

Opinion Mining of Environmental Issues on Instagram

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Abstract. Indonesia has a complicated waste issue and is one of the biggest waste producers worldwide. The development of Instagram as one of the popular social media in conveying public opinion in the form of photos and captions has the potential to produce useful information for solving the waste issue. The study aims to investigate public opinion particularly the Instagram users about the waste crisis. It applied opinion mining in which the data sets were obtained from Instagram posts. The overall number of posts using #sampah until December 20th, 2019 was 109K, and the research sample cover posts from January 1st, 2018 to December 20th, 2019, totaling 54K posts. The developed system consists of three subprocess, namely document subjectivity, opinion orientation and target detection. The data were classified using feature reduction. The result showed that the most popular type of post was about social learning, while the meme posts were relatively low. The conclusion stated that public opinion on the waste issue in the captioned photos can be categorized into five including waste crisis monitoring, social learning, information enlightenment, cultural transformation, and memes. The discussion and solutions elaborated in this study can be utilized by the stakeholders of Penta Helix to realize the solution for waste issues.

1. Introduction

There are different approaches to the waste issue in which developed countries tend to apply upstream avoidance strategy and while developing countries use a downstream repairs strategy to solve the issue [1]. Besides, there are other alternatives to solve the issue through the activity of sorting waste to the final disposal of solid waste. Open disposal and open burning of waste are the main waste management practices and final disposal systems typically applied in developing countries [2]. Most of the environmental issues are due to pollution which does not only destroy the natural resources but also harmful to health [3].

Indonesia is a country in which its amount of waste in urban areas has exponentially increased and the quality of the environment has significantly decreased as a result of aggressive urbanizations [4]. The authorities and actors involved in waste management have to know about waste issues in Indonesia so that they can provide appropriate information and encourage the public to be aware and to involve in waste recycling activities [2]. Social media is a group of websites and web-based systems that facilitate interaction, conversation, and sharing among the users [5]. Using social media data to understand the public can overcome some criticism of surveys - specifically that surveys do not capture the nature of conversation or the establishment of public opinion or the operationalization of survey questions is too narrow in defining public opinion [6]. Although the suitability of opinion models to characterize opinion formation on social media is still questionable and requires exploration,

[7] argue that online social media can provide rich data regarding opinion interactions. Ref. [8] state that researchers and official journalists examine the perceived relationship between social media and public opinion and broaden the definition of public opinion by inserting its social dimension in social media variables. The type of social media used in this study is Instagram in which the users can easily share their photos and tweaks using the available filters [9].

Instagram is one of social media platforms that focuses on visual messages and has important roles in spreading information on waste management by providing a complete picture and video features [8]. Instagram hashtags express accurate messages of the content of the posted pictures during the process of explaining explicit images such as crowdsourcing [9]. Public opinions gained from social media are public, relational, hierarchical, and measurable in nature [6]. Netizens' comments have the potential to improve understanding of public opinion, how the public makes decisions, and how beliefs are formulated, but comments are rarely used as data [10]. Measuring public opinion and behavior is crucial to formulate policies and improve understanding of the social world including policies, impacts of policy selections, and consumers' attitudes and habits [11]. Individual actions can affect the neighbors' opinions and actions in a non-linear way [7].

Ref. [12] identify how public support influences the success of advocacy by utilizing data sets regarding public opinion, advocacy positions, and policy outcomes. Comment readers often have the option to indicate whether they agree or disagree with the comments by simply clicking agree/disagree on a link, but it does not represent the general population's view [10]. Ref. [9] propose 8 categories of popular posts on Instagram, one of which is captioned photos. This study used a captioned photo category. A caption is an interesting statement that appended to a picture [13]. Ref. [14] classify types of Instagram posts into three, extraordinary, touching, and humor. Extraordinary contents show an unusual event or action and require extra work intended to attract public attention. Touching is related to empathy, while humor is intended to make the viewers happy. Humor is a type of popular posts and typically in the form of memes. The uploaded photos are often completed with humorous criticisms representing public issues [15]. The issues which are highlighted in memes become viral easily and the issue becomes a hot topic to discuss.

Opinion Mining (OM) can be defined as a task to detect, extract, and classify opinions about something using natural language processing (NLP) to track public mood on social media [16]. The idea of OM is the emerging field of data mining to extract knowledge from extremely large data in the form of comments, feedback, and reviews of certain products or topics [17]. The challenge of OM is the way to classify the polarity (positive or negative) of an opinion in which an opinion can contain a combination of opinions on an issue and small differences can change the polarity of a sentence [18]. Regarding this challenge, [19] have proposed the development of a modular rule-based approach by conducting shallow linguistic analysis and creating a number of linguistic subcomponents to produce polarity and final opinion scores rather than forcing NLP.

This current study aims to investigate public opinion about the waste crisis based on Instagram users. The data sets for this study were gathered from Instagram using the hashtag #sampah in 2018-2019, and the opinion mining technique was used to analyzed the data. The implications of this research can be utilized by policymakers and environmental organizations in formulating better waste management strategies in Indonesia. Understanding public opinion can have important consequences for predicting future events [10].

2. Methodology

This study applied the opinion mining technique in which the data sets were taken from Instagram with the hashtag of #sampah in 2018 - 2019. In English, 'sampah' refers to waste in general. The search was not limited to the type of waste such as organic or non-organic, liquid or solid, industrial or household. The number of posts using #sampah until 20 December 2019 reached 109K posts and the research sample cover posts from the first January 2018 - December 20, 2019, with a total of 54K posts.

This study only analyzed the type of posts on Instagram considered as captioned photos and ignored any comments for each post. The identification of each photo covered the name of the account, post-date, polarity, and type of post. The weakness of this mining opinion technique is researchers' strength in the analysis. Cleansing was applied in a number of posts using #sampah, but some posts refer to the figurative waste definition. Based on the cleansing results, 46% of posts used the #sampah for figurative uploads, so they were eliminated from the data set. This process was called pre-processing.

Then, the data sets were classified based on the similarity of the photos and/or captions. This stage was called feature reduction. The last stage was summarization and it adopted feature-based summarization in which the summary was presented by selecting a sentence that contains certain feature information. In general, this research is relevant to the workflow of opinion mining used by [17] but there were some adjustments to the activities presented in Figure 1.

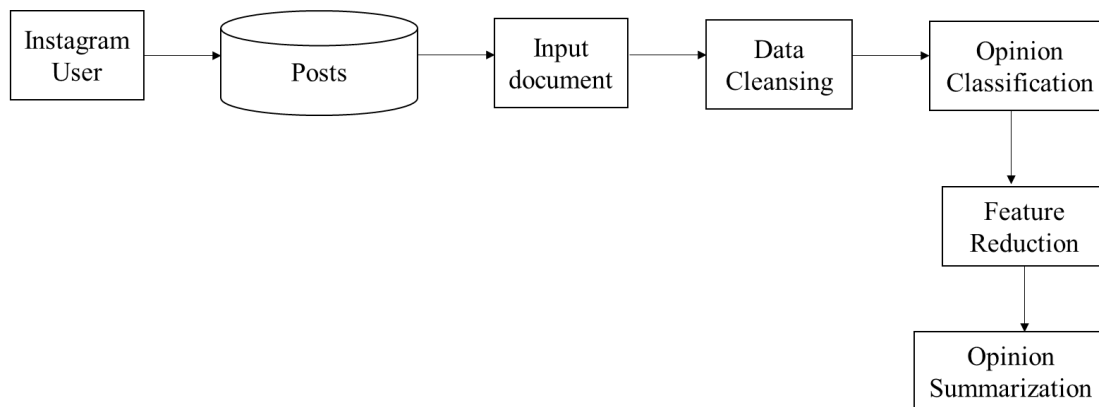


Figure 1. Workflow of opinion mining

3. Result and Discussion

In general, four features emerged from the results of data reduction with the hashtag of #sampah. They covered the monitoring of waste crisis, social learning, information enlightenment, and cultural transformation and memes. The proportion data of each finding feature is presented in Pareto diagrams in Figure 2. It can be seen that 46% of 54K posts have been eliminated. Hence, the processed data were gained from 28,080 posts.

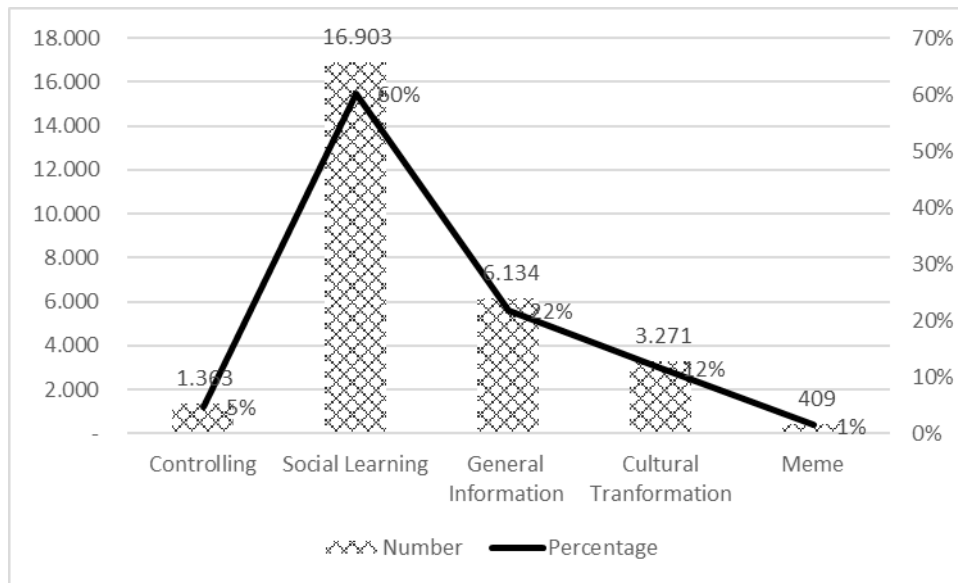


Figure 2. Frequency and Percentage Distribution of Posts

Based on Figure 2, it can be seen that the type of posts containing social learning dominated Instagram posts with #sampah from the first January 2018 - December 20, 2019, with 16,903 posts or 60% of total posts. The second type of posts was dominated general information types with a total of 6,134 posts (22%) and then it was followed by cultural transformation, controlling, and memes with 409 posts (1%).

3.1. Monitoring Government Performance

Indonesian netizen participation refers to the intense use of social media in responding to social phenomena that occur in 24 hours in Indonesia. One of the functions of social media is for monitoring government performance [19]. A total of 1,363 Instagram posts using #sampah which are categorized as monitoring of waste crisis. In this study, the definition of monitoring refers to an attempt by netizens to criticize and advise the government's performance in overcoming the waste issue in Indonesia.

Some captions of Instagram posts are as follow:

"For monitoring, just install CCTV on every street that is prone to littering. The government only needs to coordinate with the state apparatus to determine the penalties and fines." (@kamallun)

"Provide a post for Satpol PP (Public order agency officers) and set official rules regarding maintaining park cleanliness and fine those who violate the rules" (@Retnowlndry)

"Establish a special team to maintain safety and cleanliness by reprimanding irresponsible people ... Don't let them damage parks and public places." (@zammyyuviansyah)

"Establish a team to monitor public safety and order (Public order agency officers) and set clear sanctions/fines for those who litter (Regent Regulation) ..." (@teguhsulistiyanto)

Those captioned photos were posted because netizens felt the government was not optimal in monitoring its programs. It requires coordination with Public Order Agency and it is important to set regulations concerning waste disposal with clear fines/sanctions for the violators.

3.2. Social Learning regarding Waste

The definition of social learning in this study refers to the findings of [20], in which they proposed five aspects of social learning including reflection, system and thought, integration, negotiation, and participation. Educating the public about the importance of environmental issues is crucial because it instills appropriate behavior for the community itself [21].

Sample of the caption on Instagram posts:

"I'm sorry ... maybe just provide more trash cans... because the more trash cans, the more people will stop littering. Most people want to be practical, if there are a lot of trash cans, people will tend to dispose of the waste into trash cans except those who are ignorant. I hope all people are aware of environmental hygiene." (@eka__putra)

"Oh my god!!! Do not burn plastic waste as it can be used as electrical energy and even clothes. If it is continuously burned, it can cause pollution. So, dispose of the waste into the provided spaces." (@Bachtiarrk29)

The caption posted by @eka__putra is a sample of social learning for reflection aspect, while caption posted by @ bachtiarrk29 is a sample of social learning for system and thought and integration aspects. The social learning captions become the most popular posts on Instagram with the hashtag #sampah with a total of 16,903 posts or 60% of the total analyzed data. It indicates that netizens use social media as a medium to do positive things when postings something related to the waste issue.

The social learning was classified into five aspects covering reflection (20%), system and thought (40%), integration (10%), negotiation (10%), and caption participatory (20%). Some popular systems and thoughts posted by netizens concerning the solution to the waste issue such as prevention, waste banks, the role of industry, and bio-process. In terms of reflection aspect, the posts related to global development, community awareness, and limited facilities and infrastructure. Regarding the participatory aspect, #sampah is been popular during certain events for example annual social action program to combat waste issues initiated by the World Cleanup Day (WCD). Ref. [1] shows that the prevention of the waste crisis is preferred over remediation. Thus, the action requires public policies to make it practical. One popular solution is creating a waste bank. The waste bank management model does not only contribute to clean the environment but also has economic benefits. It is associated with local communities in collecting and managing their waste to reduce waste in which they receive economic benefits [22]. The industries are expected to participate by creating and implementing a reverse logistics system where plastic waste is returned to the factories that produce it [23]. Besides, [1] states that bio-process is a well-accepted solution for the local communities. Ref. [24] remind that public support is affected by household population, income, and costs.

Regarding waste management, [24] found that people are environmentally aware of the separation of waste based on its type, but they still got confused about the classification of solid waste and limited transportation media and waste disposal. Ref. [25] conclude four waste crises which most contribution to greenhouse gas emissions and global development issues such as temporary waste collection, open disposal, limited recycling and treatment facilities, and poor solid waste management practices. The environmental impacts of waste issues also can be seen from direct interaction between scavengers and hazardous waste which causes major health risks [2]. Not only in the industry, but waste management at the household-level requires intensive socialization on sorting household waste [24]. Indonesian netizen participation refers to the intense use of social media in responding to social phenomena that occur in 24 hours in Indonesia. One of the functions of social media is for monitoring

government performance [19]. A total of 1,363 Instagram posts using #sampah which are categorized as monitoring

3.3. Information

Social media has been increasingly used as a source of information, including information related to risks and crises [26]. Ref. [27] state that citizens pay more attention to content posted on social media because they are interested in knowing how science can contribute to improving their living conditions and accessing important information.

Some captions related to information about waste issues can be seen below:

"The same conditions exist in Cendrawasih Street in which waste is piling up on the sidewalks and even on the alley of private residents'. Lack of awareness and limited coverage of waste transporter become the main causes of this issue." (@ Bagusnegara5).

"The limestone turns to a landfill now." (@ setyo_88)

The number of Instagram posts related to general information reached 6,134 posts or 22% of the total data. Photo captions concerning the information of waste such as flood, unloaded waste, misuse of productive land into a landfill can be utilized by those in charge of obtaining real-time information. Thus, it is important for each Environmental Agency in each region to have an active official Instagram account so that netizens can directly mention the account to solve the waste issue.

3.4. Cultural Transformation

Community involvement in innovating and utilizing waste is needed to reduce the amount of waste in landfills. A social movement is a collection of informal networks and unaffiliated individuals struggle for changes [28]. Instagram posts regarding cultural transformation reached 3,271 posts or 12% of the total data and it got the third rank after social learning and general information. Some captions related to cultural transformation cover:

"Human behavior must be changed in order to stop littering, even if the availability of trash cans is limited, at least people are aware of the waste issue. They can keep the waste until finding the trash cans." (@dickynugrahaa__)

The cultural transformation can be done through education and community empowerment activities. Optimizing the role of waste banks can be through collaboration with other educational institutions from elementary to high school level. Materials regarding environmental management practice have to be inserted in the education curriculum, while the contents may cover waste banks.

The Coordinating Ministry of Maritime Affairs and the Ministry of Environment and Forestry work in partnership with the Global Plastic Action Partnership (GPAP) to initiate an innovative and evidence-based approach to solve the waste issue. GPAP aims to change the current 'take-make-dispose' model into a circular economy, where all produced plastics are recycled and reused. The success of the program requires the cooperation of stakeholders through the pentahelix model which involves the role of government, private sector, academicians, communities, and media. The program initiated by GPAP is expected to reduce excess packaging, use innovative plastic materials that can be recycled, replace materials, increase recycling rates, and increase waste collection rate.

3.5. Memes

Memes can be a representation of public opinion. However, we all know the dynamic of social media is an issue cannot last long so that memes cannot contribute much to public policies [15]. Data show that only 1% of netizens upload memes using #sampah. It indicates that creative criticism has not been popular in the waste issue. The solution for waste issues is considered a serious discussion, not humor.

4. Conclusions

Based on the data analysis, it can be concluded that public opinion on the waste issue in the captioned photos can be categorized into five including waste crisis monitoring, social learning, information enlightenment, cultural transformation, and memes. The most popular post was social learning (60%) in which the system and thought aspect becomes the most popular compared to other aspects such as reflection, integration, negotiation, and participation. In general, Instagram users give more positive opinions or positive posts regarding improvement, solution, and sustainability of waste management.

The high intensity of advocacy possibly increases the importance of policy issues in public debates in which the public tends to know whether their demands are accommodated and implemented into policies [12]. Therefore, it is crucial for policymakers to involve Instagram influencers to not only convey criticism but also strategies to solve the waste issue in Indonesia. The weaknesses of using social media for data collection the usage for building sample framework and recruit respondents [5]. Even, there is no representative sampling that use sentiments, topics, content, or other computational analysis to investigate netizen communication, using the total number of posts, or conclusions about aggregate public opinion [6]. The limitation of this study is raising parameters at the beginning. The next studies are expected to be able to predict public opinion trends regarding the waste issue by using actual data which can create new parameters. Even though Instagram is considered effective as a campaign media for several issues, it does not have a significant impact on the environmental movement [8]. Finally, to expand the data collection, it can be done by combining several hashtags using English such as #waste, #garbage, #plastics and so on to get more global public opinions.

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