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12-10-2023

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## Recommended Citation

Grover, Purva; Kar, Arpan Kumar; and Singh, Nimisha, "Developing Public Participation Models for the Communication of Sustainable Development Goals on Social Media" (2023). *Proceedings of the 2023 Pre-ICIS SIGDSA Symposium*. 2.
https://aisel.aisnet.org/sigdsa2023/2

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# Developing Public Participation Models for the Communication of Sustainable Development Goals on Social Media

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## Abstract

It is anticipated based on literature, that there is a need for communication of Sustainable Development Goals (SDGs) among citizens for achieving the goals universally. The use of social media platforms can positively help in achieving sustainable society through collective, coordinated and collaborative effort of citizens. This study tries to assess social media as a means of influencing citizens with issues related to SDGs. For this, sustainability related social media content posted by head of the countries on Twitter were analysed. In the analyses we had tried to capture how citizens are responding to these posts with the help of likes (signal of retaining the information) and retweets (signal of advocacy of information). Social cognitive theory has been used as the theoretical lens. The study provides inputs for developing a public participation model for different SDGs on social media platforms. The purpose of this work is to assist United Nations, governments and other organisations for increasing collective actions among citizens and also to cope up with the challenge of communicating SDGs to citizens. Findings provide directions towards the planning and dissemination of communication of SDGs.

## Keywords

Sustainable development goals; Public participation models; Information propagation; Social media; Big data analytics.

## Introduction

After the industrial revolutions, more focus had been towards socio-economic development rather than on environmental sustainability which was less sustainable in the long run. Therefore in 2015, United Nations (UN) suggested 17 Sustainable Development Goals (SDGs) for the world to be achieved by 2030 (United Nations, 2018). This was a step to enhance the coverage of the Millennium Development Goals (MDGs) in 2012 (Griggs et al., 2013). Sustainable development aims at meeting the needs for present generation along with securing earth's life support system for future generations as well (Griggs et al., 2013). Literature indicates that there is a need for institutions to develop responsible leaders, professionals and citizens for recognising sustainability dimensions and integrating it across all operations (Griggs et al., 2013).

Sustainability should be embedded within individuals through collective human actions and engagement in a social context to make related initiatives successful and accepted among stakeholders (Hilty and Ruddy, 2010). Social media platforms have the potential of supporting community-driven collective actions and engagement on sustainability goals (Tim et al., 2018) and transforming social attitudes towards sustainability (Bertot et al., 2010). However, adoption of the communications requires the support of multiple stakeholders like governments, organizations, citizens and leadership, who need to work together to realise this grand goal by 2030. Studies have established that for societal goals involving multiple

stakeholders like SDGs, the role of influencers in engaging with followers over social media platforms have higher impact on diffusion of information (Grover et al., 2019).

The study proposes a model for social media communication which has been developed by extending the social cognitive theory as the theoretical lens (Bandura, 1986). According to social cognitive theory people learn through observation of model influencers and their motivation. Model influencers can induce new behaviour among citizens, which they may perceive as positive or negative depending on their opinions. People are more likely to follow influencers they can identify well with and therefore national leaders can become influencers for their citizens for adopting social goals like SDGs.

The current study also theoretically extends the public participation model suggested by Waddell (1995), for regional deliberations on environmental sustainability, to social media discussions. Public participation models suggested by Waddell (Waddell, 1995) had four types of models: (a) technocratic model; (b) one way Jeffersonian; (c) interactive Jeffersonian; and (d) social constructionist.

Social influence has the potential of transforming attitude of the people within a society (Zhang et al., 2017). Therefore, this study tries to propose the public participation model on the social media platform for transforming the attitudes of the people towards SDGs by analysing citizen's reactions on SDGs posts which are communicated by national leaders on social media. The article tries to explore the following research questions (RQ):

RQ1. How do the social media posts on different SDGs compare on reception and advocacy among citizens?

RQ2. How should different SDGs be promoted differently on social media platforms?

The social media posts of national leaders were used for RQ1 and RQ2 exploration, because huge numbers of the stakeholders follow them on social media and there is a high probability that citizens will respond to their posts, therefore the impact of SDGs on large population can be analysed and documented. For these purposes, the tweets posted by national leaders on Twitter were extracted and analysed using natural language processing and text mining (Kar et al., 2023). The conceptual model of public participation is proposed based on statistical differences observed between the social media posts and their reception among followers.

## Background Literature

This section elaborates the need to focus on SDGs and the role of social media platforms to influence the adoption of such communication.

### *Societal Challenge – Communicating about SDGs*

"Grand societal challenge" has been defined as the "critical barrier" in sustainability literature, which if removed can solve important societal problem across the global (George et al., 2016). Sustainable Development Goals (SDG) are the most universal and widely adopted "grand societal challenge" (George et al., 2016) applicable to the larger world and includes wider range of issues which developed economies also need to focus on (Campbell, 2017). Solving "grand societal challenge" involves behavioural changes both at individual and society level (Bertot et al., 2010; George et al., 2016). One possible way for achieving these goals is through collective action of humans towards sustainability (Tim et al., 2018) which can be taught through communication (George et al., 2016). There is the need for the communication: (a) for spreading improved practices in agriculture (Pretty, 1995) and living standards (Casini et al., 2014); (b) for creating awareness related to sanitation (Cheng et al., 2018), climate change (Sampei and Aoyagi-Usui, 2009) and conservation of resources (Neumann et al., 2017); and (c) for empowering women (Dhar, 2018) and assisting human development in weaker section of the society (Bridgewater et al., 2015). Table 1 presents SDGs along with their need for communication as indicated in literature.

| **SDGs** | **Need / Urgency** | **Literature Evidence** |
|---|---|---|
| Zero hunger | Promotion of sustainable agriculture. | (Pretty, 1995) |
| Good health | To direct towards healthier lifestyles, diet and health. | (Casini et al., 2014) |

| | | |
|---|---|---|
| Gender equality | Economic empowerment of the women. | (Dhar, 2018; Stone and Can, 2021) |
| Sanitation | To improve sanitary awareness and the acceptance of toilets. | (Cheng et al., 2018) |
| Energy | Communicating uniform definition cross public for facilitating monitoring and auditing purposes. | (Thiffault et al., 2015) |
| Industry | Foster innovation through co-creation activities | (Romero and Molina, 2011) |
| Sustainable cities | Safe world through citizen engagement. | (Tim et al., 2017) |
| Climate action | Awareness regarding climate change and its impacts. | (Sampei and Aoyagi-Usui, 2009) |
| Life below water | Lack of fishery and marine regulations awareness. | (Islam et al., 2017). |
| | Protection, management, and conservation of coastal ecosystems and resources. | (Neumann et al., 2017) |
| Life on land | For assisting human development through public awareness. | (Bridgewater et al., 2015) |

**Table 1. Overview of literature for the need of communication on SDGs**

### *Social Media and Influence*

Social media is a powerful platform for sharing, disseminating, engaging, advertising and endorsing information (Bracciale et al., 2021; Häussler, 2021; Pires et al., 2021). Over time, social media influence has evolved as an integral part of information systems literature to understand how different stakeholder interact with socio-technical platforms like social media (Grover et al., 2022). Social media supports two forms of influence (Cvijikj and Michahelles, 2013), firstly, traditional influence, which refers to the communication driven by the institutions (i.e., UN, governments and other organisations). Second type of influence occurs when users communicate with other users and spread the information (Winter et al., 2021). This type of influence had been termed as social influence. Information and engagement are the two major factors of social influence (Li et al., 2013). Actors (influencers) express their opinions and feelings (either positive or negative) while tweeting (Lahuerta-Otero and Cordero-Gutiérrez, 2016; Winter et al., 2021) and are likely to have very high impact and influence on followers closest to them and can impact their actions (Lahuerta-Otero and Cordero-Gutiérrez, 2016). This influence depends on network structure and can be measured by counting likes, retweets and shares (Perdana and Pinandito, 2018).

Therefore, this study tries to explore whether social media can facilitate sustainability communication among public. On the basis of public responses across SDGs posts, a public participation model for each of the SDG on social media platforms is proposed (Waddell, 1995).

## Theory Development

The communication technologies have the potential of seeding collective commitment among people towards sustainability (Tim et al., 2018) which can lead to social change in attitudes of an individual and society (Bertot et al., 2010). Using social cognitive theory (Bandura, 1986) as the theoretical lens hypotheses of the study are framed to measure the impact of the SDGs related tweets posted by national leaders on users leaning towards sustainability. To address the research question, three factors have been visualized using social cognitive theory: (a) Frequency of SDGs posts by national leaders; (b) liking of those posts among citizens (retaining); and (c) sharing of those post among citizens (advocacy).

Social media may not be an appropriate tool for prioritizing a particular SDG, but the inclination and intent surrounding the promotion of the SDG may be captured. First hypothesis, H1 tries to test whether national leaders are tweeting equally on different SDGs.

H1: There may be a difference in the promotion intent (number of the posts posted) by national leaders on

different SDGs.

H2 attempts to explore how does retaining of the information surrounding SDGs differ across different stakeholders who follow these leaders. This will enable us to study the process of learning about SDGs based on influence which can be induced by social media platforms. Social cognitive theory talks about two types of learners (Bandura, 1986). First type of learners are enactive learners, who learn through their actions. Other type of learners are vicarious learners, who learn by observing others. Therefore, this study focuses on vicarious learners who will learn sustainability through posts on social media platforms. Therefore, hypothesis (H2) tries to investigate whether there is difference in the citizens' intent to support and bookmark the content related to different SDGs by examining the like counts of the citizens on national leaders SDGs posts.

H2: There may be a difference in retaining of information on different SDGs among citizens

Retaining of information is being captured through likes on social media platforms like Twitter.

The third exploration is about active advocacy surrounding SDGs among stakeholders which happens a step above passive support. H3 attempt to explore how does advocacy of these information surrounding SDGs differ across different stakeholders who follow these national leaders. Once the citizen is convinced with the behaviour promoted by the national leaders, the third process of observational learning converting the memory into action is initiated. Although, actions of the citizens cannot be accounted through Twitter, literature indicates once the citizen will be convinced, they will try to reproduce the content for the social behaviour (Bandura, 1986). The reproduction of the content by citizens can be accounted on Twitter through retweet count which is an active advocacy of the information (Mahdikhani, 2022). Therefore hypothesis (H3) tries to investigate whether there is difference in citizens reproduction of the content related to different SDGs. This can be accounted by examining the retweet counts of the citizens on national leaders SDGs tweets.

H3: There may be a difference in the advocacy of posts on different SDGs among citizens

Finally, on the basis of hypothesis H1, H2 and H3, the study attempts to propose a model based on activity of firm generated content and its reception of the activity among stakeholders. The last process of observational learning is the reinforcement of the imitated behaviour. But this cannot be accounted within Twitter ecosystem. Learning when induced among citizens has the potential of building desirable behaviour. Bandura (1986) pointed out learning occurs in a social context with a dynamic and reciprocal interaction of the person, environment and behaviour (Bandura, 1986). Given such a context, for the second research question, we would attempt to map the appropriate public participation model with the SDGs. This would helps us in recognizing the SDGs in which social influence can be used for promoting the sustainability at individuals and society level.

## Research Design

This section consists of four subsections, data collection, preliminary data analysis, robustness checks and model validation following the editorial guidelines of Kar and Dwivedi (2020) and Kar et al. (2023). Twitter data was used for the study for the following reasons. Firstly, 200 million users are active on Twitter (Omnicore, 2021). Secondly, Twitter has evolved over the time as an information sharing platform (Hughes and Palen, 2009). Thirdly, Twitter has been used by users for raising and responding to public concerns (Chew and Eysenbach, 2010), and in this context surrounding SDGs.

### *Data Collection*

The list of national leaders of 195 countries was taken from UN, Protocol and liaison service website. The list contains the names of head of the state, head of the government and minister of foreign affairs. In total there were around 522 national leaders in the list. The national leaders identified from the UN list were individually searched on Twitter. Among 522 national leaders only 115 leaders were present on Twitter. Among these 115 leaders, only 74 national leaders had tweeted over half the Tweets in English, which were used for the analysis.

For these 74 national leaders, tweets were extracted using Twitter REST API. For this Twitter had imposed the restriction of collecting only 3200 latest tweets from each Twitter handle only. Therefore, for these 74 national leaders approximately 3200 latest tweets posted by them were extracted. In total 168,010 tweets were extracted for the study and analysed. Each post extracted contains five attributes date of posting, identification number, content, retweet frequency and like frequency of the tweet.

### *Data Analysis*

The first step in the data analysis is to identify the SDGs related post posted by national readers. For this step, automated content analysis used by Grover, Kar and Ilavarasan (2019) was used for identifying SDGs related posts posted by national leaders. Automated content analysis automatically tracks linguistic patterns in the text. Grimmer and Stewart (2013) had outlined the dictionary method for classifying the text into categories. On the basis of the keywords appearing in the text, dictionary method classified posts into different SDGs.

The rule of categorization, codebook for classifying the national leader's posts into different SDGs had also been adopted from Grover, Kar and Ilavarasan (2019), article appendix A. While preparing the codebook 169 indicators proposed by United Nations and expert opinions were also taken. An automated analysis program searches codebook keywords for each SDGs in the all the posts posted by national leaders.

### *Reliability and validity*

Inter-coder reliability for the development and mapping of the code-book was conducted. Two independent researchers first independently evaluated the keywords which was followed by consensus based approach for dissimilarities which may have evolved (Kar and Dwivedi, 2020; Kar et al, 2023). On the basis of this automated analysis, the tweets were classified as SDGs and non-SDGs tweets for each national leader. For testing hypothesis H1, H2 and H3, SDGs related posts were used. Further these SDGs tweets were classified into 17 groups of the SDGs, on the basis of the keyword in the tweet for each national leader. If the tweet contains the keywords associated with two different SDGs, then that tweet had been considered in both SDGs.

### *Hypotheses Validation*

The model was developed by testing the three hypotheses. For testing the hypothesis H1, 17 variables were computed. These 17 variables capture the tweeting frequency of each political leader towards each SDG. For testing of the hypothesis H2, 17 variables were computed. These 17 variables capture the likes per SDG per tweet posted by political leader for each SDG. For testing of the hypothesis H3, 17 variables were computed. These 17 variables capture the retweet per SDG per tweet posted by political leader for each SDG. For testing normality, Kolmogorov-Smirnov was applied. The p-value, $p<.0001$, indicates that the data are not normally distributed. For testing homogeneity, Levene statistic was adopted. The p value, $p<0.001$ which is less than recommended value of 0.05 (and above) indicates that the variance is not equal across groups. For testing hypothesis H1, H2 and H3 Kruskal Wallis test was applied because computed variables did not satisfy the normality and homogeneity test.

## Findings

The findings and the descriptive statistics are presented in this section to present the overview of data, nature of data and their distribution.

Figure 1(a) depicts that among 74 national leaders; 58 national leaders had posted more than 1000 tweets. Figure 1(b) depicts that national leaders had posted less than 400 tweets related to SDGs. Hypothesis, H1 tries to investigate whether national leaders are posting equally on SDGs or there is difference in number of posts related to different SDGs.

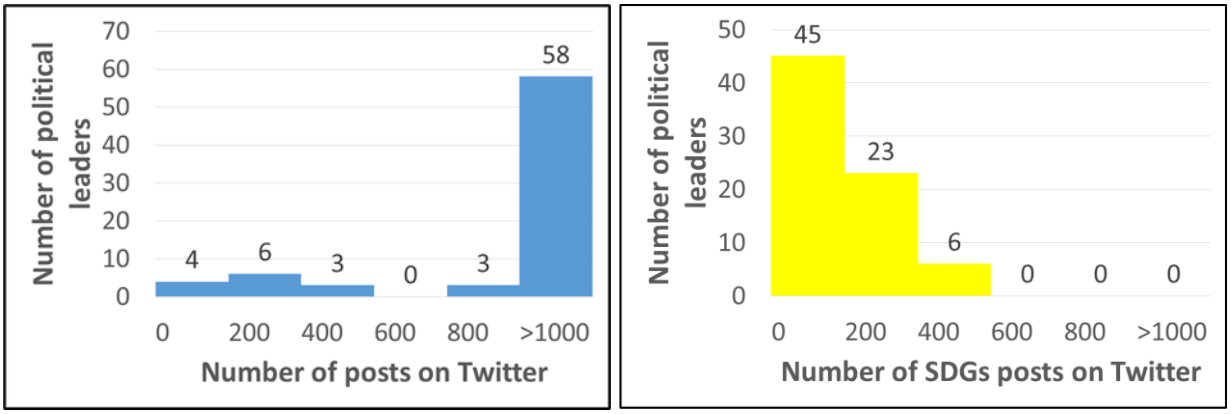


**Figure 1. (a) Tweets posted by national leaders; (b) SDGs related tweets posted by national leaders**

Table 2 depicts that national leaders had been liked less than 200 times on different SDGs. There are some SDGs which had been highly considered by citizens in remembering and retaining information such as PEAC and REDU. Tweets related to PEAC posted by 12 national leaders had been liked more than 1000 users on Twitter; followed by tweets related to REDU posted by 8 national leaders had been liked more than 1000 users on Twitter.

| **SDG** | **Likes per SDG Tweet shared by national leaders** | | | | | |
|---|---|---|---|---|---|---|
| | 0-199 | 200-399 | 400-599 | 600-799 | 800-999 | 1000 and more |
| NOPO- No poverty | 69 | 3 | 0 | 1 | 0 | 1 |
| ZERO- Zero hunger | 72 | 2 | 0 | 0 | 0 | 0 |
| GOOD- Good health & well being | 66 | 2 | 1 | 2 | 0 | 3 |
| QUAL- Quality education | 62 | 4 | 1 | 2 | 1 | 4 |
| GEND- Gender equality | 67 | 2 | 3 | 1 | 0 | 1 |
| CLEA- Clean water and sanitation | 73 | 1 | 0 | 0 | 0 | 0 |
| AFFO- Affordable, clean energy | 70 | 1 | 1 | 0 | 0 | 2 |
| DECE- Decent work | 68 | 3 | 1 | 0 | 0 | 2 |
| INDU- Industry, innovation, infrastructure | 64 | 6 | 1 | 1 | 0 | 2 |
| REDU- reduced inequalities | 53 | 8 | 4 | 1 | 0 | 8 |
| SUST- Sustainable cities | 74 | 0 | 0 | 0 | 0 | 0 |
| RESP- Responsible consumption | 71 | 0 | 1 | 0 | 1 | 1 |
| CLIM- Climate action | 69 | 0 | 2 | 1 | 0 | 2 |
| LIFW- Life below water | 74 | 0 | 0 | 0 | 0 | 0 |
| LIFL- Life on land | 73 | 0 | 0 | 0 | 0 | 1 |
| PEAC- Peace, justice and strong institutions- | 54 | 4 | 3 | 1 | 0 | 12 |
| PART- Partnership for goals | 74 | 0 | 0 | 0 | 0 | 0 |
| Grand total | 1153 | 36 | 18 | 10 | 2 | 19 |

**Table 2: Likes per SDG Tweet shared by national leaders**

Thus figure 2 depicts there is a difference in liking of national leaders' tweets on different SDGs. Therefore, to statistically test the same, hypothesis H2 had been proposed and tested.

Table 3, depicts the SDGs tweets posted by national leaders on Twitter is reproduced (shared) less than 200 times mostly, irrespective of different SDGs. The data depicts sharing of posts on different SDGs varies which is tested through H3.

| **SDG** | **Retweets per SDG Tweet shared by national leaders** | | | | | |
|---|---|---|---|---|---|---|
| | 0-199 | 200-399 | 400-599 | 600-799 | 800-999 | 1000 and more |
| NOPO- No poverty | 70 | 2 | 1 | 1 | 0 | 0 |
| ZERO- Zero hunger | 74 | 0 | 0 | 0 | 0 | 0 |
| GOOD- Good health & well being | 67 | 3 | 1 | 0 | 0 | 3 |
| QUAL- Quality education | 67 | 3 | 0 | 1 | 0 | 3 |
| GEND- Gender equality | 69 | 2 | 2 | 0 | 0 | 1 |
| CLEA- Clean water and sanitation | 72 | 0 | 0 | 0 | 1 | 1 |
| AFFO- Affordable, clean energy | 72 | 1 | 0 | 0 | 0 | 1 |
| DECE- Decent work | 70 | 2 | 0 | 0 | 0 | 2 |
| INDU- Industry, innovation, infrastructure | 70 | 2 | 0 | 0 | 0 | 2 |
| REDU- reduced inequalities | 58 | 4 | 3 | 3 | 2 | 4 |
| SUST- Sustainable cities | 74 | 0 | 0 | 0 | 0 | 0 |
| RESP- Responsible consumption | 70 | 3 | 0 | 0 | 0 | 1 |
| CLIM- Climate action | 70 | 2 | 1 | 0 | 0 | 1 |
| LIFW- Life below water | 74 | 0 | 0 | 0 | 0 | 0 |
| LIFL- Life on land | 71 | 2 | 0 | 0 | 0 | 1 |
| PEAC- Peace, justice and strong institutions- | 51 | 7 | 4 | 4 | 1 | 7 |
| PART- Partnership for goals | 74 | 0 | 0 | 0 | 0 | 0 |
| Grand total | 1173 | 33 | 12 | 9 | 4 | 27 |

**Table 3: Retweets per SDG tweet posted by national leaders**

A Kruskal-Wallis H test was conducted to test the hypotheses. The results indicate that there is a statistically significant difference in number of the posts posted by leaders on different SDGs, $\chi2(16) = 529.880$, $p<0.001$, liking (retaining) of leaders posts by citizens on different SDGs, $\chi2(16) =477.549$, $p<0.001$, sharing of politicians tweets across different SDGs, $\chi2(16) =483.194$, $p<0.001$. Descriptive statistics about communication on SDGs is depicted in Table 4.

| **Sustainable Development Goals (SDGs)** | **Statistical analysis about SDG communication** | | |
|---|---|---|---|
| | Posts by leaders $\chi2(16) = 529.880$, $p<0.001$ | Likes for posts by leaders $\chi2(16) = 477.549$, $p<0.001$ | Sharing of leaders. Tweets $\chi2(16) =483.194$, $p<0.001$ |

| | | | |
|---|---|---|---|
| NOPO- No poverty | 534.57 | 561.43 | 553.03 |
| ZERO- Zero hunger | 525.41 | 507.09 | 526.58 |
| GOOD- Good health & well being | 710.41 | 719.15 | 710.16 |
| QUAL- Quality education | 848.28 | 833.66 | 829.34 |
| GEND- Gender equality | 634.42 | 612.05 | 635.23 |
| CLEA- Clean water and sanitation | 508.09 | 505.8 | 513.22 |
| AFFO- Affordable, clean energy | 483.95 | 498.38 | 497.36 |
| DECE- Decent work | 635.81 | 645.89 | 631.94 |
| INDU- Industry, innovation, infrastructure | 755.45 | 732.49 | 745.39 |
| REDU- reduced inequalities | 1184.04 | 1127.14 | 1144.78 |
| SUST- Sustainable cities | 400.91 | 439.64 | 408.16 |
| RESP- Responsible consumption | 617.27 | 601.59 | 603.55 |
| CLIM- Climate action | 504.62 | 525.05 | 527.36 |
| LIFW- Life below water | 457.99 | 472.79 | 460.9 |
| LIFL- Life on land | 491.36 | 507.89 | 500.26 |
| PEAC- Peace, justice and strong institutions- | 1004.51 | 970.03 | 1002.79 |
| PART- Partnership for goals | 404.42 | 441.43 | 411.45 |

**Table 4: Descriptive statistics about communication on SDGs**

## Discussion

There is a need for a plan for sustainability related communication among the citizens to enhance awareness surrounding such initiatives. Social media can be used for facilitating civic participation among citizens (Tim et al., 2017). Therefore, there is need for developing public participation models for virtual ecosystems such as Twitter. This study tries to address this need by developing public participation model for SDGs based on public participation model proposed by Waddell (1995) and the way information is perceived, retained and reproduced by humans, visualized through social cognitive theory.

On the basis of the empirical validation undertaken in the study, H1 indicates there was a statistically significant difference in number of the posts posted by national leaders on different SDGs. This signifies national leaders consider citizen support and participation for some SDGs and for some SDGs not to use social media for communication purposes. Likewise, H2 also indicates that the likeability of the tweets also differs among citizens in general and citizens in particular based on the SDG that has been discussed. H3 indicates that there is a difference of active support among citizens towards advocating information which would be relevant for specific types of SDGs.

The findings of RQ1 as well as the descriptive statistics on the social media behaviour are evaluated in the light of extant literature for providing insights for the second research question. The brief overview of public participation model for regional deliberations on environment sustainability by Waddell (1995) is presented in table 5. The first model suggested by Waddell (1995) was technocratic model. Technocratic model assumes that (a) some of the technical decisions should be taken by the experts in the field of science, engineering, industry and government; and (b) there is no role for public participation in decision making.

These types of the decisions contain high risk of rejection form public. Waddell (1995) points out public have a right to participate in decisions that affect their well-being. Therefore, the second model for public participation, one-way Jeffersonian model had been suggested in this context. In this model the citizens will be educated related to policy decisions leading to empowering of the citizens. The third model for public participation, interactive Jeffersonian, suggests two-way communication among the experts and public. In this model technical experts communicate their expertise to the public, and in turn public communicate its values, beliefs and emotions to technical experts. The fourth public participation model suggested by Waddell (1995) was social constructionist model which expands upon interactive Jeffersonian. Both experts and public communicate, appeal and engage for taking public policy decisions. This model can be used when there is a need for adjusting ideas to people and people to ideas. Using this model public policy decisions can be socially constructed. This model has the potential of facilitating open and democratic communication within governance.

| **Public Participation Model** | **Overview** |
|---|---|
| Technocratic model | ○ Policy related decisions taken by experts.<br>○ No communication to public about decision.<br>○ High risk of public rejection related to policy related decision. |
| One way Jeffersonian | ○ Educating public about the policies<br>○ Empowering citizens by creating awareness related to policies |
| Interactive Jeffersonian | ○ Two ways communication in public policy decisions<br>○ Public adjusts to expert insights and knowledge; and experts adjusts to public sentiment. |
| Social constructionist | ○ All participants (i.e. experts and non-experts, public) communicate, appeal and engage for taking public policy decisions.<br>○ Adjusting ideas to people and people to ideas. |

**Table 5: Brief overview on public participation model given by Waddell (1995)**

On the basis of the public participation models suggested by Waddell (1995) for regional deliberations surrounding environmental sustainable development, the study proposes public participation model for creating awareness and promoting SDGs on Twitter. Literature highlights collaborative participation in the digital era can solve complex, contentious problems through authentic dialogues, networks and institutional capacity (Innes and Booher, 2004). Maturity of public participation models in social media were also proposed based on initial conditions, data transparency, open participation, open collaboration and ubiquitous engagement (Lee and Kwak, 2012).

The proposed model for public participation on social media is presented in Table 6. To identify the SDGs for which national leaders consider there is a need for public participation, tweeting frequency of SDGs tweets by politicians was considered as first factor. Liking of SDGs tweets among citizens was considered as a second factor because according to observational learning, the content perceived by the user leads to retaining it. This help us in recognizing the SDGs which users considered for themselves in improving, therefore users are retaining it to improve in future.

The SDGs having low frequency, should follow technocratic model. The SDGs having high frequency and low liking should follow one-way Jeffersonian public participation model. The SDGs having high frequency, high liking and low sharing should follow interactive Jeffersonian model. The SDGs having high frequency, high sharing and high bookmarking should follow social constructionist model. To explore the applicability of this model, we attempted to look at out research questions one by one, and analyse them for validation.

| **Public Participation Model** | **Tweeting Frequency** | **Liking** | **Sharing** |
|---|---|---|---|
| Technocratic | Low | - | - |
| One Way Jeffersonian | High | Low | - |

| | | | |
|---|---|---|---|
| Interactive Jeffersonian | High | High | Low |
| Social Constructionist | High | High | High |

**Table 6: Proposed Public Participation Model for social media**

To identify the SDGs which had been posted less number times by national leaders, ranks computed by Kruskal-Wallis H test for H1 was used. Among all the SDGs having rank lesser than lower quartile of ranks were assumed that national leaders had not used social media for their communication. Therefore, the model suggested in the study suggests SDGs: SUST, PART, LIFW, AFFO and LIFL should follow technocratic model. For rest of the SDGs, it appears from the sample, ample amount of the content had been posted by national leaders.

To identify the SDGs with low retaining, ranks computed by Kruskal-Wallis H test for H2 was used. SDGs which had a lower rank, also had low amount of likes. Based on the model we suggest one-way Jeffersonian model to be followed for CLIM, CLEA and ZERO SDGs. We argue that there is low retention among these SDGs and also sample indicates that these SDGs have low social influence.

Governments, non-governments and other organizations have to play an active role by creating awareness related to policies on social media platforms. One-way Jeffersonian model can be used by governments, non-governments organizations and other institutions for educating the citizens to policy decisions leading to empowering of the citizens. Therefore one way Jeffersonian public participation model can be a solution: (a) for supporting sanitary awareness (Cheng et al., 2018); (b) for increasing the acceptance of toilets among public; (c) for promoting sustainable agriculture (Pretty, 1995); (d) awareness related to climate change and its impacts (Sampei and Aoyagi-Usui, 2009) and many more.

For rest of the SDGs it seems most of the citizens had reached to third stage of observational learning i.e. converting the memory into action initiates. Literature indicates once the citizen will be convinced, he/she will try to reproduce the content for the social behaviour (Bandura, 1986). Therefore, for rest of the SDGs, to identify the SDGs with low reproduction ranks computed by Kruskal-Wallis H test for H3 was used. The rank lesser than lower quartile of ranks were considered low in reproduction. On the basis of reproduction behaviour interactive Jeffersonian public participation model can be followed for NOPO, RESP and DECE SDGs. This study indicates interactive communication is needed between technical experts and public on SDGs NOPO, RESP and DECE. Therefore, public participants can communicate its values, beliefs and emotions to technical experts on consumption, production, work and economic growth.

For the rest of the SDGs having high posting from national leaders, high likes and high retweets, it indicates high social influence among civic participants. For these SDGs (GEND, GOOD, INDU, QUAL, PEAC and REDU) social constructionist public participation model can be used. Using social constructionist public participation model following can be facilitated in the society: (a) healthier lifestyles can be embedded among citizens (Casini et al., 2014); (b) empowering of women in society (Dhar, 2018); (c) innovation through co-creation of activities (Romero and Molina, 2011); (d) community-driven environmental sustainability; and many more.

Table 7 summarizes the different public participation model for the different SDGs computed with the model proposed in the study on the basis of three factors, tweets frequency, liking and sharing among civic present on Twitter.

| SDG | Tweets Frequency | Liking | Sharing | Public Participation Model |
|---|---|---|---|---|
| SUST | Low | | | Technocratic |
| PART | Low | | | Technocratic |
| LIFW | Low | | | Technocratic |
| AFFO | Low | | | Technocratic |
| LIFL | Low | | | Technocratic |
| CLIM | High | Low | | One-Way Jeffersonian |
| CLEA | High | Low | | One-Way Jeffersonian |

| | | | | |
|---|---|---|---|---|
| ZERO | High | Low | | One-Way Jeffersonian |
| NOPO | High | High | Low | Interactive Jeffersonian |
| RESP | High | High | Low | Interactive Jeffersonian |
| DECE | High | High | Low | Interactive Jeffersonian |
| GEND | High | High | High | Social Constructionist |
| GOOD | High | High | High | Social Constructionist |
| INDU | High | High | High | Social Constructionist |
| QUAL | High | High | High | Social Constructionist |
| PEAC | High | High | High | Social Constructionist |
| REDU | High | High | High | Social Constructionist |

**Table 7: Public participation models for different SDGs**

### *Theoretical Contributions*

Our inductive study developed a public participation models for different SDGs following the steps of observation, interpretation and application for promoting them on social media for higher engagement among citizens. Based on the reception of the tweets, SDGs have been mapped to different public participation model, in which they are likely to have better receptivity and engagement when they would be discussed. Public participation models suggested in this study is based on Waddell (1995) public participation models for regional deliberations on sustainable development. The models had been suggested for virtual environment by considering the learning process highlighted by social cognitive theory (Bandura, 1986) taking into consideration the way humans perceive the information, retain the information and reproduce the information. These public participation models can be used by UN, governments, and other organizations for spreading awareness for sustainable development goals.

Social media posts serve as an indirect experience which enables individuals to acquire knowledge and skills and take actions accordingly (Bandura, 2008). Thus, individuals can learn to perform behaviors through media modelling (Bandura, 2001) by encoding the content presented in mass media (Bandura, 2011). Although, the study does not test the cognitive process, the user behavior in relation to Tweets by national leaders has been used to design subsequent model for public participation based on the public participation model by Waddell (1995). Based on our findings and mapping of the follower behaviour, our study indicates that SUST, PART, LIFW, AFFO and LIFL could benefit most if a technocratic model of public participation was followed. Further for CLIM, CLEA and ZERO; the preferred public participation model could be One-Way Jeffersonian. Again, for NOPO, RESP and DECE, the preferred public participation model could be Interactive Jeffersonian. Lastly for GEND, GOOD, INDU, QUAL, PEAC and REDU; the preferred public participation model could be Social Constructionist. To the best of our knowledge, such a mapping has been developed and validated empirically for the first-time surrounding SDGs and how public participation models could be developed for gathering support across stakeholders.
Collective action of humans towards sustainability (Tim et al., 2018) can be taught through communication (George et al., 2016). People perceive sustainable development differently (Aras & Crowther, 2008) as how they process information is impacted by how information resonates with their audience's cognitive schema (Scheufele, 2014). By categorizing the 17 goals into four different models, study has provided a way forward for strategically crafting communication messages.

For different SDGs, the model has delineated different types of public participation that includes no role of public participation, one way transfer of expert knowledge, transfer of knowledge and adjustment between public and experts, and social construction of public policy decision making by taking into consideration the communication, appeal, and engagement with values, beliefs and emotions.

### *Practical Implications*

From the literature it seems citizens will not be able to follow sustainability goals proposed by UN on their own. There is need for promoting learning around SDGs through observations, experiments and by describing consequences. The study indicates there is statistically significant difference retaining and reproducing attitudes of citizens towards SDGs. Therefore, this study suggests different public participation model for SDGs on social media. These public participation model can help in teaching public and transforming their attitudes towards sustainability.

The study suggests policymakers need to take an active role in governments in making a demarcation for public participation on SDGs. The way SDGs are being perceived, retained and reproduced by citizens can be taken into the account for citizen participation. A synthesis of findings taking into consideration the characteristics of each public participation model depicts how needs and urgency can be answered using these public participation models (Table 8). One way Jeffersonian public participation model can used for low social influence on issues and concerns for increasing awareness, acceptance and promotion among citizens. Interactive Jeffersonian public participation model can used for moderate social influence on issues and concerns for exchanging of values, belief and emotions; whereas social constructionist model can be used where there is a need for adjusting ideas to for adoption by people.

| **Public participation models for Twitter** | **Characteristics** | **Need and urgency can be answered?** |
|---|---|---|
| Technocratic model<br>(Decision solely by government) | ○ No communication through social media platforms to civic. | - |
| One way Jeffersonian<br>(Increases awareness, acceptance and promotion among citizens) | ○ Social influence is low on the issues, concerns and policies.<br>○ Needed for educating citizens on issues and policies through social media platforms.<br>○ Highly active role of governments is needed. | (a) For awareness related to sanitary issues.<br>(b) Can be used for increasing the acceptance of toilets among public.<br>(c) For promoting sustainable agriculture.<br>(d) Climate change and its impacts awareness. |
| Interactive Jeffersonian<br>(Exchange of values, belief and emotions) | ○ Social influence is medium on the issues, concerns and policies.<br>○ Communication is needed between technical experts and public.<br>○ Active role of governments is needed. | Needed for prosperity and economic growth of the country.<br>Public communication with the experts on consumption, production, work and economic growth can be undertaken through this model. |
| Social constructionist<br>(Decision can be socially constructed) | ○ Social influence is high on the issues, concerns and policies.<br>○ Experts and civic communicate, appeal and engage.<br>○ Moderate role of governments is needed. | (a) Facilitates open and democratic communication.<br>(b) Can embed healthier lifestyles among citizens.<br>(c) Leads to innovation through co-creation of activities among civic. |

| | | |
|---|---|---|
| | | (d) Community-driven focus for environmental sustainability can be supported. |

**Table 8: Public participation models for Twitter, their characteristics and urgency supported synthesis of findings**

### *Limitations and Future Work*

One of the major challenges and possible limitation is that only tweets containing identified keywords for SDGs were classified as the SDGs tweets, whereas there is a possibility that some posts were on SDGs but their relevant keyword is not in the codebook. The second limitation of the study is political leaders also have a significant amount of fake followers and spam. Future researchers can explore the same analysis on larger sample by considering other national leaders at different positions in the government. Future researchers can use a public participation model suggested in the study for addressing issues and concerns through social media platforms and can measure the impact of the same among citizens.

### *Conclusion*

In the last decade, a number of studies have demonstrated the benefits of communication studies. This study tries to present the use of the social media platforms for dissemination and promotion of SDGs through public participation model on Twitter. For suggesting these models tweets posted by national leaders on SDGs on Twitter had been explored on three factors: (a) tweeting frequency; (b) sharing; and (c) liking. For statistically validating these factors hypothesis H1, H2 and H3 was tested.

Hypothesis H1 indicated there was a statistically significant difference in tweeting by politicians on different SDGs. This signifies national leaders are considering some SDGs for citizen's participation and on some SDGs they want to discuss with only experts and want to take solely decision on their own. The study had identified the SDGs that belong to solely decisions category of national leaders these are SUST, PART, LIFW, AFFO and LIFL. For these SDGs technocratic public participation model can be followed. Hypothesis H2, indicates there is statistically significant difference in retaining of tweets on different SDGs by citizens. For some SDGs retaining power is low among citizens, in these tweets social influence is low, therefore highly active role of governments is needed in those SDGs. For these SDGs one-way Jeffersonian public participation model can be followed. According to our analysis CLIM, CLEA and ZERO SDGs should follow one-way Jeffersonian public participation model. Hypothesis H3, indicates there was a statistically significant difference in sharing of leaders tweets across different SDGs. For some of the SDGs social influence is low but retaining power is high for those SDG interactive Jeffersonian public participation model can be followed. According to our analysis undertaken in the study NOPO, RESP and DECE SDGs should follow interactive Jeffersonian public participation model.

Now on the basis of how content had been retained by citizens on Twitter, the SDGs public participation model was developed by mapping the three factors to table 4. We extend the understanding of the social cognitive theory-based model which has been mapped by considering three factors (a) Frequency of SDGs posts by national leaders; (b) liking of those tweets among public; and (c) sharing of those tweets among public. For SDGs highly tweeted, highly retained and reproduce social constructionist public participation model can be followed. For SDGs GEND, GOOD, INDU, QUAL, PEAC and REDU, social constructionist public participation model can be followed. The findings of the research are expected to benefit the UN and its member countries in devising implementation plans in general, and communication dissemination strategy for SDGs, in particular.

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