

# Understanding Time Engagement Dynamics via Virtual Socialization on Instagram

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## Abstract

The emergence of social media in the past decade owing to faster internet and accessibility devices has led to the influx of the modern generation into the web of virtual social presence. The various popular social media include Facebook, Instagram, and Twitter. In this research paper, we have tried to carry out a microscopic study for ascertaining the engagement of today's youth in terms of spending time on different activities on Instagram. A sample survey was performed on 105 samples using random probability sampling which yielded some fruitful results. The age group of 21 to 25 years mainly comprising of postgraduates and graduates are spending more time on sending direct messages rather than viewing direct messages. The results of this research paper can be suitable for social media companies, academicians, and social reformers to utilize them in a more positive and coherent manner.

*Keywords* : Instagram, messages, social medias, stories, youth

## I. INTRODUCTION

**“ We don't have a choice on whether we do social media, the question is how well we do it.” Erik Qualman [50]**

### A. What is Social Media ?

Social media can be thought of as web-based technology that makes it easier for people to connect with one another on a social level. The internet is a commonly used network. Social media platforms, however, are also used by local networks[1,32,33].

There are numerous theories regarding how social media first appeared. "For a large portion of human history, we have created tools that facilitate communication between us." (Carton, 2009) [9].

Telegraph was used for long-distance communication in 1792 [37]. In the late 1800s, social networks were first developed by German sociologist Ferdinand Tonnies and French sociologist Emile Durkheim, who is often

regarded as the father of sociology. According to Tonnies, social groupings can form as a result of members having conflicting values and views or because of common values and beliefs. His philosophy focused on societal notions of the social contract.

Durkheim merged social theory and empirical inquiry [13]. Additionally, both the radio and the telephone [36] were utilized for social engagement in the late 1800s, albeit only one-way with the radio [36]. Tonnies [44] believed that social groups could exist because members shared values and beliefs or because they shared conflict. Over the years, social networks have changed into the contemporary version we know today that utilizes digital media. Social networking isn't particularly new, though. Phreaks were able to finish their work by using conference circuits and test lines from the phone provider. According to Brett Borders [6], hackers were able to access idle voicemail boxes at businesses to host the first blogs and podcasts.

Information Technology in the 1970s and social media underwent additional development. Role-playing games,

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interactive fiction, and online chat were all featured in the real-time virtual environment known as MUD, often referred to as Multiuser Dungeon, Multi-User Dimension, or Multi-User Domain. Since MUD is mostly text-based, users must input commands using everyday language. The same year as MUD, 1978, saw the birth of Bulletin Board System (BBS). Users sign-in to the platform to download and upload software, read news, or message other users. In the beginning, just one user at a time could access a bulletin board using a modem connected to a phone line. Bulletin boards did not initially contain colour or images. The World Wide Web's forebears were bulletin boards. The Usenet, which was created in 1979 and launched in 1980, is comparable to a BBS. Usenet [37] is a platform for publishing news or articles. Usenet differs from a BBS in that messages are delivered to multiple servers via news feeds rather than a central server or dedicated administrator.

General Electric Network for Information Exchange is referred to as Genie [13]. It was viewed as competition for CompuServe because it was an ASCII based internet service. On the time-sharing mainframe computers, General Electric Information Services (GEIS) ran GENie during off-peak times. When GENie first started to expand, GEIS initially declined to do so. The first software programme for electronic email lists was called Listserv, and it was introduced in 1986. Email lists had to be manually managed before it was created.

A single email can be sent using the software to several recipients. Listserv was initially offered as freeware but is now a paid product. There is a free version available for upto 10 lists and 500 subscribers. Group communication [37] is the purpose of IRC, or Internet Relay Chat. Real-time chat, commonly referred to as internet text messaging or synchronous conferencing is a type of it. IRC's primary usage is for group communication, but it also lets users send and receive private messages, chat, and data transfers with one another [37].

Using social networks in the 1990s, a lot of social networking websites were developed. Six Degrees, BlackPlanet, Asian Avenue, and MoveOn are a few examples. The sites for public policy advocacy and social network built on a web of contacts paradigm are, or have been, niche social networking platforms where users can communicate. Additionally, blogging platforms like Blogger and Epinions were developed. Consumers can read or write product reviews on the websites [39].

Software programmes from the 1990s like ThirdVoice and Napster have since been taken off the market. Users could leave comments on websites using the free plug-in ThirdVoice. The software [37] was criticised for the frequent use of obscene or defamatory language in comments. Peer-to-peer file sharing was made possible by Napster, a piece of software. Users were given permission to distribute music files outside of the established channels, which was ultimately ruled to be against copyright rules [37].

The emergence of numerous social networking websites in 2000 greatly increased the popularity of social media. The contact of people and organisations with similar interests in music, education, movies, and friendship was greatly strengthened and revolutionised as a result, thanks to social networking. Wikipedia, Six Degrees, Cyworld, and LunarStorm were among the sites that were launched.

Altogether, the company has about 1000 employees. MySpace users have the option to personalize their profile information to include specific information about who they are and what interests them. Additionally, MySpace [30] includes a specific profile for musicians where they may download all of their tracks in mp3 format.

### **(1) Facebook**

Facebook [7], a private website for social networking, was introduced in February 2004 and is run by Facebook Inc. The site was initially only available to Harvard students when it was established. Facebook was created by Mark Zuckerberg and others while he was a student at Harvard. Later, high school students were given the same privilege, and then everyone aged 13 or older [7]. More than 500 million people were active users of Facebook as of July 2010. The most popular social network globally as of January 2009 was Facebook.

Additionally, Google reported in May 2010 that more individuals accessed Facebook than any other website. It claimed that this was found after research at 1,000 different sites throughout the world [45]. Additionally, Facebook users can join user groups with similar interests that are categorised by places of employment, educational institutions, or other factors. Anyone who is at least 13 years old who wants to use Facebook can register as a user. The number of people using the Facebook network is increasing every day. Additionally, Facebook surpassed

all other social networks in eight distinct Asian markets, that is, the Philippines, Australia, Indonesia, Malaysia, Singapore, New Zealand, Hong Kong, and Vietnam [23].

## **(2) Microsoft**

Microsoft said on October 24, 2007 that it had acquired a 1.6% stake in Facebook for \$ 240 million, giving Facebook an implied total value of \$ 15 billion. The rights to run international advertisements on Facebook were part of Microsoft's purchase, and other businesses have already done the same [41]. For instance, Nike ran a Facebook advertisement during the 2010 FIFA Football World Cup, and within minutes, an average of 8 million people had signed up for Facebook [27].

## **(3) YouTube**

The most well-known online video community in the world is YouTube which was formed in 2005 and allows millions of users to find, watch, and share unique videos [48]. A major distribution network for original content producers and advertisers, both big and small, YouTube offers a platform for individuals to connect, educate, and inspire others around the world.

Using Adobe Flash Video technology, YouTube, which has its headquarters in San Bruno, California, showcases a diverse range of user-generated video content, such as movie, TV, and music videos as well as amateur productions like video blogging and brief original movies. Within a year of its debut in November 2006, YouTube was acquired by Google Inc. in one of the most publicised deals to date. With content producers like CBS, BBC, Universal Music Group, Sony Music Group, Warner Music Group, NBA, The Sundance Channel, and many others, YouTube has entered into a variety of cooperation agreements [48].

## **(4) Social Media vs Social Networks**

According to Nations [51], social media is difficult to describe and allows for two-way communication. Does that imply that social media, like any other social network is a tool for communication? Are there any distinctions between these two ideas? While social networking is a resource and a means of engaging with people, social media may be seen as a strategy and a platform for broadcasting [11, 40].

Additionally, according to Cohen [11] "the distinction is not merely semantics but rather in the features and functions that these website creators built into them, which governs how they are to be utilised." Actually, social networks and social media differ in a number of ways [19]. The first one could be the definition: social media is still a form of media that is primarily used to share information with a large audience, whereas social networking is an act of participation in which individuals with like-minded interests come together and form relationships through a sense of community [9,14].

Another distinction between social media and social networks is the return on investment or ROI. The ROI from social media is tough to quantify. However, the ROI from social networking is somewhat clear [19, 21, 47]. The prompt responses and the "asking or telling" fact are two further differences between social networks and social media.

## **(5) Twitter**

Twitter was founded in 2006, the same year that Facebook started to make its services available to everyone. Twitter [26] gained a lot of popularity for two reasons: first, it provided more possibilities including microblogging, and, second, certain celebrities used it [25, 46]. A number of social media platforms were developed until 2010, including Friend feed, which was acquired by Facebook in 2009 and served as a feed for updates from social media and social networking websites [25]. Ping.fm, which was founded in 2008, bills itself as "the auto magic" microblogging and networking website service that lets users publish to several social networks at once [20,34].

## **(6) Social Media Technology**

Social media uses the "long tail" notion, which refers to dialogues that can be spread over several online venues, to enable topics to reach a wider audience. Meetings, calls, and emails are just a few of the channels of communication that exist in an organisation. These lines of communication have their own drawbacks, such as the potential for message forgetfulness, failure to take notes during meetings, and difficulty in information searching in a sea of emails. The effectiveness of communication channels within the firm has risen thanks to the use of social media websites. Social media serves as a resource

in these circumstances, enabling people to create and share their own ideas. The effectiveness of a team as a whole can be improved through communication and cooperation. If an employee has a strong social profile, the employer must allow him to use its networks. As these social media will permit collaboration without leaders in their respective sectors, this will contribute to professional advances. Additionally, this will assist the staff in keeping abreast of the most recent business advancements and maintaining connections with the most influential figures.

## II. LITERATURE REVIEW AND RELATED WORK

Ilavarasan [22] investigated various different social media platform's business models and operations in India, management of social media strategy within organizations, usage of specific features of platforms. The exploratory research revealed that although research on computer science has been gaining a lot of momentum but needs to be applied in other domains including tackling social media usage related problems such as fake news or scam related domains. Alexandra Olteanu et al. (2016) tried to understand phenomena specific to social software platforms, sometimes with the objective of improving them. She further concluded that with the growing social media usage, research on individuals meant for marketing purposes are revealed for negative purposes, which further initiates the need for auditing social software systems. Azizi, Soroush, and Khatony investigated the relationship between social networking addiction and academic performance of students in Iran [4]. His empirical research indicated that social networking addiction was higher in male students than in female students and also negatively affected their academic performances.

Chen, Fay, and Wang [10] tried to examine the relationships between consumer posting behavior and marketing variables, such as a product price and product quality and also explored how internet and consumer review websites attract more universal acceptance. The research revealed that most of the consumers post online reviews at both higher prices and lower prices. This shows how important the online postings of consumer can be from a marketing point of view. McCord, Rodebaugh, and Levinson [5] studied the usage of social media for security strategies and deployment of such

strategies based on means available. The study emphasized on the need for military ties with academia and industry in buying or supporting them or boycotting these brands or ideas.

Perrin [3] also conducted a demographic pattern research on usage of social media and concluded that in terms of age differences, seniors are more active on social media. Also, the rate of social media usage remains almost same for both the genders. The fact is that people with higher education and higher income are spending more time on the internet, and the trend of social media usage is also spreading to rural areas. Jan, Soomro, and Ahmad found that social media has a very strong impact on self-esteem of individuals [24]. They concluded that although social networking is used for collecting information, communication and maintaining relationships, it has also impacted majority of people in terms of upward or downward comparison with others. Another research on the use of social media based on demographic variables founded that females are more exposed to social media than males. He further added that females tend to communicate or share more personal information, revealing more about their personal lives [2]. They are more vocal, expressive, and more biologically wired for social networking.

Müller and Schwarz [29] also supported the fact that alongside the positive effects of social media, there are many emerging issues such as social media being used as a ground for spread of hateful ideas and may motivate real life action. He further adds that the lines between free speech and hate speech can be blurry and distinction can be a difficult task. Mathewson [28] conducted a correlation study to measure the relationship between social media usage and the mental health of college students at a large, public, professional doctoral institution in the mid-western region of the United States. His study revealed that resources available on campus can supplement social media usage for reducing stress among students by providing opportunities for employment to students while they attend universities. In a descriptive research conducted by Kolan and Dzandza [16] who studied the level of exposure of Ghana university students to social media sites and found that students were able to share lecture notes from friends and teachers using social interaction, but on the other hand there remains dangers of negative utilization.

Fiester [17] tried to explore how millennials perceive interactive movie promotions on social media and online.

The researcher's findings included the fact that social media continues to be an effective tool for advertisers with the use of nature and content including use of color schemes that can attract digital audiences (more suitable on Instagram). The 16–25 year age group of the youth is seen more involved in the usage of social media for purposes such as surfing, chatting, entertainment etc. with an average time spend between 1 to 5 hours which has led to issues of mental fatigue, strain, anxiety, and panic etc. [31]. In [12, 31] the authors examined the positive and negative aspects of usage of social media among youth in Bangalore. She concluded her research by inferring that although social media offers both positive and negative sides, the youth are more likely to pick the negative sides.

In [35] the researchers conducted an exploratory research to identify the differentiation in behavior, principles, and choices of Gen Z with respect to social media usage. The study included a discussion on how Gen Z indulges in buying or supports in buying or supporting brands or boycotting these brands/ideas. The use of word of mouth advertising has become more common than before. Gasser, Cortesi, Malik, and Lee [18] tried to identify the patterns in youth information seeking behavior in social media utilization. He identified how social networking services allow users to connect with other users and make interaction possible within such a network, with possibilities of sharing photos or videos. He also mentioned how self-authored creative content has blossomed in different sites such as YouTube, Flickr and many more.

Carmichael, Archibald, Lund [8] examined the idea of social value in communication networks. He further added that social capital theory provides useful analysis of online social interactions. He also explored how information technology can support the communication structure underpinning social capital as so many research studies have been conducted in this domain. Stone [41] tried to identify potentially distracting nature of social media and the negative effects that can arise from usage. The exploratory research revealed the key factors such as portability, performance, payment, and privacy which must be used in digital marketing by e-retailers. Singh and Guruprasad [38] also emphasized the users on various sites like Facebook and Twitter to analyze the growing issues on youth due to the constant use of Social Network. Corniani [14] mentions that the ease of flow provided by digital technology is also the fundamental

disadvantage of digital communication. Controlling digital flows in all of their effects and interactions is difficult, and this limitation opens the door to rival activities and rumours.

In [43, 37] the researchers conducted an empirical research to identify users' habits to determine the economic, social, and cultural effects of social media. Abrenica [2] revealed that high school students use social media frequently for education and entertainment purposes rather than for the purpose of social interaction. McCord, Rodebaugh, and Levinson [5] examined the relationship between social anxiety, anxiety on Facebook, and social Facebook use. The descriptive research led to the understanding of inconsistent relationships between social anxiety and the time spent on Facebook possibly arising due to varieties in degree of social interactivity. Brooks suggested that little research has looked at the potentially distracting nature of social media and the negative effects that can arise from usage of social media applications [42].

As discussed in the literature survey there was a need to find how different age groups are spending their time on Instagram, one of the most rapidly growing social media tools. We considered the following alternative hypotheses:

- (1) Existence of high dependency between time spent on *sending direct messages on Instagram vs age group of young generation (H1)*.
- (2) Existence of high dependency between average time spent on a *daily basis for viewing direct messages on Instagram and age group of young generation (H2)*.
- (3) Existence of high dependency between *average time spent on a daily basis for viewing posts/stories of others on Instagram and age group of young generation (H3)*.

For such purposes, I conducted a primary survey on 105 samples across varied age groups using random probability sampling within the period of July 29, 2022 to August 18, 2022.

### III. ANALYSIS AND RESULTS

The data collected from samples were put together systematically and descriptive analysis was done using SPSS (Version 12).

The different types of analysis included the following:

### A. Descriptive Measures

#### (1) Age Group of Samples

As seen in Fig. 1, the age group of 21 to 25 years (58.65% of samples) was the major participant among the samples. This shows the enthusiasm among the young generation in the age group of 21 to 25 years for usage of social media.

#### (2) Gender of Samples

As seen in Fig. 2, both genders (male 51.92%, females 48.08%) equally participated in the sample survey. This indicates equal level of interest among both the genders for social media usage.

#### (3) Education Level of Samples

As seen in Fig. 3, majority of the samples (47.12%) were

post graduates followed by undergraduate samples (36.54%).

### B. Cross Tabulation of Ordinal Variables

(1) Cross tabulation of age group of samples and average time spend on daily basis for sending direct messages on Instagram: As seen in Table I, out of 61 samples in the age group of 21 to 25 years, 34 samples spent less than 1 hour on Instagram for sending direct messages to others, while 11 samples spent 1 to 2 hours in the same age group.

(2) Cross tabulation of age group of samples and average time spend on a daily basis for viewing direct messages on Instagram: As seen in Table II, out of 61 samples in the age group of 21 to 25 years, 38 samples spent less than 1 hour on Instagram viewing direct messages, while 14 samples spent 1 to 2 hrs viewing direct messages in the same age group.

(3) Cross tabulation of age group of samples and average

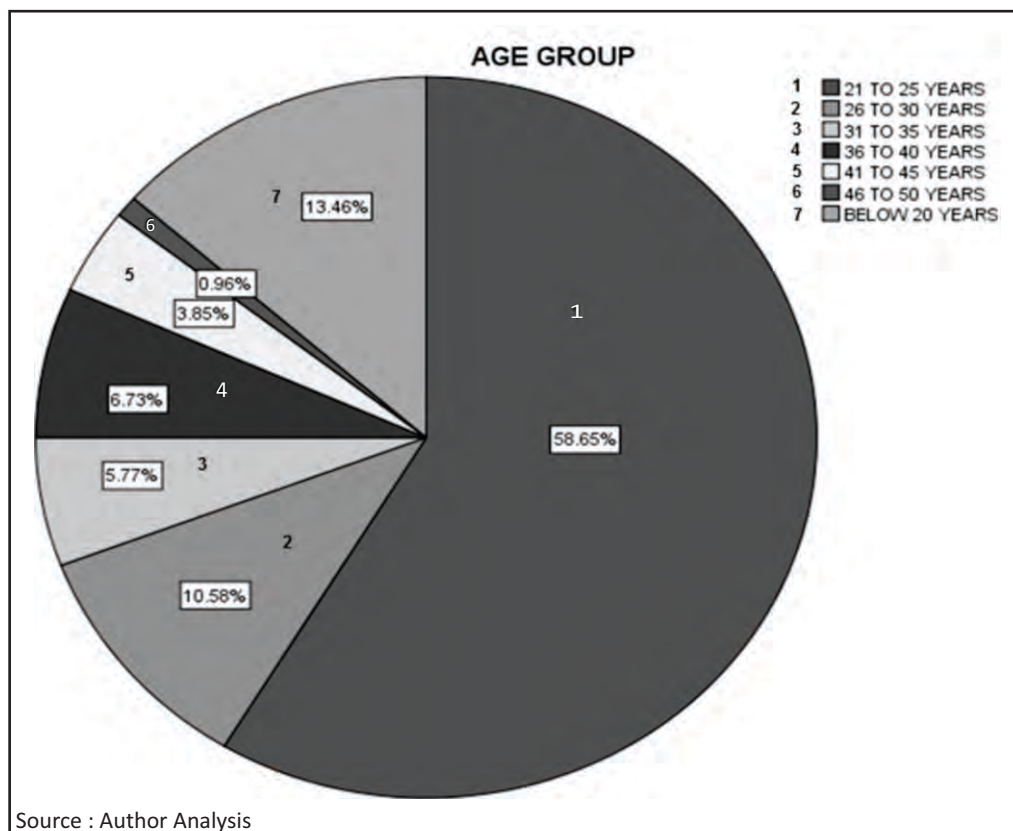


Fig. 1. Age Group of Samples

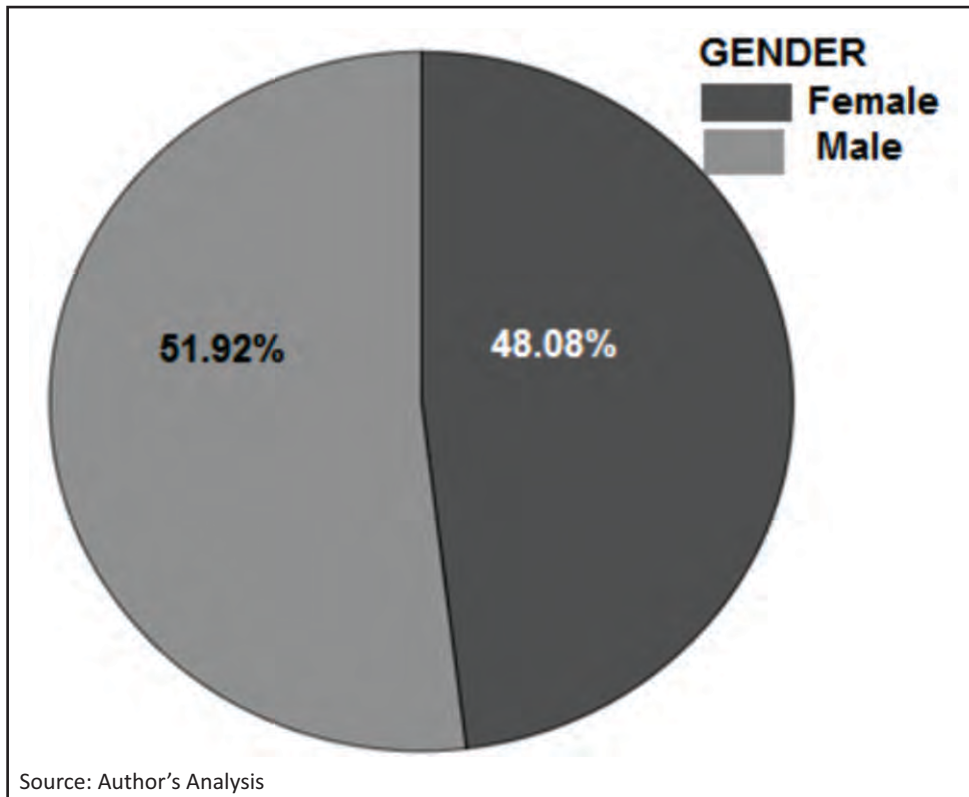


Fig. 2. Gender of Samples

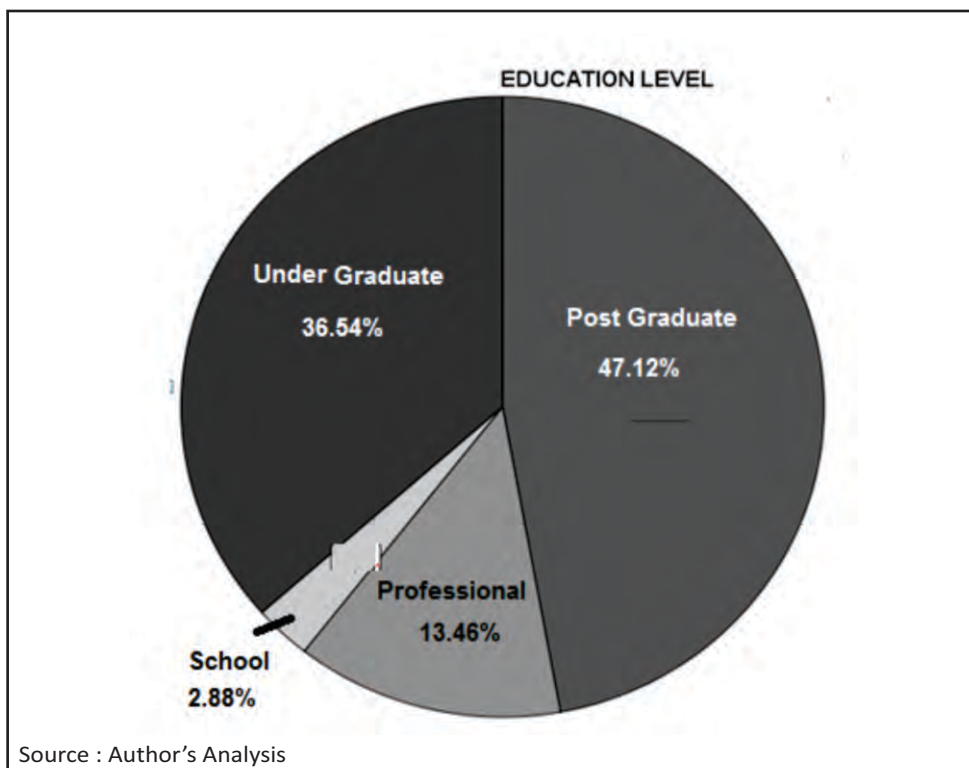


Fig. 3. Education Level of Samples

**TABLE I.**  
**CROSS TABULATION BETWEEN AGE GROUP OF SAMPLES AND SENDING DIRECT MESSAGES ON INSTAGRAM**

		Cross Tabulation					
		Count					
How much time do you spend (on average) on daily basis? [sending direct messages on Instagram]							Total
		1 hr to 2 hrs	2 hrs to 3 hrs	Lessthan 1 hr	More than 3 hrs	Not Applicable	
<b>AGE GROUP</b>	21 TO 25 years	11	6	34	6	4	61
	26 TO 30 years	0	4	6	1	0	11
	31 TO 35 years	0	0	3	0	3	6
	36 TO 40 years	0	0	3	0	4	7
	41 TO 45 years	0	0	1	0	3	4
	46 TO 50 years	0	0	1	0	0	1
	Below 20 years	2	3	7	0	2	14
<b>Total</b>		13	13	55	7	16	104

Source : Author's Analysis

**TABLE II.**  
**CROSS TABULATION BETWEEN AGE GROUP OF SAMPLES AND VIEWING DIRECT MESSAGES ON INSTAGRAM**

		Cross Tabulation					
		Count					
How much time do you spend (on an average) on daily basis? [viewing direct messages on Instagram]							Total
		1 hr to 2 0hrs	2 hrs to 3 hrs	LESS THAN 1 hr	More than 3 hrs	NOT APPLICABLE	
<b>AGE GROUP</b>	21 to 25 years	14	3	38	1	5	61
	26 to 30 years	0	3	7	1	0	11
	31 to 35 years	0	0	4	0	2	6
	36 to 40 years	0	0	3	0	4	7
	41 to 45 years	0	0	1	0	3	4
	46 to 50 years	0	0	1	0	0	1
	below 20 years	3	0	8	1	2	14
<b>Total</b>		17	6	62	3	16	104

*time spend on daily basis for viewing posts/stories of others on Instagram:* As seen in Table III, out of 61 samples in the age group of 21 to 25 years, 25 samples spent less than 1 hour on Instagram viewing posts/stories of others, while 18 samples spent 1 to 2 hours viewing posts/stories of others in the same age group.

### C. Predictabilty Tests

**(1) Sending direct messages on Instagram vs age group:** As seen in Fig. 4, there exists a high predictability between age group of samples and sending direct messages on Instagram.

**(2) Viewing direct messages on Instagram vs age group :** As seen in Fig. 5, there exists a medium predictability between age group of samples and viewing direct messages on Instagram. As seen in Fig. 6, there exists a medium predictability between age group of samples and viewing posts/stories of others on Instagram.

## IV. INFERENCES AND CONCLUSIONS

The sample survey yielded quite significant results.



**TABLE III.**  
**CROSS TABULATION BETWEEN AGE GROUP OF SAMPLES AND VIEWING POSTS/ STORIES OF OTHERS ON INSTAGRAM**

		Cross Tabulation					
		Count					
How much time do you spend (on average) on daily basis? [viewing posts/stories of others on Instagram"]		1 hr to 2 hrs	2 hrs to 3 hrs	Less than 1 hr	More than 3 hrs	Not Applicable	Total
AGE GROUP	21 to 25 years	18	7	25	8	3	61
	26 to 30 years	1	6	2	2	0	11
	31 to 35 years	0	1	4	0	1	6
	36 to 40 years	0	0	3	0	4	7
	41 to 45 years	0	0	1	0	3	4
	46 to 50 years	0	0	1	0	0	1
	Below 20 years	3	1	7	1	2	14
Total		22	15	43	11	13	104

Directional Measures						
			Value	Asymp. Std. Error <sup>a</sup>	Approx. Tb	Approx. Sig.
Ordinal by Ordinal	Somers' d	Symmetric	0.157	0.086	1.808	0.071
AGE GROUP Dependent			0.151	0.083	1.808	0.071
How much time do you spend( on average) on daily basis? [sending direct messages on Instagram] Dependent			0.162	0.089	1.808	0.071
a Not assuming the null hypothesis.						
b Using the asymptotic standard error assuming the null hypothesis.						

Source : Author's Analysis

**Fig. 4. Somer's D measurement of reliability between age group of samples and sending direct messages on Instagram**

Directional Measures						
			Value	Asymp. Std. Errora	Approx. Tb	Approx. Sig.
Ordinal by Ordinal	Somers' d	Symmetric	0.242	0.083	2.828	0.005
AGE GROUP Dependent			0.247	0.085	2.828	0.005
How much time do you spend( on average) on daily basis? [viewing direct messages on Instagram ] Dependent			0.236	0.083	2.828	0.005
a Not assuming the null hypothesis.						
b Using the asymptotic standard error assuming the null hypothesis.						

Source : Author's Analysis

Fig. 5. Somer's D measurement of reliability between age group of samples and viewing direct messages on Instagram

Directional Measures						
			Value	Asymp. Std. Errora	Approx. Tb	Approx. Sig.
Ordinal by Ordinal	Somers' d	Symmetric	0.206	0.079	2.548	0.011
AGE GROUP Dependent			0.19	0.074	2.548	0.011
How much time do you spend( on average) on daily basis? [viewing posts/stories of others on Instagram"] Dependent			0.226	0.087	2.548	0.011
a Not assuming the null hypothesis.						
b Using the asymptotic standard error assuming the null hypothesis.						

Source : Author's Analysis

Fig. 6. Somer's D measurement of reliability between age group of samples and viewing posts/stories of others on Instagram

The observations were:

(1) The age group of 21 to 25 years (58.65% of samples) were the major participants among the samples. This shows the enthusiasm among the young generation in the age group of 21 to 25 years for usage of social media.

(2) Both genders (male 51.92%, females 48.08%) equally participated in the sample survey. This indicates equal level of interest among both the genders for social media usage.

(3) Majority of the samples (47.12%) were post graduates followed by undergraduate samples (36.54%).

(4) Out of 61 samples in the age group of 21 to 25 years, 34 samples spent less than 1 hour on Instagram for sending direct messages to others, while 11 samples spent 1 to 2 hours in the same age group.

(5) Out of 61 samples in the age group of 21 to 25 years, 38 samples spent less than 1 hour on Instagram viewing direct messages, while 14 samples spent 1 to 2 hours viewing direct messages in the same age group.

(6) Out of 61 samples in the age group of 21 to 25 years, 25 samples spent less than 1 hour on Instagram viewing posts/stories of others, while 18 samples spent 1 to 2 hours viewing posts/stories of others in the same age group.

(7) There exists a high predictability between age group of samples and sending direct messages on Instagram.

(8) There exists a medium predictability between age group of samples and viewing direct messages on Instagram.

(9) There exists medium predictability between age group of samples and viewing posts/stories of others on Instagram.

The attractiveness of social media usage was highly and similarly visible across both genders between

the age group of 21 to 25 years who were mostly postgraduates or graduates spending 1 to 2 hours of time on social media. Among the significant activities on Instagram, the same age group (21 to 25 years of age), 55% were spending less than one hour for sending direct messages while another 18% of the same group spent one to two hours on internet. A higher percentage of samples (61%) were involved in viewing direct messages for less than one hour while another 22% spent a higher amount of time between 1 to 2 hours viewing direct messages. 40% of samples in the same age group were spending less than 1 hour to view posts/stories and another 29% approximately were spending between 1 to 2 hours on viewing posts or stories of others. The predictability criterion using Sommer's D revealed higher predictability when age groups of samples were considered for predicting sending messages on Instagram while medium predictability was gathered for viewing direct messages on Instagram and viewing posts/stories of others on Instagram.

Therefore, it can be concluded from the inferences drawn from sample survey of users of Instagram that today's youth are actively participating in Instagram activities and are preferring Instagram as a means of communication that includes sending direct messages, viewing direct messages, and viewing posts or stories of others. The results of this analysis thus proves that H1 is highly apparent while H2 is moderately possible and H3 to some extent can be possible.

## **AUTHOR'S CONTRIBUTION**

Sandeep Bhattacharjee performed the entirety of the work described in this paper. He prepared the training and test datasets, ran various models against the data, and analyzed the output.

## **CONFLICT OF INTEREST**

The author certifies that he has no affiliation with or involvement in any organization or entity with any financial interest or non-financial interest in the subject matter or materials discussed in the transcript.

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