

Applications of Latent Dirichlet Allocation Algorithm of Published Articles on Cyberbullying

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Abstract

With huge information available regarding traditional forms of bullying, (i.e., verbal, physical, relational), cyberbullying research is only recently beginning to thrive. To determine cyberbullying incidence, it is vital to dig available documents of the top ten countries which take the most incidence in cyberbullying as shown in Google trends for the past ten years with published papers in google scholar. Hence, this study utilizes a new dimension of research adopting web mining technique and topic modeling mainly unsupervised machine learning with the application of Latent Dirichlet Allocation Algorithm in the content analysis of the published articles available online. Five Latent themes were identified by the researcher points of view which based on the result generated by the R-programming software and supported through various literature, analysis, and discussions.

Keywords: Cyberbullying, Bullying, Latent Dirichlet Allocation Algorithm, Unsupervised Machine Learning, Social Science Research Philippines

INTRODUCTION

In many advanced countries, the ubiquitous of the internet is now a given. It permeates social interactions, culture and daily life, politics and even the commerce of men. While internet accessibility rapidly continues to grow, developing countries are still a long way to go before the world is completely wired. The increase in internet accessibility brought positive effects to the general public may it be in communications, changes in the way work are done, and to do more with effectiveness and efficiency with less time and cost in the working sector of the society. However, the increase in internet accessibility has also “dark side” that harms individuals, especially young adults in the society.

Cyberbullying is usually defined as a form of bullying that uses electronic means such as email, mobile phone calls, text messages, instant messenger contact, photos, social networking sites, and personal web pages, with the intention of causing harm to another person through repeated hostile conduct. This can include forms of aggression such as humiliation, harassment, social exclusion, mockery, and rude comments [Smith et al., 2008].

Cyberbullying, unlike other cyber abuses, occurs among young people. Cyberbullying happens when both the victim and the perpetrator are underage. When an adult is involved, cyberbullying may escalate to a more severe act called as cyber-harassment or cyberstalking, a crime that can have legal consequences and include jail time (What is cyberbullying? 2011). Although bullying is considered as a long time problem that happens in school among school-aged kids, cyberbullying is seen as a different problem in the age of the Internet. Chait (2006) explained that unlike the traditional form of bullying where the bullies attack their victims face to face, perpetrators of cyberbullying could use all types of communications technologies to attack others deliberately and repetitively.

At present, the number of internet users continuously increases and more they become active in the online world which consequently intensifies the cyberbullying problem. With the continually growing number of netizens today, cyberbullying is no longer a common issue. It is now raising concerns not only among internet users but as well as the authorities and even ordinary people. Legal and ethical issues are now confronting the abuse of using the social media to bully other internet users. Hence, it is on this premise that this study is conducted to dig more information the challenging phenomenon about the incidence and potential consequences on cyberbullying using topic modeling particularly on Latent Dirichlet Allocation Algorithm (LDA) by conducting a content analysis of the published articles online.

Framework of the Study

Cyberbullying is discussed within the context of choice theory by Glasser. He explained his theory in rebuttal to the view that people cannot be responsible for their behaviors, including psychological problems (Kaner, 1993). Glasser, objecting to the view that the reasons behind psychological problems are some mental disorders, stated in his theory that the real source of problems is individuals' own choice (Glasser, 2000; Haight and Shaughnessy, 2003) and that our behaviors are directed by internal factors, which he called a “Quality World”, not by external factors.

When people experience a problem with someone else, they want to change the other by controlling the other's behaviors rather than changing and controlling their own. This leads to communication being damaged. However, according to the choice theory, an individual has the competence to control only his behaviors (Glasser, 1997; Özmen, 2006).

According to Glasser, five primary motives are originating from humans' genetic endowment (Glasser, 1985). These are (1) surviving and reproducing, (2) belonging (to love, to be loved and to be of value), (3) acquiring power, (4) being free and (5) having fun.

Quality World and picture album are other vital concepts in choice theory. Though the needs of all humans are similar, their wills as to how to meet these needs are different because their lives are not the same. The solutions that we find to meet our requirements from the personal Quality World. One's Quality World consists of perceptions and pictures related to subjects, phenomena, and persons that one wants to exist in the real world. We build our whole life to reach the images in this world. Therefore, our Quality World is the most crucial part of our entire life (Glasser, 1998a).

According to choice theory, a behavior includes elements of doing, thinking, feeling and physiology. Glasser calls this total behavior (Glasser, 1998b; Zeeman, 2006). The element of doing in our overall behavior is always under our control. Therefore, when this element changes, other elements, namely thinking, feeling and physiology will be under our control (Glasser, 1998b).

The choice theory focuses on the concept of successful and unsuccessful identity. Glasser (1998b) claims that the degree of satisfying the requirements of belonging, loving and feeling secure has a vital role in the formation of successful identity. A feeling of responsibility is the most important indicator of having a successful identity. Successful identity brings responsibility with it. If a person has a successful identity, he can acknowledge the consequences of his behaviors, accept realities as they are and behave accordingly. People who have a successful identity can satisfy their needs of being of value, belonging, loving and being loved (Palanci, 2004).

Choice theory highlights responsibility. Responsible people are aware of what they want and what they can achieve, and they are independent people who are active in achieving these. From this perspective, responsible people are the people who can control their lives and behave accordingly (Palanci, 2004).

OBJECTIVES OF THE STUDY

This study is conducted to dig more information the challenging phenomenon about the incidence and potential

consequences on cyberbullying to understand further the published articles found on the internet as an input to unsupervised machine learning.

Specifically, this seeks answers to the following questions:

1. What are the countries that are active on the web related to cyberbullying?
2. What are the topics and its trends related to cyberbullying for the last five years?
3. What are the latent themes generated from the online documents?
4. What recommendations can be derived based on the findings of the study?

METHODS

Research Design

This study utilized *sequential exploratory design* using content analysis of online published articles. This type of design also has two phases (qualitative and quantitative) but allows the theoretical perspective of the researcher to guide the study and determine the order of data collection. The results from both methods are integrated together at the end of the study during the interpretation phase (Creswell, 2013). Further, the published articles are derived from the following countries presented in the table below.

Top Ten Countries with Documents Published Related to Cyberbullying from April 2012 to March 2017

Ranking	Country	# of Documents Published
1	Philippines	100
2	Singapore	46
3	New Zealand	44
4	Australia	41
5	United States	34
6	Canada	27
7	United Kingdom	26
8	Ireland	23
9	South Africa	21
10	Portugal	19

Source: Google Trends

Research Method

The method used in this study is derived from Gibb Sampling and Latent Dirichlet Allocation Algorithm.

Gibbs Sampling:

Gibbs sampling is one of the Monte Carlo Markov Chain (MCMC) technique suitable for the task. The idea in Gibbs sampling is to generate posterior samples by sweeping through each variable (or block of variables) to sample from its conditional distribution with the remaining variables fixed to their current values (Yildirim, 2012). The underlying logic of MCMC sampling is that we can estimate any desired expectation by ergodic averages. That is, we can compute any statistic of a posterior distribution as long as we have N simulated samples from that distribution:

$$E[f(s)]_p \approx \frac{1}{N} \sum_{i=1}^N f(s^{(i)})$$

where P is the posterior distribution of interest, f(s) is the desired expectation, and f(s⁽ⁱ⁾) is the ith simulated sample of P. For example, we can estimate the mean by E[x]p = $\frac{1}{N} \sum_{i=1}^N x^{(i)}$. How do we obtain samples from the posterior distribution? Gibbs sampling is one MCMC technique suitable for the task. The idea in Gibbs sampling is to generate posterior samples by sweeping through each variable (or block of variables) to sample from its conditional distribution with the remaining variables fixed to their current values. For instance, consider the random variables X₁, X₂, and X₃. We start by setting these variables to their initial values x₁⁽⁰⁾, x₂⁽⁰⁾, and x₃⁽⁰⁾ (often values sampled from a prior distribution q). At iteration I, we sample x_i⁽ⁱ⁾ ~ p(X₁ = x₁ | X₂ = x₂⁽ⁱ⁻¹⁾, X₃ = x₃⁽ⁱ⁻¹⁾), sample x₂ ~ p(X₂ = x₂ | X₁ = x₁⁽ⁱ⁾, X₃ = x₃⁽ⁱ⁻¹⁾), and sample x₃ ~ p(X₃ = x₃ | X₁ = x₁⁽ⁱ⁾, X₂ = x₂⁽ⁱ⁾). This process continues until “convergence” (the sample values have the same distribution as if they were ample from the true posterior joint distribution (Yildirim, 2012).

Gibbs Sampler General Algorithm:

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Initialize x(0) ~ q(x)
for iteration i = 1, 2, ... do
    x1(i) ~ p(X1 = x1 | X2 = x2(i-1), X3 = x3(i-1), ..., XD = xD(i-1))
    x2(i) ~ p(X2 = x2 | X1 = x1(i), X3 = x3(i-1), ..., XD = xD(i-1))
    .
    .
    .
    xD(i) ~ p(XD = xD | X1 = x1(i), X2 = x2(i), ..., XD-1 = xD-1(i))
end for
    
```

Latent Dirichlet Allocation Algorithm

Latent Dirichlet allocation (LDA) is a generative probabilistic model of a corpus. The basic idea is that documents are represented as random mixtures over latent topics, where each topic is characterized by a distribution over words (Abramowitz & Stegun, 1966; as cited by Blei, Ng, & Jordan, 2003).

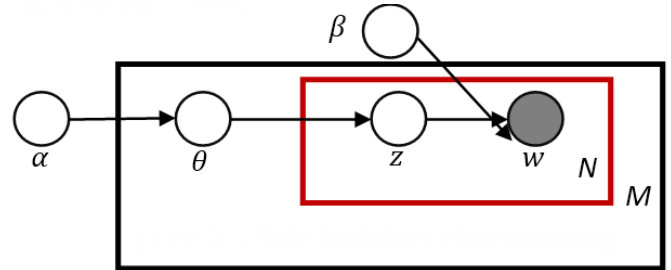


Figure 3: Plate Notation Representing LDA

With plane notation, the dependencies among the many variables can be captured concisely. The boxes are “plates” representing replicates. The outer plate represents documents, while the inner plate represents the repeated choice of topics and words within a document. M denotes the number of documents, N the number of words in a document. Thus:

α is the parameter of the Dirichlet prior on the per-document topic distributions,

β is the paramant of the Dirichlet prior on the per-topic word distribution,

θ_m is the topic distribution for document m.

φ_k is the word distributed for the k,

z_{mn} is the topic for the nth word in document m, and

w_{mn} is the specific word.

The w_{ij} are the only observable variables, and the other variables are latent variables. Mostly, the basic LDA model will be extended to a smoothed version to gain better results. The plane notation is shown on the right, where K denotes the number of topics considered in the model and

φ is a K * V (V is the dimension of the vocabulary) Morkov matrix (transition matrix), and each row of which denotes the word distribution.

The generative process (algorithm):

1. Choose θ_i ~ Dir(α), where i ∈ {1, ..., M} and Dir(α) is the Dirichlet distribution for parameter α
2. Choose φ_k ~ Dir(β), where k ∈ {1, ..., K}
3. For each of the word position i, j, where j ∈ {1, ..., N_i, and i ∈ {1, ..., M}

- a. Choose a topic $z_{ij} \sim \text{Multinomial}(\theta_i)$
- b. Choose a word $w_{ij} \sim \text{Multinomial}(\phi_{z_{ij}})$

(Note that the Multinomial distribution here refers to the Multinomial with only one trial. It is formally equivalent to the categorical distribution.)

The lengths N_i are treated as independent of all the other data generating variables (w and z). The subscript is the often dropped, as in the plate diagram shown here.

Finally, this paper uses software to generate the output for Latent Dirichlet Allocation Algorithm such as:

- Google Trend, for identifying the number of recent documents related to cyberbullying for the past 5 years.
- Rstudio and R-programming, for LDA algorithm application using Python programs like gibbs sampler and lda.

Ethical Consideration

The information used in this research was raw data come from various published articles from the top ten countries who contributed much on cyberbullying. Hence, one published article for every country involved in the study. Further, data was obtained via google scholar and to protect the authors from any future predicaments their identities were not divulged in the study and will remain confidential. This study is more on the philosophical view of the researcher, and its results need further validation and evaluation.

It can be gleaned in Table 1 of the documents collected from the web that was transcribed using LDA to topics. There were ten (10) documents, and each document was given particular topic that LDA found. Similar topics that are prominent and commonly discussed were from document 8 and 9; document 2, 3 & 6; document 1 & 7; document 4 & 5; while document 10 talks differently from the others.

RESULTS AND DISCUSSION

Table 1: LDAGibbs Documents to Topics

#	Document	Topic
1	BullyingCyberbullyingandSuicide.txt	3
2	CyberbullyingBehavioursamongMidleandHighSchoolStudents.txt	2
3	CyberbullyinginSouthAfricaImpactandResponses.txt	2
4	CyberbullyingtheNewFaceofWorkplacebullying.txt	4
5	CyberVictimizationandCyberAggressionamongPortugueseAdolescents.txt	4
6	Exploring traditional and cyberbullying among Irish adolescents.txt	2
7	ExploringtheConsequencesofBullyingVictimizationinaSampleofSingaporeYouth.txt	3
8	SocialMediaasaChannelanditsImplicationsonCyberBullying.txt	1
9	Suicide onlinePortrayalofWebsiteRelatedSuicidebytheNewZealandMedia.txt	1
10	TheEmotionalImpactofBullyingandCyberbullyingonVictimsAEuropeanCrossNationalStudy.txt	5

Table 2: Sample Terms and Frequencies

Terms	Freq	Terms	Freq	Terms	Freq	Terms	Freq
Bullying	825	emotional	85	forms	58	another	45
cyberbullying	368	ideation	85	hinduja	58	well	45
Cyber	341	table	85	analysis	57	affected	45
School	262	parents	84	two	57	responses	45
Online	231	results	83	victim	57	first	44
Victims	210	respondents	81	experiences	56	number	44
Internet	201	one	80	behaviours	56	types	44
Suicide	201	among	79	aggression	55	users	44
reported	180	risk	78	age	54	acts	43
Study	168	significant	77	experience	54	environment	43
traditional	166	related	75	email	53	phones	43

victimization	164	used	74	life	53	someone	43
media	155	girls	73	three	53	direct	42
research	143	boys	71	schools	52	important	42
children	140	reporting	71	time	51	low	42
suicidal	139	patchin	70	associated	50	via	42
social	129	behaviour	69	report	50	years	42
students	124	studies	68	variables	50	questions	41
news	112	using	67	due	49	safety	41
family	111	differences	66	findings	49	suicides	41
bullied	105	information	66	data	48	university	41
health	105	support	66	high	48	included	40
mobile	100	young	66	home	48	less	40
negative	96	different	63	access	48	prevention	40
technology	95	others	62	need	48	world	40
sample	89	workplace	62	issue	47	consequences	39
youth	89	phone	61	adolescents	46	involved	39
impact	88	gender	60	experienced	46	messages	39
found	86	however	59	individuals	46	type	39
people	86	participants	59	way	46	communication	39

Table 2, presents the collection of words from the ten (10) documents with its frequency. The number of times a word (term) appears in the 10 documents and is sorted by the most number of occurrences to the least number of occurrences.

The researcher opted to present one hundred twenty (120) words drawn from a sample of 5028 terms in the 10 documents as shown in Table 1.

Table 3: LDAGibbs Topics to Terms

	Topic 1	Topic 2	Topic 3	Topic 4	Topic 5
1	suicide	cyber	bullying	cyberbullying	bullying
2	media	bullying	school	family	victims
3	news	online	victimization	negative	cyberbullying
4	social	children	suicidal	workplace	emotional
5	internet	school	ideation	respondents	reported
6	reporting	health	youth	support	impact
7	online	study	patchin	bullying	different
8	suicides	risk	bullied	acts	traditional
9	research	young	online	results	found
10	reported	girls	students	study	affected
11	information	internet	research	involvement	direct
12	users	traditional	traditional	rules	internet
13	used	people	hinduja	environment	mobile
14	websites	behaviours	sample	parents	results
15	zealand	life	mobile	email	types
Latent Themes	Role of Social Networking Sites and Media in Reporting Suicidal Issues	Studies on health risks and behaviors of young adults in using the internet	Mobile device as a tool for cyberbullying in school	Family support against cyberbullying	Impact and emotional stress brought by cyberbullying

Table 3 shows the groupings as identified by the algorithm per topic. These were arranged by topics 1 to 5 as prescribed in the algorithm. This also presents that latent themes drawn from the philosophical views of the researcher derived from the words of each topic.

Table 4 shows the reliability of the topics using Gibbs sampler per documents and topics. It indicates that the identification of topics from Table 1 and Table 4 was very consistent and was illustrated in Table 3 showing the collections of words per topic. The consistency and reliability of document 8 to topic 1 have 57.38%, and document 9 has 80.20%, this means that the latent theme *“Role of Social Networking Sites and Media in Reporting Suicidal Issues”* have a very high indicator that the documents were talking and sharing the same topics. While documents 2, 3, & 6 talks in common to Topic 2 having 55.76%, 77.77%, and 56.84% respectively with the latent theme *“Studies on health risks and behaviors of young adults in using the internet”*. Moreover, document 1 & 7 talk in common to Topic 3 having 70.83% and 81.27% with the latent theme of *“Mobile device as a tool for cyberbullying in school”*. Further, document 4 & 5 talk in common to Topic 4 having 69.14% and 74.93% with the latent theme of *“Family support against cyberbullying”*. Finally, document 10 having 84.84% talk about Topic 5 with the latent theme of *“Impact and emotional stress brought by cyberbullying”*.

CONCLUSION

Based on the findings of the study, the researcher established an idea that Cyberbullying is a public health concerned as it affects their everyday lives and is a constant source of distress and worry. Social media, as we understand it today, has created virtual communities without physical borders which can be used as a tool to prevent cyberbullying from suicidal issues. The role of social media and its potential influence on suicide-related behavior is a relatively new and evolving phenomenon that society is only beginning to assess and understand. The emerging data regarding the influence of the Internet and social media on suicide behavior have suggested that these forms of technology may introduce new threats to the public as well as new opportunities for assistance and prevention. Because social media are mostly created and controlled by end users, the opportunity for surveillance and prevention can be extended to all users.

Legal issues must also be considered when contemplating public health approaches to addressing some of the problems of social media and suicide. In particular are the legal complexities associated with the monitoring and filtering of content on the Internet. Although some countries can control Internet Web sites created within their borders, international jurisprudence makes it difficult to obtain jurisdiction over sites that originate outside the United States

Table 4: LDAGibbs Topic Probabilities

	Topic 1	Topic 2	Topic 3	Topic 4	Topic 5
1	0.046296296	0.063271605	0.708333333	0.085493827	0.096604938
2	0.013213213	0.557657658	0.312312312	0.060660661	0.056156156
3	0.049873592	0.777752241	0.068490002	0.036543323	0.067340841
4	0.012458074	0.145663632	0.077144226	0.691423095	0.073310973
5	0.022667543	0.07260184	0.059461235	0.74934297	0.095926413
6	0.013352408	0.568431092	0.13018598	0.130662852	0.157367668
7	0.015975336	0.060257848	0.812780269	0.034473094	0.076513453
8	0.573858115	0.274538387	0.044217687	0.06462585	0.042759961
9	0.802060738	0.073752711	0.037689805	0.048806941	0.037689805
10	0.013426037	0.031167586	0.065691681	0.041237113	0.848477583

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