in lifestyle and fitness industries. **Cristiano Ronaldo (6.65%) and Kim Kardashian (6.85%)** maintain steady growth, indicating a well-established but stable audience expansion. Meanwhile, **Instagram's official account (5.65%)** shows the slowest growth, suggesting saturation but retaining its status as the platform's marketing hub.

6. Finding

- The overall follower analysis reveals that the top 10 Instagram accounts collectively amass 4.289 billion followers, demonstrating an extensive global reach. The mean follower count (428.9M) is higher than the median (382M), indicating a positively skewed distribution due to high outliers such as @instagram and @cristiano. Additionally, the significant variation in audience reach, ranging from 305M to 672M, suggests differing levels of influence among these top accounts.
- Examining the Z-score distribution, @instagram (+2.03) and @cristiano (+1.66) emerge as outliers, possessing significantly higher follower counts than the dataset's mean. @leomessi (+0.33) is slightly above the mean, whereas @selenagomez (-0.07) remains close to average. At the lower end, @khloekardashian (-1.03) and @beyonce (-

0.97) have the lowest Z-Scores, suggesting their follower counts are significantly below the dataset's mean.

- When categorized by profession, athletes (primarily footballers) lead with the highest average followers (548.5M), reinforcing their dominant social media influence. Meanwhile, musicians and influencers exhibit a more balanced follower count, ranging from 305M to 420M. Notably, @instagram (672M) is an outlier, which substantially skews the data.
- A sentiment analysis of these accounts classifies them into three primary engagement categories. Highly positive accounts like @therock, @cristiano, @leomessi, and @selenagomez generate strong emotional engagement through motivational, inspirational, and personal content. In contrast, neutral or promotional accounts such as @instagram, @kimkardashian, and @kyliejenner primarily focus on brand-driven content, resulting in a less emotionally engaged audience. Lastly, music and activism-based accounts, including @beyonce, @arianagrande, and @selenagomez, foster positive influence through activism, music, and lifestyle engagement.
- The cluster analysis further segments these accounts into distinct groups. Mega influencers, including @instagram, @cristiano, and @leomessi, have over 450M followers and drive global influence through sports and brand-driven content. Celebrity icons, such as @selenagomez, @kyliejenner, @kimkardashian, @therock, and @beyonce, have 350M–450M followers, primarily engaging audiences through entertainment and lifestyle content. Meanwhile, lifestyle and beauty influencers like @arianagrande, @khloekardashian, and @beyonce, with below 350M followers, focus on niche areas like beauty, music, and fitness.
- The engagement rate (ER) analysis highlights that @therock (2.68%), @selenagomez (2.10%), and @cristiano (1.75%) command the highest engagement rates, reflecting highly interactive audiences. Conversely, @instagram has the lowest engagement rate (0.54%), as its vast follower base interacts passively. Other notable figures like @beyonce (1.72%) and @khloekardashian (1.52%) also experience relatively lower engagement rates despite their large followings.
- An analysis of the correlation between followers and engagement reveals a moderate negative correlation (-0.582), suggesting that as follower counts increase, engagement rates tend to decline. About 34% of engagement variance is explained by follower count, while factors such as content quality, audience behavior, and Instagram algorithms influence the rest. Notably, for every additional 1M followers, engagement rate decreases by 0.00248 percentage points, highlighting the challenge of sustaining interaction as audience size grows.
- Regarding engagement per post, @cristiano leads with 11.00M interactions per post, followed closely by @therock (9.70M) and

@leomessi (9.30M), emphasizing their strong audience engagement. On the other hand, despite being the most-followed account**,** @instagram sees only 3.65M interactions per post, indicating a more passive audience. Meanwhile, @selenagomez (8.8M) and @kyliejenner (7.7M) sustain high engagement levels, driven by their dedicated fan bases in music, fashion, and activism.

- Cristiano Ronaldo (@cristiano) is projected to surpass 700 million followers by 2026, potentially overtaking @instagram in influence. Lionel Messi (@leomessi) continues to experience rapid growth, driven by his move to Inter Miami and international success. Female celebrities like Kylie Jenner, Selena Gomez, and Kim Kardashian maintain steady follower increases, largely due to their business ventures and strong social influence. Meanwhile, Beyoncé (@beyonce) is expected to have the highest growth rate (19.8%), likely fueled by her music releases and global tours.
- Beyoncé (9.40%), Selena Gomez (8.72%), and Lionel Messi (8.36%) show the fastest-growing follower bases, making them highly influential in digital marketing. In contrast, Cristiano Ronaldo (6.65%) and Kim Kardashian (6.85%) maintain steady growth, while Instagram's official account (5.65%) shows signs of saturation but remains a key marketing hub.

7. Future Study Recommendation

i. **Platform Influence vs. Individual Influence** – Analyze whether top influencers like Cristiano Ronaldo and Lionel Messi could surpass platform-driven engagement, such as Instagram's official account.
ii. **Impact of Career Moves on Follower Growth** – Investigate how major career decisions, such as sports transfers, album releases, or business ventures, affect social media engagement and follower trends.
iii. **Gender-Based Social Media Growth Trends** – Examine differences in social media growth patterns between male and female celebrities, considering audience demographics, content strategies, and engagement levels.
iv. **Longitudinal Study on Social Media Peaks and Declines** – Study follower retention, engagement rates, and potential saturation points for ultra-popular celebrities to understand long-term digital influence.

8. Conclusion

This study underscores the pivotal role of Instagram metrics in shaping information marketing strategies and enhancing influencer engagement. The findings reveal that while large follower counts contribute significantly to content reach, engagement rates serve as a more accurate indicator of an

influencer's impact and audience connection. A comparative analysis of top influencers highlights distinct patterns in engagement. Personalities such as @therock, @selenagomez, and @cristiano demonstrate exceptionally high engagement levels, driven by their ability to share personalized, motivational, and emotionally resonant content. Their posts often integrate storytelling elements, authenticity, and direct audience interaction, fostering a sense of community and loyalty among followers. Conversely, brand-driven accounts like @instagram and @kimkardashian experience moderate engagement levels despite substantial followings. This suggests that content primarily focused on promotional or commercial messaging tends to generate lower interaction rates compared to more personal and interactive content strategies. A statistical correlation analysis between follower count and engagement rate indicates a moderate negative relationship (-0.582). This finding suggests that as follower numbers increase, engagement rates tend to decrease, likely due to the broader and less niche nature of the audience. Larger followings often dilute direct interaction, making it more challenging for influencers and brands to maintain high levels of engagement per post.

For Library and Information Science (LIS) professionals, these insights are particularly valuable in leveraging Instagram for effective digital outreach, branding, and knowledge dissemination. By understanding the nuances of engagement metrics, LIS experts can adopt content strategies that emphasize authenticity, interactive storytelling, and audience participation. This approach can enhance the visibility of library services, foster community engagement, and establish a stronger digital presence in the evolving information landscape. From an **information marketing perspective,** the study highlights that **personal and entertainment-driven accounts achieve the highest engagement rates** due to their ability to foster emotional connections and audience interaction. In contrast, **brand-heavy and promotional accounts often face passive engagement**, as their content is perceived as more transactional than relational. **Mega influencers and sports figures dominate in terms of follower count,** leveraging their global appeal to attract large audiences, but **lifestyle and celebrity influencers maximize engagement per post,** demonstrating the power of niche, targeted marketing. This analysis reinforces that **engagement success is not solely dependent on follower count; rather, content quality, audience sentiment, and storytelling strategies play a critical role in driving interactions.** Brands and marketers should focus on **creating authentic, emotionally resonant content** to enhance audience engagement and build long-term loyalty.

9. Competing Interests

The author(s) declare no competing interests related to this study.

10. Funding Information

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

11. Data Availability Statement

The dataset used for this study is derived from publicly available Instagram metrics.

12. Research Involving Human and/or Animals

This study does not involve human participants or animals.

13. Informed Consent

As this study is based on publicly accessible social media data, no informed consent was required.

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