Female online community in disasters:

an analysis of the Pohang mom`s café

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Abstract

This study analyzed the 2017 Pohang Earthquake response activities of victims who participate in the local online community, Mom Café. The Mom Café is oriented from the parenting women who have been recognized as the vulnerability at disaster. However, women affected by the Pohang earthquake showed voluntary and active earthquake response activities through the online community environment. Accordingly, this research analyzed the online posts from the Mom Café Earthquake Preparedness board and to identify the motivation of earthquake response activities.

The result of interviews showed that victims have negative emotions toward the 2017 Pohang earthquake. The earthquake was caused by geothermal power plants and it created the need for earthquake response activities to the victims. Through the activities, earthquake victims felt positive emotions by recovering themselves. This helped to ensure the continuity of the activity. Positive emotions also influenced some users in the Mom Café to become HUB users. They showed high support by conducting various earthquake response activities based on emotions.

The HUB user showed high influences on the information production and mediation in the Mom Café. This affected lay members to behave like the HUB users. Their behavior is to participate in earthquake response activities and to write review postings of the earthquake response activities. It has high support, gives the opportunity to become a HUB user, and keeps earthquake response activities continuously. These activities were gathered into a group, which led to organizational earthquake response actions such as opposition sessions and press conferences. This indicates that online communities can stimulate people to participate in disaster response.

The victims of the 2017 Pohang earthquake responded to the countermeasure against earthquake to relieve negative emotions. Earthquake victims also formed positive emotions to overcome their negative situation. Thus, making good utilization of online communities in disaster situations can eventually decrease disaster vulnerability.

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I. Introduction

On November 15th 2017, a magnitude 5.4 earthquake occurred in Pohang, Korea (BBC NEWS Korea, 2017.11.17). On March 20th 2019, the Korean Government Commission announced that the Pohang earthquake was induced by a geothermal power plant (Ki-bum Kim, 2019.03.19). Before the government's announcement, JTBC, one of the Korean representative broadcasting system, has raised suspicions on the interrelationship between the Pohang earthquake and the geothermal power plant (JTBC, 2017.11.15). The news report claimed that the Pohang earthquake was an artificial disaster caused by the water injection from a geothermal power plant. As a result, Pohang citizen organizations have been asked to investigate the cause of the Pohang earthquake. Among them, there were earthquake response activities led by parenting women in Pohang.

Parenting women groups in Pohang participated in earthquake response activities through an online community named "Pohang Mom Noliteo". This online community is one of the Mom Cafés that is widely run in Korean society. The Mom Café was established to exchange information for childcare and domestic life. This online community is led by parenting women in local areas. That is why the Mom Café can check information about various events in the corresponding area. The suspicion of the geothermal power plant as the cause of the Pohang earthquake was also controversial at the Mom Café. Pohang parenting women used the Pohang Mom Noliteo`s Earthquake Preparedness Board to discuss about this issue. The board users communicated with each other through posts and comments. They also shared their experiences to inform people from the news media. Eventually, communication in the online community led to offline earthquake response activities. The users responded to the earthquake response of community by holding a press conference to investigate the cause of the Pohang earthquake and purchasing banners against geothermal power plants.

It is noted that parenting women led the earthquake response activities. They are vulnerable to disasters because they are responsible for the family by their gender and the role of mother. The anxiety of safety for children caused negative emotions after a disaster can motivate disaster response activities (Terpstra, 2011). Thus, the anxiety about safety of children can lead to earthquake response activities.

The purpose of this study is to focus on earthquake response activities of parenting women in the case of Pohang earthquake. This study analyzed the relation between the emotion of parenting women and the earthquake response activity in the Mom Café, an online community of mothers in Korea. Accordingly, this research intended to suggest the usefulness of online community in future disaster situation.

II. Backgrounds

1. Pohang Earthquake

Immediately after the Pohang earthquake of magnitude 5.4 on November 15th 2017, the issue about its cause had emerged. The Korean broadcasting station, JTBC, raised the possibility of induced earthquake caused by geothermal power plant. The Pohang citizens strongly urged an investigation to identify the cause of the earthquake in Pohang and started a campaign against geothermal power plants.

On November 28th 2017, the Pohang Earthquake Citizens' Countermeasures Headquarters was established online, focusing on victims of the Pohang earthquake. The Pohang citizens who were mentally and physically damaged by the earthquake started actions through the online community service called "BAND" (band.us) on NAVER (www.naver.com) which is the most representative portal site in Korea. On December 16th 2017, the Pohang Citizens' Earthquake Countermeasures Headquarters was launched offline and their activities were centered on the offline headquarters. An internal community of the Pohang earthquake was also formed at the Pohang Mom Noliteo. On November 24th 2017, an official online space was opened to discuss about the Pohang earthquake and its responses named the Earthquake Preparedness board. The community members responded to the earthquake response with the Pohang Citizens' Earthquake Countermeasures Headquarters and Pohang Federation for Environment Movements. In addition, Pohang citizens belong to various civic groups. Citizens held a demonstration against a geothermal power plant and insisted on the investigation on the relation between geothermal power plant and earthquake tremors.

Pohang citizens have actively opposed geothermal power plants. On April 2nd 2018, the Pohang City government organized a private earthquake research team. They filed a lawsuit against the plant for damages on December 19th, 2018. They announced the Pohang earthquake was caused by the geothermal power plant. After the March 20th 2019, Korea Government Commission concluded that the 2017 Pohang earthquake was induced by a geothermal power plant. Pohang citizens held an enactment of the Special Pohang Earthquake Act hosted by the Pohang 11.15 Promote Citizens Countermeasure Committee on June 3rd 2019. Moreover, they raised the National Petition related to the Pohang earthquake and its special act.

2. Pohang Mom Café, Pohang Mom Noliteo

In Korean society, the online community of parenting women called Mom Café is actively run. The Mom Café is composed of mothers who live in a specific local area. Thus, it is used as a space for discussing about various issues in the community. This study focused on the earthquake response activity of Pohang Mom Noliteo. This is a unique case of earthquake response from following three perspectives.

First, Pohang Mom Noliteo is the only group which consists of mothers among civic groups responding to the 2017 Pohang earthquake. The Pohang Mom Noliteo manager provided a space for discussion on earthquake preparedness board through user requests. The users developed earthquake response activities oriented on parenting women by using the provided board. They are mainly engaged in information sharing activities to protect their children and their families from potential risks. For example, they shared how to prepare disaster evacuation bags in their homes without purchasing commercial products, how to apply seismic damage applications, and their experiences of child trauma caused by earthquakes.

Second, various earthquake response activities are carried out at the Pohang Mom Noliteo only with the basic rules of the online community. As a rule, the user should be anonymous. They give their nicknames with the user's birth year and residence area. In addition, the community has prohibiting profanity and using membership ratings. Thus, the rules also apply to the activities of the Earthquake Preparedness board. As a result, the earthquake response proceeded with earthquake response activities without slander and abusive language. This allows users to communicate in a free atmosphere. They write a variety of objective posts for sharing information and subjective posts to relieve anxiety and fear. It also encourages earthquake response activities by using features such as "Like" and "Comments" within the posts.

Third, Pohang Mom Noliteo has a culture of reviews. Users share their earthquake experiences. This also applies when participating in group earthquake response activities conducted by specific civic groups. Thus, the earthquake preparedness board has a structure to share information of various civic groups in earthquake response activities. Pohang Mom Noliteo users often write informative posts shared by other NGOs. As a result, various types of civic groups emerged, including the Pohang Federation for Environment Movements, Pohang Earthquake Citizens 'Countermeasures Headquarters, Pohang Heunghae Emergency Response Committee and so on. One of the most representative cases is a press conference urging the investigation on the causes of the Pohang earthquake together with the

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Pohang Federation for Environment Movements (Seok-Jun Moon., Pohang CBS, 2017.12.19). The press conference was organized by the Pohang Federation for Environment Movements. However, there are many posts in the Earthquake Preparedness board that users encouraged to participate in press conferences and shared the information articles. In addition, users urged to suspend the construction of biomass thermal power plants in the Pohang area. They selected a proper place to insist for participating in campaigns in the Earthquake Preparedness board and worked to receive the document of opposition residents' signatures in front of Hwanho Park, Heunghae Market and Pohang Lotte Department Store. Since then, users who participated in the dissent demonstration wrote a review, which received constant attention within the Earthquake Preparedness board of the Mom Café.

III. Literature Review

1. Online community and disasters

Online community and disasters

Nowadays, people enjoy articles, communities and Social Network Service (SNS) activities in Online. After a disaster, people also enjoy talking about their situation through online communities and social media. Yoo et al. (2016) noted the spread of information after a disaster. The researchers used the user information of Hurricane Sandy in Twitter posts. They chose the information such as post author and creation time. Those represented the information sender(producer) and information diffusion speed. It suggests that online interactions can help in emergency situations. Like this, the online community can have many functions after disaster. One study analyzed the various roles of the online disaster community. There are two main roles of the online disaster community. First, the online community leads the immediate emergency response. The victims communicate in the online community using features such as chat, messages, and posts. Disaster victims can map the damaged areas through detailed information sharing. Also, the community assists the organizational disaster relief. This enables both emotional and economic supports for the disaster region and helps to find missing persons. Accordingly, the use of online community can cover a wide range of issues, including disaster itself, disaster damage, and rescue. (Kodrich, K., & Laituri, M., 2005)

Due to the variety of online contents, prior studies have redefined the variables and contents according to the research method. Jeon and Shin (2013) specified the service posts on SNS and measured the consumer response through the number of comments and empathy of the posts. Shen and Bissell (2013) also measured the consumer response by counting the number of "Like", Comment and Share in Facebook media. Park (2013) reintroduced it and measured as the agreements of comments. In addition, he counted the number of specific information in the article and used for research variables. A study that measured visual information by using the number of pictures attached to a post, determined the degree of information on the post (Ham, 2011). Lee (2005) used the amount of information that attempted to measure the number of post lines. Ko (2009) measured the degree of consumer involvement through event information that provides consumers with some reward as well. One study analyzed information from online posts to identify information and categorize overall post types. It analyzed the reactions of users which is from the famous online community in China during the 2008 Sichuan earthquake. During the first week after the earthquake, the focus was on how users used the online community to respond and recover from disasters. As the results, researchers defined posts into four categories as information-related and opinion-related, action-related and emotion-related. This was

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used to understand what community users think of the Sichuan earthquake and how to respond to emergencies (YanQu et al., 2009).

Previous studies that analyzed the contents of online comments confirmed their relevance to the posts. Jo (2007) identified the relation between comments and articles. Researchers identified the frequency of keywords in comments. The study that confirmed the quality of comments through contents analysis was divided into the usefulness and readability of comments. The usefulness of the comments was based on concrete evidence, and highly reliable information and comments with many interesting elements were selected. In the readability judgment, comments that were easy to understand and had less spelling errors were selected (Kimand Seon, 2006; Lang et al., 2003). Likewise, previous studies used contents analysis method mainly focused on contents itself and the relation between comments and others

Studies that interpreted online content using network analysis have focused on the activities of online community users and their relationship with others. Kim and Hastak (2018) analyzed social networks on the Facebook platform after the 2016 Louisiana flood to develop a pre- and post-disaster mitigation plan. The researchers collected the data about post contents considering the tags among communications of users on the platform. Also, they identified the relevance between users and the keywords on post using the degree centrality and betweenness centrality analysis. The degree centrality revealed that the users in individual units are the core section of the communication in Facebook users. The betweenness centrality revealed the relationship between users in organizational units mainly influenced the information mediation. A study by Panzarasa et al (2009) focused on community usage time to quantify user patterns and measure how much community activity (interaction) they exhibited. They analyzed the users' out-strength based on the number of messages with others to check the biased connectivity between users. Moreover, they tried to identify how users responded to the reactions of others. Since the online community is a small world, they thought that users would build online relationships based on certain regularities. As a result, they identified Hub users who responded quickly. The Hub users have a significant impact on the online community as reproduces and evolves the information.

Table 1 The Comparison of the previous researches to analyze the online contents with own definitions.

Division	Variables	Definitions	Measurements	Judgement basis	References
Comments analysis	Empathy to comments	The number of "Empathy" buttons to comments	Calculate the number of Empathy minus the number of Dislike(Empathy-Dislike)	-	Chang-ho Park; Hye-sun Jeon & Hyung-deok Shin
	malicious comment	How much it gives the harm to person	Contents analysis	Used words that violated social notions such as slander	Tae Hyung Ahn
	Relation with article	How much the comments are related to article	Contents analysis	1 The number of key keywords in the article have been mentioned.	Soo-Sun Cho; Hye Mi Kim & Jun Woong Lee
				2 The content is directly related to the article	
	Comments Quality I: Usefulness	How much the comment contains the information/fact/interest	Contents analysis	1 Evidently based on facts or facts	Eunmi Kim & Seonhwahwa; Lang et al;
				2 The importance of information is high	
				3 There are many interesting elements in comments	
	Comments Quality II : Readability	How much the comment contains the understandable/readability	Contents analysis	1 It's easy to read because there are few slangs, emoticons, or shorthand	Eunmi Kim & Seonhwahwa; Lang et al;
				2 Few Spelling errors and typos, easy to understand	
Online Contents analysis	Consumer response	The number of Comments and "Empathy"	The number of comments and Empathy buttons	-	Hye-sun Jeon & Hyung-deok Shin
	The visual information	The amount of visual information	The number of pictures in posts	1 Have visual information such as photos and videos	Ham Jaemin

			2 Acoustic factors can be used on a limited basis	
Attraction for participating	The contents for consumer engagement	Providing participation information or not	1 Event posts that consumers can join	Seok-ho Ko / YanQu et al
			2 Give the consumer some form of compensation.	
The amount of information	The amount of information included	The amount of lines in a post	-	Hye-sun Jeon & Hyung-deok Shin; Sun-jin Park et al;
Categorical analysis	Information-related	The total number of posts included in each category by four categories	The number of posts in each category	Effective and robust information exchange	YanQu et al
	Opinion-related			Expressing and exchanging opinions by community members	
	Action-related			Planning and coordinating actions	
	Emotion-related			Emotional supports	

2. Women and disaster

Disaster vulnerability in women is manifested in various studies. One study found that women are less likely to receive treatment and have seven times higher mortality rates than men do (Bradshaw and Fordham, 2013). This is because women have several limitations. They have less mobility in cultural situations, have more difficulties in approaching to proper information in disaster situations. The shelters are gender insensitive as well. Accordingly, women become vulnerable when a disaster strikes. Traditionally, mothers are socially vulnerable since they have responsibilities for their families and children (Ahlburg and DeVita, 1992; Ernarson and Morrow, 1998). It is also difficult for mothers to pursue economic income due to childrearing at home. It makes difficulties to provide a safe environment using resources in a disaster situation (Blaikie et al., 1994; Enarson and Morrow, 1998).

As such, many studies argue the needs to consider women in disaster response and recovery. The studies use cases in which women actively responded to disaster response and recovery. In one study, women focused on organizing welfare groups after the Australian wildfires. The affected women reduced the damage by creating community communities (Alstone et al, 2016). Women-driven communities create resilience and support sustainable development in post-disaster. The community will take participatory actions and seek solutions as necessary during recovery. Women-oriented communities make their social networks. It can help the female victims recover mental health from the disaster. Communities address the helplessness, loneliness and anxiety experienced during disasters through communication (Drolet, J. et al, 2015).

3. Online Mom Café in Korea

Commonly, the Mom Café means the online community for mothers in Korean society. This community is the categorical community purposed sharing the parenting information (Armstrong and Hagel, 1996). DeSena (2006) identified that women use their local networks to make the decision and to collect the information. The Mom Café is a kind of the mothers` local network in Online society. Hence the Mom Café has following three characteristics.

First, community empowerment of parenting women is actively performed at Mom Café. According to Nina et al. (1994), community empowerment is defined as a social action. It aims to become the subject in which people want to change the socio-political environment. It is expressed as forming social movements and acting directly for their rights. The Mom Café has become a online space where members find their subjectivity and express their opinions through the role of "Mom". Users share basic

parenting information and deepen it with health and educational part in the online community. Based on information, learning occurs among parenting women. Duflo (2012) argues that empowerment occurs in women through learning and education. The community empowerment occurs when people communicate and change (Freire, 1987).

Second, the Mom Café shows the women-led grassroots movement (Grassroots women) and social participation behavior. Batliwala (2002) argued the grassroots are the people based of local society. It is sometimes referred to socioeconomic alienation, such as the poor and the working class. Accordingly, the grassroots movement is the political expression of lay people in organizational units. The Café seems to have similar characteristics as women-led grassroots movement from Jenkins (2008). They act voluntarily but do not pursue the economic profit. Also, it shows the bottom-up level of decision making because there is no literal leader except rule manager.

In addition, Mom Café, the online space has formed a continuous grassroots movement as its ease of access and use. The most representative example of this is the Mom Café`s boycott. Recently, "NO JAPAN", which is the boycott of Japanese products, is ongoing in Korean society. Many Mom Cafés share a list of Japanese products and Korean replaceable items. Moreover, some Mom Cafés have created a bulletin board called "Boycott Japan", demonstrating the potential for continuous movement. Members of Mom Café support movements with writing the review article such as purchasing or using replacements for boycotts (Sang-Ik Lee., Daily Today, August 5, 2019).

Third, Mom Café shows the Emotional support. Erina (2003) found that women express more emotional support than men. The study also found that women expressed more empathy by seeking needs and help in posts. This shows that emotional support among users in Mom Café is more frequent than other communities. This feature affects Mom Café users' empathy with local events. It may be net function or dysfunction in society. For example, in October 2018, a nursing teacher who was suspected of child abuse at a local Mom Café suicide. The case of the nursing teacher formed an emotional public opinion within the Mom Café, and then bcame into a collective action called "protest" in offline (Jun-cheol Park., Hyanghyang Newspaper, Oct. 15, 2018). The problem of Mom Café, referred to as witch hunting and cyber bulling, appeared as the Blue House National Complaint on October 15, 2018, showing the influence of the group name 'Mom Café' (Jin-gu Lee., Dong-a, Nov. 3, 2018).

The Korean Mom Cafés are often formed on the portal site called NAVER(www.naver.com). According to Park et al. (2005), the portal site was created in 1998 and ranked first in the Korean Web Search category in 2003 in the National Customer Satisfaction Index. An average of 7,000,000 people use NAVER daily (reference). NAVER users can perform various activities such as writing news comments, SNS, Live show (V app), web search and online community. NAVER organizes activities

in a similar form to share various functions. Thus, the types of online community services used by Mom Café members are similar. Basically, there is a post writer and comment writer service with two-way communication principle. And users can communicate directly by activating individual or group chat only for the desired user. The bulletin boards are classified according to the age, grade of children and residence area. Also, there is a space for offline meetings. The Mom Café helps the lay user, "Mom", to make various kinds of relationships (Farrior et al., 1999).

IV. Research framework

1. Research questions

After the 2017 Pohang earthquake, parenting women showed the active response activities. They made the social relation to take the earthquake response actions. This social relation is formed in online community. So the parenting women worked in online community to decrease their damage. Thus, this study has the purpose to find the motivation of earthquake response activities among parenting women in the online community. This research tends to identify the emotion of victims related to the earthquake response activities influencing the motivation.

This study consists of qualitative interview, online contents analysis and user network analysis. All analysis was based on the posts from the Earthquake Preparedness board in Pohang Mom Café named Pohang Mom Noliteo (here in after called 'Mom Café'). The semi-structured questionnaires were conducted to gather experience from the Pohang Earthquake and its response behavior in qualitative interview. The network analysis identified the relationship among the users. The purpose of the network analysis was to find the characteristics of information exchange in the Earthquake preparedness board with identifying the leading user (HUB user). Through the online content analysis, the research identifies the sentiment of the post and the behavior of users. This research measured the user support score and sentiment score of the post. This identifies the sentiment related to the actions.

2. Methods

This study conducted mixed method analysis. The researcher interviews with Mom Café users and utilizes content analysis from posts of the Mom Café where they are active, and network analysis among each user.

2.1 Qualitative interview

The interview was targeted with users of the Mom Café Earthquake Preparedness Board. Two interviews were conducted. On April 13th, 2018, the focus group interview was first conducted with five users. Since then, individual interviews have been held from May to June 2019. Individual interviewee was limited to whom had a high impact on both information production and mediation within the board. After that, parental status and economic activities were checked as an additional condition and subjects were selected for those had a Pohang earthquake with their children. As a result, interviews with individuals were conducted with four users. The Mom Café Earthquake Preparedness Board has an online earthquake response activity followed by an offline earthquake response. The interview lasted about an hour using a semi-structured questionnaire.

Interview questions consisted of the following categories: 1) Feelings about Pohang Earthquake; 2) Experience in Pohang earthquake preparedness activities in organizational unit; and 3) Changes through earthquake response activities. In the interview, the reasons for participating in earthquake response activities were investigated based on the emotional status of the interviewees. The main questionnaire was about what kinds of activities the interviewees had done and how they felt at that time. The emotional experiences included interviews with worries and concerns about the expectant children as well as interviewees. In order to understand the emotions of the interviewees, the Korean emotional morpheme was considered (Hong&Jeong., 2009).

Table 2 The Interview list with the types and date (9 interviewees)

ID	Interview Type	Date
A	Focus group	April 13th 2018
B	Focus group	April 13th 2018
C	Focus group	April 13th 2018
D	Focus group	April 13th 2018
E	Focus group	April 13th 2018
HY78	Individual	May 25th 2019

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BJ78	Individual	June 24th 2019
BD82	Individual	June 24th 2019
HH82	Individual	June 25th 2019

2.2 Network analysis

The social network analysis was conducted for the Mom Café Pohang Earthquake Preparedness board users. Users are classified into two types: post writer and comment writer. This is used to check the degree of information exchange and influence between users. After that, high-impact HUB users were selected. The keyword analysis was conducted for the post written by the user. This identified the material that affected the influx of posts between mom Café users. The research used Net Miner 4.0 as an analysis tool. Net Miner is software from Korea's CYRAM company that uses social network analysis techniques to assist research, learning and professional analysis. (Kim et al., 2014). Using social network analysis, all data has nodes and links. Nodes are individual IDs that identify data, and links represent the number of connections between nodes. The more links a node has, the more the connections between other nodes. Links can also be directional, specifying direction when the sender and receiver are separated (CYRAM, 2012).

Network analysis performs centrality and coherence analysis. The Centrality analysis uses two indicators: Degree Centrality and Node Betweenness Centrality. The Coherence Analysis uses Community (Betweenness) indicator. Since degree centrality is higher with more directly connected nodes (users), I can know the magnitude of direct influence (Freeman, 1978). It can also be used as an index to evaluate the oral influence of nodes (users) (Morrison, 2002; Song, 2015). In this study, the higher the degree centrality, the more users attempted to interact with the user's posts and comments. Since node betweenness centrality is measured by the frequency of mediating connections between different nodes (users). The more nodes appear in the shortest path between nodes, the higher they appear. It is possible to identify nodes(users) that mediate the flow of information between nodes that are not directly connected in the entire network (Opsahl et al., 2010). In addition, it selects users with high connection (degree centrality) and intermediary (node betweenness centrality) at the same time and defines them as HUB users. The user has an outstanding influence on both producing the information directly and delivering the generated information. Accordingly, they can form the public opinion flow of the Earthquake Preparedness board. It is expected that earthquake response activities focused on HUB users will be able to play the role of leader at the board. Community: Betweenness clusters nodes of similar attributes. By connecting around specific nodes, this research captures the big features that surround each node. In this analysis, community cluster indicator analysis was conducted,

Social network analysis is focused on the morphology measured by the interactions between units (Wasserman et al., 1994). The interaction between users defined in this study is "Opinion exchange". At Mom Café, there are two ways to exchange opinions. The first is the behavior that occurs between the author and the commenter. The two users exchange opinions by writing comments. Usually, commenters read posts and write comments. The second is the interaction between commenters and re-comments. Responders can reply using re-comments function. The function admits referring to a specific person inwriting comments. In summary, there are two kinds of exchanges in this process, the ones that refer to a specific person with comments and the other that do not. For data analysis, refer to Kim and Hastak (2018).

The network analysis was conducted after all the users of the Earthquake Preparedness board. In addition, according to the theorem, since the voluntary exchange of information between Mom Café users, it was judged as the data without direction (Kim et al., 2018). For example, there is a situation like Figure 1. ABCDs are all different users in the picture. A is the author of the post. B read A and wrote a comment (A-B). Thus, there was an exchange of opinions between A and B. C read and responded to B's comment (B-C). Therefore, there was an exchange of opinions between B and C. B then replied, referring to C (C-B). There was another exchange of opinions between C and B. The author of the post, A, also commented on C and commented on it (C-A). There was an exchange of opinions between C and A. Subsequently, since D wrote a reply referring to C, an exchange of opinions occurred between C and D (C-D). This can be referred to Table X.

Figure 1 The example of the communication in the Mom Café.
Note: The A,B,C,D are the users. A is the post author and others are the commenters. The yellow box means the writer of the communication, post author or commenter. The blue box means the tagged users ID.

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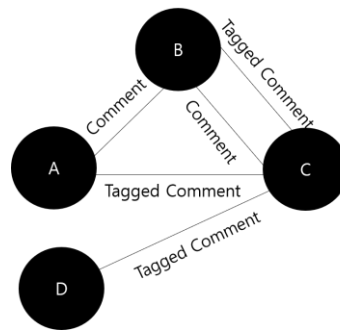
Figure 2 The data connection of the user network of Figure 1 example`s communication[1]

2.3 Contents analysis

The content analysis of this study was conducted based on the contents of the Earthquake Preparedness board of Pohang Mom Noliteo (Mom Café). The board was opened after the Pohang earthquake on November 15th, 2017, with the suggestion of users. The web crawling technique was conducted by using R and PYTHON to collect content data (Mitchell, 2018). Through this technique, all the articles the users wrote, links to shared news articles and images were collected. Since then, all posts by users who are not supposed to be parenting women have been removed. Eventually, a total of 1,337 articles were collected on August 9th, 2019. The first article on the Earthquake Preparedness board was written on November 24th, 2017, and the most recent post at the time of collection was written on July 22nd, 2019.

After that, the content analysis was classified into four periods (Chung and Yun, 2013). The analysis period was based on the events that were the subject of the bulletin board. In the first stage, the incident occurred after the Pohang earthquake occurred, and the Pohang Citizens' Earthquake Countermeasure Headquarters(포항범시민대책본부) representing the entire Pohang area occurred. Since the earthquake of magnitude 5.4 (BBC NEWS Korea, 2017.11.17) occurred at the time, there was an active exchange of information on earthquake response on board. On February 11th, 2018, the second and third period were distinguished based on the aftershocks of 4.6 magnitude in Pohang (The Korea Meteorological Agency's Seismic Volcano Monitoring Division, Feb. 11, 2018). On March 20th, 2019, the government investigation team announced to identify the relation between Pohang earthquake and

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[1] Joo-ho Kim., & Hastak, M. (2018). Social network analysis: Characteristics of online social networks after a disaster. International Journal of Information Management, 38(1), 86–96. https://doi.org/10.1016/j.ijinfomgt.2017.08.003

Geothermal power plant (Lee et al., 2019). There were many discussions at the Mom Café for the contents of the survey and the future response. The case was defined as third period and the all posts were arranged in four period.

Table 3 The Pohang earthquake issues with periods in the Earthquake Preparedness board

Term	Period	Issue	Posts
1	2017.11.15~ 2017.12.16(30days)	Pohang earthquake occurred~ Pohang Earthquake Citizens' Countermeasures Headquarters established	277
2	2017.12.17~ 2018.02.11(57days)	After establishment~ Aftershock earthquake occurred	394
3	2018.02.12~ 2019.03.20(402days)	Aftershock occurred ~ Korea Government Commission announced	647
4	2019.03.21~ 2019.08.09(151days)	After announcement~ Present	30

2.3.1 Variables

A total of four items were measured for the articles selected for the analyses. They were classified into article content analysis, user behavior analysis, user support analysis and user sentiment (emotion) analysis. For the article content analysis and the user behavior analysis, the tone and type of the posts were determined by the coder's judgment using coding scheme. Posts can have up to two types of tone. The object of analysis must have one type and tone according to the analysis of post content. According to the user behavior analysis, one additional case was selected. User support analysis is represented by the number of LIKE counts and comments. So, the coder didn`t measure it separately. User sentiment(emotion) analysis studied the classification and examples of the emotions by the practice. The coders were also offered the example emotion morphemes with the coding scheme.

As a result, the variables have three coding schemes. Coders conducted pilot tests and data coding based on the coding schemes. Coders also learned about the coding scheme and found exceptions that were not present in the scheme. This was discussed with the coders and reflected to the scheme. The coding scheme I, II and III are the final version provided to the coders during pilot test and data coding. Also, all the references in the coding schemes were used to determine the measurements and the basis of the judgement to each variable.

Article content analysis

① Information post – Objective tone: This is the type of informative contents including visual information(Ham, 2011). It is focused on delivering the facts and information. The content should contain a concrete basis or a clear source of fact. This is regarded as an objective tone because the article was written with only the facts from the observer's point of view (Chung and Yun, 2013)

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② Opinion post – Subjective tone: This is the type of focusing on the opinion of authors. Editorial and column in the newspaper are included. When the post combined with the fact information, the coders count the amount of descriptive contents in post. If the descriptive part is over the half of the post, the coders determine the post as the Opinion post with the subjective tone (Chung and Yun, 2013)

③ Composited post – Combined tone: This is the type of containing fact information and description. This type of post could identify both tones, the objective information and author`s opinion (Chung and Yun, 2013). If the descriptive part is less than half of the post with factful information, the coders determine it as the Composted post with combined tone.

User behavior analysis

① Action-related post – Participatory tone: This is the type of attracting the Earthquake response participation (YanQu et al., 2009). It contains the information of active behavior like National petition. All users of the Mom Café could access it.

② Question post – Questioner tone: This is the type of question and answer in the Earthquake Preparedness board. It contains the specific question or answer. For example, the cases of an aftershock earthquake and an earthquake damage application procedure are asked.

User support and sentiment(emotion) analysis

① User support score: User support score consists of two kinds, and these are not combined. One is the number of Comments, the other is the number of "Like". It measures based on the amount of Comments and LIKE on the post (Shen and Bissell, 2013). The Mom Café users put the button when they agree to the post. Also, when they think it is necessary, they write the comment to receive or show their opinion. Thus, the more amounts of comments and LIKE exists, the higher support takes by users. The number of two support score from each post were collected in this research, however the support score was separately considered.

② User sentiment (emotion) score: It measures the sentiment of authors based on the post contents. User sentiment score is the frequencies of emotional words (morpheme) in each post (Tong, 2001). Thus, it can be various kinds of sentiment in one post. To define the kind of sentiment, it is limited as the 6 types of observed emotions in Earthquake Preparedness board. The emotions are Joy, Hate, Sadness, Dread, Surprise noted by Eckman (1992). The coders use the Korean morpheme (Hong and Jeong, 2009). The average sentiment score per post was calculated to compare user behaviors.

Table 4 Coding Scheme I for Article content analysis

Division	Tone	Variables	Measurements	Judgement basis	References
Article content analysis	Objective	Information post	Posts that only contain news and other information, including visual information	1 Share only facts	Jae-min Ham
				2 Specific evidence based on a clear source or fact	Lang et al
				3 Includes visual information such as news stories, image captures, and video	
	Subjective	Opinion post	Posts that focus on the author's claim	1 Identify the author`s opinion	
				2 A post that shares an individual's claim, such as an editorial	YanQu et al
				3 Description written by the author exceeds ½ of the total amount of posts	Ji-bum Chung and Gi-woong Yun
	Combined	Composited post	It is based on facts but contains a part of the author's commentary.	1 Include the facts, information	Ji-bum Chung and Gi-woong Yun
				2 Description written by the author is less than ½ of the total amount of posts	

Table 5 Coding Scheme II for User behavior analysis

Division	Tone	Variables	Measurements	Judgement basis	References
User behavior analysis	Participatory	Action-related	Posts that encourage Mom Café users	1 There is guidance on the earthquake response behaviors that users can participate in.	YanQu et al
				2 There are direct actions such as National Petitions and assemblies.	
	Questioner	Question post	Containing the question in post	Specific questions such as earthquake occurrence and earthquake damage application procedures	

Table 6 Coding Scheme III for User support and sentiment analysis

Division	Variables	Measurement	Judgement basis	References
User support analysis	User Support	Comments and LIKE counts	Views are not included because bulletin board posts are divided into public and private posts.	Shen B and Bissell K
User sentiment analysis	User Sentiment	Contents analysis	Using negative emotional keywords in posts	Jong-sun Hong and Yeon-ju Jeong
			Used Sentiment: Joyful/Sadness/Anger/Hate/Surprise	Eckman / Tong

2.3.2 Intercoder Reliability

In this study, two coders were trained and employed to analyze the post. Each coder conducted article content analysis and user behavior analysis based on the contents of the posts. They also measured six emotions (joy, sadness, surprise, fear, hate, and anger) based on emotional morpheme. In the training session, three hands-on exercises were conducted using the article example. After each training, a meeting for coordinating the determination was held with coders. The pilot test was conducted using 32 examples. For all training and pilot tests, the coder was provided with the same coding scheme as Tables 4, 5, and 6 above, and used Table 7 as an example of emotion morpheme for the sentiment analysis. The synonyms and antonyms were judged by the individual coders and they shared their opinions on those at the meeting. For example, the meeting found an emotional morpheme "displeased" and decided to classify "hate" through discussion.

Before a pilot test result, the variables were mixed with different types. The article content and user behavior are Nominal variable and the user sentiment is ratio variable. Thus, the correlation between coders was calculated using the Krippendorft`s Alpha (Krippendorff, 2011). To calculate it, the SPSS MACRO for Krippendorft`s Alpha was utilized (De Swert, 2012). The coders interpreted differently to determine the nominal variables. Accordingly, the training was repeatedly conducted. As a result, the article content analysis, the first nominal variable, showed 0.87 score of Krippendorft`s Alpha. The user behavior analysis, the second nominal variable, recorded 0.803 score of Krippendorft`s Alpha. The user sentiment analysis, ratio variable, was assumed no difference between coders. Thus it compared the frequencies of each emotion between coders. Hence, all six kinds of emotions were determined as there was no difference (Krippendorf`s Alpha = 1.00). As a result, a total of 1,337 data were generated.

V. Results

1. The result of Qualitative Interview – Pohang earthquake and mothers

Interview aimed to find the reason for the earthquake response behavior based on the emotions on parenting women. Also, the research trended to identify the relation between the response behavior and the vulnerabilities when parenting women are put in disaster situation. Thus, this research analyzed the interviews into three categories: 1) Emotion to Pohang earthquake; 2) Experience of earthquake response behavior in organizational units; and 3) Change through the Earthquake response behavior. These categories consisted of the emotion that used in user sentiment analysis.

1.1 Emotion to Pohang Earthquake

SADNESS at the stage of evacuation

Interviewees felt dreadful, fear and helpless when they evacuated. This is related to the vulnerability which means parenting women had less economic independence. When they evacuated after the earthquake, they felt sad. Because they did not know what to do and could not do anything.

"(At the evacuation) I couldn`t do anything outside when the earthquake occurred. I called my husband for help but he could not come to because he was working. So then he said we need to stay outside until his work end. We trembled in the cold until he came. Even if there was no light, but all the stuff and cars were leaving the playground. - (2018.04.13, A, Focus group Interview)

The parent who had baby infants had difficulties during the evacuation process itself. The mothers in the focus group interview showed the trauma.

"The earthquake occurred when I was home with my second son. He was one year old, so he can barely walk. The apartment was shaking until I reach the outside. I could hear the sirens of 911 all around, so I thought it would hurt a lot. In that situation, I couldn't go anywhere. As I didn't have a baby belt and diaper. Although, it was cold outside, I took my second son with no shoes and went out to take care my first son. I had no choice." (2018.04.13, B, Focus group Interview)

ANGER to Geothermal power plant

"Well, there was no one who knows about Geothermal power plant issues. We just knew by watching the JTBC broadcast." (2018.04.13, D, Focus group Interview)

All interviewees knew nothing about geothermal power plants before the Pohang earthquake. They learned from the news media about the existence of geothermal power plant and the potential risk for induced earthquakes. The Earthquake Preparedness board was created at Pohang Mom Noliteo. The users expressed anger toward the geothermal power plant. It was speculated that the Pohang earthquake could be an induced earthquake cases and other national earthquake experience.

"Before Gyeongju earthquake and Ulsan earthquake the Pohang earthquake was regarded as a natural disaster. So it was just fear. I did not feel any anger." (2019.05.25, HH82 Interview)

"The most upset point is the geothermal powerplant had the previous earthquake case, the overseas one. Furthermore, I wanted to strongly complain against the Geology Research Institute near Pohang area. What do they do research? And Pohang citizens don't know the plant was even near located." (2019.05.25, HY78 Interview)

"Since the earthquake was caused due to the geothermal power plant being reported in JTBC news. (we thought) wasn't this a natural disaster? Was it man made? Should we just stay? Many people thought a lot about this" (2018.04.13, A, Focus group Interview)

1.2 Experience of earthquake response behavior in organizational units

Dread to the children`s safety

Women are vulnerable to disasters with their responsibility for home and parenting. When the Pohang earthquake occurred, the interviewees also felt a lot of concern and responsibility for their children. But based on that, parenting women felt the need for earthquake response activities.

"We have a child. I am responsible to take care of him. So I feel scared. If not, I would not think about it at all whether the earthquake occurs or not." (2018.04.13, C, Focus group Interview)

"The driving force is children. If I don't have children, I won`t go for something. I don't think I have to do it. But my children now live in here, and anyway, until they are 20 years old, they go to another place and get a different company. I think I have to change a myself as they grow up safely." *(2019.06.25, HH82 Interview)*

Interviewees say the online community has helped with earthquake response activities. They were stimulated by each other's posts and worked together. It couldn't have been done alone, but the online community, Mom Café, allowed them to discuss their opinions and encourage each other. The Mom Café is the online community for mothers. All members can understand their dread and give empathy to each other. Ultimately, they met in person to solve this problem.

"(If I was alone) I couldn't have done it rather than feeling hardship. I didn't think I would be interested in it. Because it wasted my time a lot to making banners and uploading the post in the Café. <u>But I thought that we could do something as we are together</u>." *(2019.06.25, HH82 Interview)*

"Frankly speaking, an individual could not do these things even if she was interested. To be honest, I felt we, my children and I, could die in this earthquake disaster. (...) Thus, even if I had an interest but didn`t know what to do. "(2019.06.25, BJ78 Interview)

<u>*HATE: Self-reflection with earthquake response behaviors*</u>

Since mother` role and social perception have not changed much in modern times, women are still passive and vulnerable to disaster especially in Korea. However, after the Pohang earthquake, the behaviors of mothers in the Pohang region were somewhat different. The mother of Pohang city behaved actively to the earthquake response. They held a press conference to investigate the cause of the Pohang earthquake and geothermal power plant together with the Pohang Federation for Environment Movements.

"Mom Café named Pohang Mom Noliteo called me first to require safety measures. I had a chance to meet young mothers in my apartment. The mothers in the Mom Café community heard this and told me. They worried about the geothermal power plant, so they insisted on monitoring. Since then, we had a press conference asking for safety, including earthquake shelters and geothermal power

plants."(2018.03.24, A, Pohang Federation for Environment Movements.)

The users of the Pohang Mom Noliteo Earthquake Preparedness board faced the Pohang earthquake with an active attitude. The community participated in a protest of geothermal power plants and produced the banner against geothermal power plants. To prevent the occurrence of another earthquake, they opposed the construction of energy plants such as biomass thermal power plants, participated in various public hearings, and submitted the opposition of residents' signatures.

"Just as a response or asking for these things, try to stop the biomass plant from entering now? (...)
After working with an environmental organization, response behaviors became more environmental.
Anyway, <u>we realize that it is important because it is an environment</u> where we live with children."
(2019.06.25, HH82 Interview)

The earthquake response activities of parenting women represented by Pohang Mom Noliteo are voluntary and active. This is an extension of activity offline through repeated discussions within the online community. Interviewees emphasized that they were ordinary full-time housewives. It is difficult for the interviewee as a mother, so she lacks professional knowledge and is not a mainstream class of economic activity. Thus, all interviewees said that they completed earthquake response activities through the online community.

"<u>We are just mothers</u>. As we were so much depressed, we used the Mom Café. The post is updated fast that we determined to change something. (...) At that time, we made a banner. This is a man-made disaster, we ca not admit the operation of the geothermal power plant. <u>So, we made the additional SNS and studied about earthquake relevant with others.</u>" (2018.04.13, B, Focus group Interview)

"I did not know whether a geothermal power plant exists or not. At that time, I found out that I was too ignorant. Even though I was a Pohang citizen, I didn't know what kinds of facilities were next to me. <u>I regretted myself, because the fear of the earthquake still existed.</u>" (2019.06.25, HH82 Interview)

After the Pohang earthquake, the relation between the geothermal power plant and the Pohang earthquake that emerged. With this issue, the direct damages that experienced became the basis for the

emotional behavior. They tried to solve the lack of information and indifference. There are anxiety and fear. That if I don't act, earthquake can cause harm to my family again

Positive Emotions through the Earthquake response behavior

Interviewees got the earthquake response behaviors through the self-reflection and development. This made the positive development to them. One of the cases, interviewees could overcome trauma through earthquake response activities. She got the confidence to her children`s safety. These changes have encouraged interviewees to recommend and push the earthquake response activities to others. In the end, this behavior becomes the wills of improving negative emotional states.

"Now I feel the trauma less than before. At that time, I felt that even falling sound made me scared. I couldn't work normally in daily life due to shaking hands. (…) No one can know when the earthquake comes. So it feels better because just in case, I can take care my children when I am with them." (2019.05.25, HY78 Interview)

"Oh, first I saw that SJ82 user`s post. Moms shouldn`t just sit here, let's do something. (…) I want mothers not to lose interest in here, so I keep contact and told them to see again." (2019.06.25, BD82 Interview)

"I did not know whether a geothermal power plant was existent and did not know that makes the earthquake either. But I thought I knew the (safe) way, response much faster than others whatever Pohang City does, through this activity." (2019.06.25, HH82 Interview)

In summary, parenting women have developed their earthquake response behaviors. They used online community to give the support and empathy. Interviewees noted the same reason for the response. They are working in groups as mothers to ensure the safety for their children. In the process, new social relations are formed to achieve a mental health recovery. Also, this is not the only positive effect. According to the study, the existence of a community is important. It can help the vulnerable during a disaster to build the community resilience (Rachel et al, 2019). Community resilience helps the vulnerable to respond to disasters and to recover from them.

2. Network analysis results

2.1 Basic result of User Network analysis

The total data has 3657 nodes(users), but the data has been preprocessed within NetMiner 4.0 software for analysis. The number of links was set to two or more weight references, leaving only nodes that had more than two interactions. Afterwards, The nodes were reanalyzed for whose degree centrality exceeded zero. The degree centrality 0 was interpreted to mean that it has no influence from other users. In conclusion, a total of 2014 user data were used for analysis. The basic analysis results of the whole network provide Density, Degree Centralization, and Betweenness Centralization. Density was an index between 0 and 1 that indicates the connection between nodes. The analysis showed that there were 0.002(0.2%) connections between nodes(users). It means that the interaction between users in the network was sporadic and relaxed. The degree centralization was 12.811%, which shows that the node is not much biased. The betweenness centralization was 32.998%, somewhat higher than the link center. This indicated that there is a user who works significantly with other users.

Table 7 Basic results of the users` network analysis

Index	Value
Node	2014
Density	0.002
Degree Centralization	12.811%
Betweenness Centralization	32.998%

2.2 Degree centrality analysis

The Mom Café users have a similar level of influence. There was also information exchange among various users. By multiplying the number of nodes by the degree centrality index, the number of nodes was assumed in the direct network (Sun-deok Kim et al., 2014). According to Table 8, the SJ82 had the highest impact index of 0.129652 and had a direct network with about 262 users. The average score of 36 people, whose the degree centrality index was the top 1% of the number of users was 0.02305, which referred that they were connected to 47 users on average.

The higher degree centrality score makes, the more ability to producing information. It refers the high score user writes more posts, so she has the more opportunities to get the attention than other users.

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Thus, the posts of high score user will raise the continuous communication and the frequency of user activities. She would affect keeping the all kinds of earthquake response behavior online and offline. It made her the core leader in the earthquake action.

Table 8 The top 1% users of degree centrality score

Rank	ID	Degree Centrality	Rank	ID	Degree Centrality
1	SJ82	0.129657	19	MH80	0.015897
2	HY78	0.073522	20	HD91	0.014903
3	HH82	0.04769	21	SJ85	0.014903
4	KC71	0.03229	22	LB72	0.014903
5	EL82	0.027322	23	KC68	0.014903
6	YO77	0.025832	24	SH86	0.014903
7	KJ82	0.023845	25	TY74	0.014903
8	PH84	0.022355	26	HJ78	0.014406
9	SH80	0.020368	27	CY76	0.01391
10	HH72	0.020368	28	DS81	0.01391
11	BD82	0.019871	29	TW83	0.013413
12	NY79	0.018877	30	PJ78	0.013413
13	TH83	0.018381	31	SC75	0.013413
14	SH81	0.018381	32	IW86	0.012419
15	MY82	0.018381	33	MH89	0.012419
16	HH82	0.018381	34	MJ83	0.011923
17	YH80	0.018381	35	TW83	0.011426
18	NJ78	0.01689	36	OH77	0.010929

2.3 Node betweenness centrality analysis

SJ82 and HY78 had the higher node betweenness centrality score than other users. It refers they appear in the center of the other users` communications much more than others. Other users communicated through the SJ82 and HY78. Brandes et al. (2016) studied the higher node betweenness centrality score gives the opportunities for mediating and communicating the information within the users. The Mom Café Earthquake Preparedness board was mediated by them. Thus, if some users were not linked with them, the information would not be spread smoothly.

They also used to make the new communication and deliver the information. Thus, they wrote more

comments and contacted more with others. They tried to solve the problems and issues using posts and comments. It made the more chances to be called (tagged) by other users in comments. This infers that other users remember the contents of SJ82 or HY78 in the board. Their behaviors were discussed, so it made the inflow of other users in their behaviors. They were contributed to the organizational behavior in the Earthquake Preparedness board.

Table 9 The top 1% users of betweenness centrality score

Rank	ID	Betweenness Centrality	Rank	ID	Betweenness Centrality
1	SJ82	0.331281	19	MH80	0.023633
2	HY78	0.136958	20	NJ78	0.023014
3	KC71	0.061828	21	TH83	0.022485
4	HH82	0.060018	22	MY82	0.022176
5	KJ82	0.048573	23	SH86	0.021335
6	HH72	0.040099	24	KC68	0.021123
7	EL82	0.040052	25	HJ78	0.020791
8	YO77	0.039995	26	MH89	0.020197
9	PH84	0.039478	27	DS81	0.019888
10	TY74	0.035187	28	MJ83	0.018208
11	YH80	0.034802	29	SH81	0.017743
12	SJ85	0.031232	30	DY88	0.016968
13	NY79	0.030078	31	PH83	0.0169
14	SH80	0.029844	32	HH82	0.015222
15	CY76	0.025395	33	LB72	0.014733
16	HD91	0.024441	34	BJ78	0.014039
17	BD82	0.024305	35	KM86	0.013917
18	OH77	0.023675	36	SC75	0.013486

2.4 Network community(betweenness) analysis

This community analysis used betweenness centrality (Tyler et al, 2005). The method can identify specific groups of users. The group influences the tendency of the whole users. The NetMiner 4.0 program examined the cluster based on Modularity. As a result, the modulus was 19.07 with the highest value and the number of clusters was 76. The number of communities was too many so there were many duplicated users to each community. This showed that it was not possible to distinguish specific clusters

between users. Thus, the Mom Café Preparedness board users did not have biased opinion from specific groups. In addition, it can be inferred that in the earthquake response activities, they worked with various users and voluntarily without the control of specific groups.
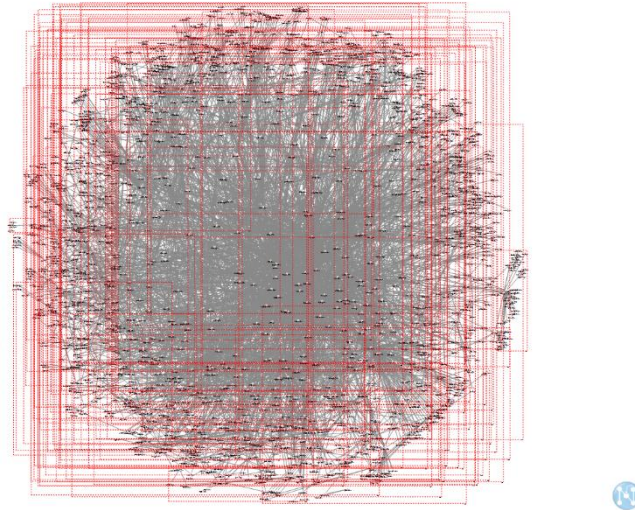

Figure 3 The communities of user communication.
Note: The red box is the boundary of group. Each group includes at least 2 users.

2.5 HUB user analysis

There were the users who have the both high in degree centrality and node betweenness centrality. These users can link the information among other users while they receive attention from others. Thus research designated them as the HUB USERS, the core active users in the board, and seek to find the characteristics of their posts.

2.5.1 Select the HUB user

HUB users were selected through network centrality analysis. Degree centrality and Node betweenness centrality were used to make the boundary of the top 36 users (about 1% of all users). HUB users should be ranked top 1% of both centrality score. Accordingly, the final HUB users could be selected less than 36 users.

Finally, 32 users are selected as the HUB user. The users with high degree centrality and node betweenness centrality (HUB users) provided a common issue. It attracted users' attention and connected with other users through direct posts. Many users could gather around the issue. Two of the 32 selected HUB users did not write a single post. Nevertheless, the reason why their centralities were high can be inferred to the comments. Because it affected directly to users with communicating specific

person in the comment section. If another user read some comments and wrote a comment referring to them, and the frequency of this situation is high, it could be more influential than a user who just wrote a post. However, this analysis only considered the content of posts written by HUB users. Thus, a total number of posts of HUB users used for keyword analysis was 376 posts.

Table 10 The list of selected HUB user list
Note: All users are included the top 1% of both the degree centrality and betweenness centrality score.

	HUB ID		
1	SJ82	17	MY82
2	HY78	18	HH82
3	HH82	19	YH80
4	CH71	20	NJ78
5	EL82	21	MH80
6	YO77	22	HD91
7	KJ82	23	SJ85
8	PH84	24	LB72
9	SH80	25	KC68
10	HH72	26	SH86
11	BD82	27	TY74
12	NY79	28	HJ78
13	TH83	29	CY76
14	SH81	30	DS81
15	SC75	31	MH89
16	MJ83	32	OH77

After that, text mining was conducted using the same software NetMiner 4.0. Several data preprocessed for text mining. First, the TF-IDF was specified. It is the importance of each word in a document by the frequency. It was calculated by dividing the frequency of words in a specific document and the ratio of the document in which the word (Ramos, 2003). The software suggests TF-IDF (importance by the frequency of word appearance) of 0.1 or more in article analysis and 0.5 or more in twitter SNS analysis (CYRAM, 2012). The analysis is conducted based on 2 criteria considering the characteristics and number of HUB user posts on the Earthquake Preparedness board. In addition, meaningless words and typos were removed. The word should be two or more letters in length, 15 or more occurrences, and three or more posts in which the word is used.

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2.5.2 HUB user post keyword network analysis

Figure 4 shows the two communities of post keyword network analysis. The Community (Betweenness) functions was conducted to identify the cohesion of the keywords. This represents the relation between the keywords that wrote in the HUB users` post. So it is helpful to find the main issue which the whole users were interested in. The size of nodes represents the proportional to the number of links to keywords. This analysis proved HUB users had actions as the leader of the Earthquake Preparedness board with communicating the information in Online community.

G1 community shows the informative keywords to the victims. It represents how the victims needed the information related keywords. For example, "Damage", "Application", "Shelters" are the repeated as lack of information. One of the biggest nodes, "CO2", was related to aftershock earthquake at February 2018. The aftershock occurred near the CO2 landfill, so the victims needed the information about it. It appears the connection with G1 community`s keyword "Geothermal". It can be inferred that they had a doubt the similarity with the CO2 landfill and the Geothermal power plant. HUB users shared the information of this doubt to prepare the hazard.

Next G2 community showed the organizational behavior keywords. The biggest node was "Project", and it was appeared with "National Petition" and "Public hearing" keywords. It came from the Geothermal power plant business issue with 2017 Pohang earthquake. From the G1 community keywords, it can be inferred that that the users thought the energy powerplant would affect the earthquake. Thus, they did the organizational disagreements with the offline behaviors to the power plant business in Pohang.
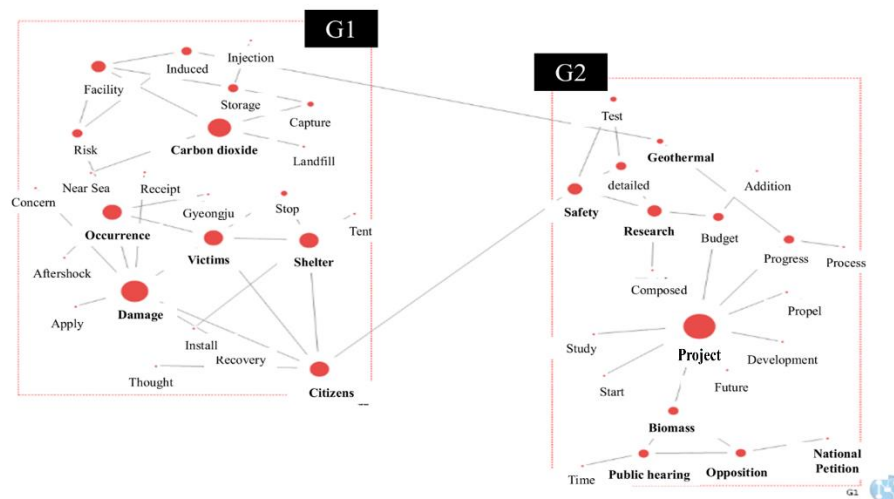

Figure 4 Keywork community network of the HUB users` post

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3. Contents Analysis results

3.1 The frequency analysis of user sentiment in Earthquake Preparedness board
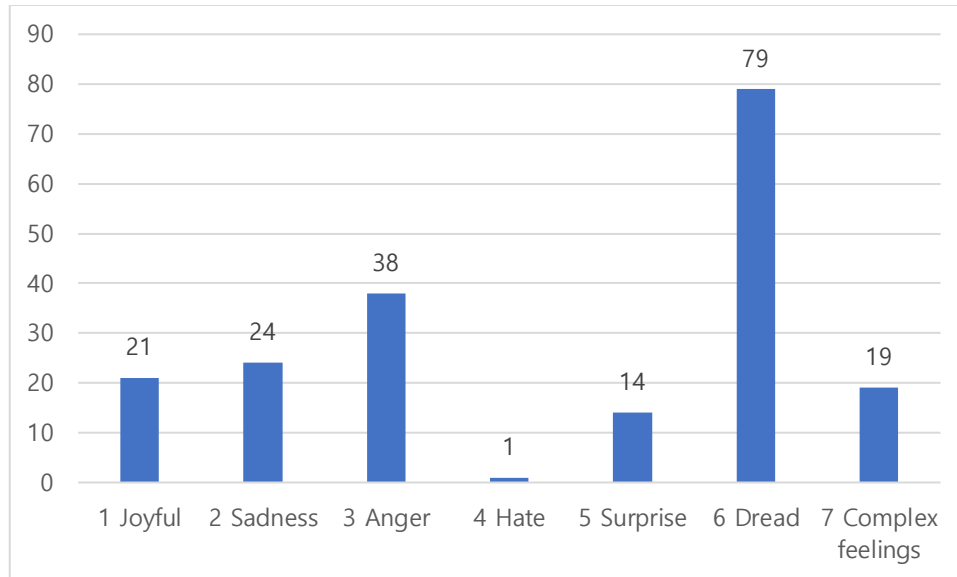

Figure 5 The observed sentiment frequency in Earthquake Preparedness board
Note: "7 Complex feelings" means the sentiment post which expressed at least 2 kinds of sentiment in one post.

Figure 5 shows the frequencies of observed emotions in post. A total of 254 times of emotions were observed. 6 Dread recorded the most frequent among the emotions. The reasons were that the earthquake is unfamiliar disaster in Korea society, and the aftershock earthquake occurred many times including magnitude 4.6 aftershock earthquake in February 11 2018. In contrast, the emotion 4 Hate was recorded only 1 time in whole posts. The Hate emotion examples were the self-loathing and disgust. The author used this emotion when she felt the unconcern of the Geothermal power plant. Even if the frequency of Hate emotion was less than others, we could recheck the Mom Café users on the Geothermal power plant that caused the Pohang earthquake. Based on these judgments, it was reasonable for 3 Anger to have the second highest frequency. Because the users understood the Pohang earthquake as a man-made disaster, not a natural disaster. They felt depressed about the physical and mental damages caused by the artificial earthquake. As such, users of earthquake preparedness boards show different emotions depending on the social atmosphere and situation. In response, users agree with the feelings of the posts through supportive expressions LIKE and comment. The result of analyzing the emotion and the support of the entire user are as follows.

Table 11 The frequency of sentiment post in Earthquake Preparedness board

Frequency analysis	N	Percentage
No sentiment	1130	85.2
Sentiment	196	14.8
Total	1326	100.0

Table 12 The t-test result between sentiment post and the Comment counts
Note: Comment counts used as the average count, which means the number of comments in one post.

t-test	N	Comment count average	SD	P
No sentiment	1130	10.85	11.673	0.002*
Sentiment	196	13.58	10.582	

Table 13 The t-test result between sentiment post and the LIKE counts
Note: LIKE counts used as the average count, which means the number of comments in one post.

t-test	N	LIKE count average	SD	p
No sentiment	1130	5.81	14.588	0.742
Sentiment	196	6.17	13.484	

According to Table 11, the number of no sentiment post was 1130, and the number of sentiment post was 196. The posts showed differences between the number of comments. Sentiment post showed more comments than no sentiment post. The sentiment post got 13.58 average counts of comments to each post. But there is no differences between the LIKE counts between the existence of sentiment in post. This is because 'LIKE' support action is related to the positive sentiment. In coding scheme, six sentiment were utilized, but the positive sentiment was only one, "Joyful". Thus, the existence of sentiment to analyze the support of 'LIKE' could have difficulties.

Table 14 The difference between the sentiment post and the user behavior

Chi-square	Action	Others	X^2	p
No sentiment	150 (83.8%)	980 (85.5%)		
Sentiment	29 (16.2%)	166 (14.5%)	18.619	0.570
Total	179 (100%)	1146 (100%)		

Table 15 The difference between the detailed sentiment post and the user behavior

Chi-square	Action	Others	X^2	p
0 No sentiment	150 (83.8%)	980 (85.5%)		
1 Joyful	11 (6.1%)	10 (0.9%)		
2 Sadness	5 (2.8%)	19 (1.7%)		
3 Anger	5 (2.8%)	35 (3.7%)		
5 Surprise	0 (0%)	14 (1.2%)	36.251	0.000***
6 Dread	4 (2.2%)	75 (6.5%)		
7 Complex feelings	4 (2.2%)	15 (1.3%)		
Total	179 (100%)	1146 (100%)		

The sentiment post did not show the big difference to the user behavior. As only the 179 posts contain the action related information and 29 posts expressed the emotion in those action related posts. However, the 1 Joyful sentiment is relatively more related to the user action behavior. Also other posts was related to the sentiment 6 Dread.

3.2 HUB user post analysis

Table 16 The user difference to the sentiment post

Chi-square	HUB	Common	X²	p
No sentiment	328 (87.2%)	802 (84.4%)		
Sentiment	48 (12.8%)	148 (15.6%)	1.592	0.229
Total	376 (100%)	949 (100%)		

Table 17 The user difference among the detailed sentiment post

Chi-square	HUB	Common	X²	p
0 No sentiment	328 (87.2%)	802 (84.4%)		
1 Joyful	18 (4.8%)	3 (0.3%)		
2 Sadness	9 (2.4%)	15 (1.6%)		
3 Anger	3 (0.8%)	35 (3.7%)		
5 Surprise	2 (0.5%)	12 (1.3%)	56.208	0.000***
6 Dread	9 (2.4%)	70 (7.4%)		
7 Complex feelings	7 (1.9%)	12 (1.3%)		
Total	376 (100%)	949 (100%)		

HUB user wrote the 48 sentiment posts. Among the posts, the 1 Joyful was observed 18 posts and it was more than other sentiments. According to Table 17, HUB users wrote more number of Joyful posts than the common users. When the user behavior related to the HUB user was analyzed, the HUB user showed more action than the common user. Thus, the 1 Joyful sentiment was related to the user behavior.

The post of SJ82 and HY78 were identified. Those users who have higher score of degree centrality and node betweenness centrality and their posts included the action behavior related to the sentiment. Those two HUB users wrote the Joyful sentiment from the earthquake response activities.

*"http://v.media.daum.net/v/20171219120835942http://naver.me/xk4KuDbfhttp://naver.me/FaU0H
73fhttp://naver.me/xgPR16Bqhttp://cbs.kr/qhcTtrhttp://m.nspna.com/news/?mode=view&newsid=257
447 Moms are the best!! Since it is very cold, it might hard to attend here. However, it`s thankful
to you to attend with your brave!" (Post ID: 2137006, SJ82)*

Among the HUB users, SJ82 user wrote the earthquake response activity process through a post. She
was free to use the facts about her activities and other people's post such as National petitions and news
links and so on. The above article, post ID 2137006, shared the press conference with users of the
Earthquake Preparedness Board with the Pohang Federation for Environment Movements. She quoted
this news and expressed her appreciation to the users who participated in the activity and worked with.

*"If you`re curious about how to help us or how to act, please ask your neighbors. It would be very
appreciated that we can put the disagreement signature board to your homes." (Post ID: 2174838,
SJ82)*

SJ82 also wrote a post that informs the procedure for earthquake response activities. Thus, it can be
inferred that SJ82 could receive a lot of attention from the common user through the post based on
Joyful sentiment and facts.

Unlike SJ82, HY78 wrote a post focusing on personal experience. That is why HY78's posts contain
a lot of information about the actions that she led. For example, there was a collection of public opinion
statements against biomass thermal power plants. According to HY78 posting, HY78 led the action by
distributing the signature board directly in some playground. In the article, she expressed her
appreciation for the positive emotions she received as the support.

*"Yesterday I went to 'Nolaya-Playground' to have my children play and receive a signature against
to the biomass thermal powerplant. Thank you, to all. I got tangerines as a gift, and thank you for
writing an opinion and leaving the comments to write each other. Thank you very much. Today and
tomorrow, still have time. So if you haven't submitted your opinion yet or haven't let others know, let`s
try a little bit more. Many people still do not know what the biomass thermal power plant is." (Post ID:
2595272, HY78)*

The two users wrote about earthquake response activities based on Joyful sentiment. In addition, the two users presented various types of participation information that can cause future actions to other users. Thus, the common users may be more concentrated to the users, SJ82 and HY78, because of the information presented with the feeling of Joyful. The common users would support the HUB user through the sentiment of the post and feel high trust due to the information which the common users can identify.

VI. Conclusion

The 2017 Pohang earthquake was caused by the Geothermal power plant. This fact made the various behaviors to the victims. Parenting women (mothers) who have the responsibilities to children showed the earthquake response activities using Mom Café. The earthquake response activities from the Mom Café gave the meanings to parenting women. It helped to create the positive emotion by processing the earthquake response activities in mothers` aspect. Accordingly, they can recover their mental health themselves and get the confidence about safety for her children. In this regard, this research suggests the needs to use the online community after the disaster.

1 The positive emotion affects the earthquake response behavior

The Mom Café users felt fulfilled and rewarded through earthquake response activities. Parenting women got the confidence in their safety. As shown in interviews and contents analysis, parenting women felt negative emotions such as dread, anger, sadness and self-loathing(hate) when they experienced the Pohang earthquake. However, they were able to carry out the earthquake response activities from the Mom Café. It made parenting women were able to form new networks and social relationships in the Mom Café community. Social relations formed in disaster situations led to emotional support to each other. This support has produced a variety of review posts based on the Mom Café culture. Users were participated in earthquake response activities to increase relevant knowledge and relieve anxiety. So, the users can get the confidence for children`s safety. The Earthquake Preparedness board showed a significant amount of Joyful sentiment score in the Action-related posts. The user started to solve their negative state, and it led to a change as positive emotion. Because the users felt positive emotion from the activities, users kept participating to the earthquake response activities.

This repeated behavior created HUB users on the board. Network analysis revealed that there were HUB users who produce and deliver information on the Earthquake Preparedness board. Even if the HUB users existed, the information and communication in the board was not biased. Also, the earthquake response activities have developed into organizational units. So, the users have led to positive changes within individuals and organizational units. Finally, the emotion of the HUB users were compared with the common users, the HUB users wrote more positive emotional post than the common users did.

In summary, parenting women began earthquake response activities to improve their negative state by using the online community (Mom Café). It made the continuous earthquake response activities for positive improvements. The below scenario was the imagined process that HUB users were created in

Scenario

First time users showed anger at Geothermal power plants at the Earthquake Preparedness board, November 24th,2017. Since the Pohang earthquake was a social disaster caused by geothermal power plants, an Anger article about earthquake occurred and damage appeared. So, the user felt the need to actively respond to the Pohang earthquake. The interview revealed that users experienced various types of earthquake response activities. In addition, the user solved the problem of lack of information and indifference by using the Earthquake Preparedness board. Their posts included participatory information or personal opinions, depending on the mood of the board. As a result, users became a HUB user who led the earthquake response action by receiving much attention from others. The HUB users have had direct and indirect influences to the common users. They helped to ensure the sustainability of earthquake response activities by participating in or supporting posts of HUB users`. This has also become a process in which the common users have influence from other users. Thus, the common users were given the opportunity to become HUB users. In the Pohang Mom Noliteo Earthquake Preparedness Board, the circulation of being HUB users had occurred. Exchanging the influence between users make them participate to the earthquake response activities voluntarily.

2 Meaning of online community activities to mothers in disasters

Households and communities have very important impact, not distinguishing private and public, but from responding and recovering from risk (Enarson and Morrow, 1998). The purpose of this study is to prove that women's disaster vulnerability can be reinforced through community activities. In fact, the parenting women affected by the Pohang earthquake actively worked to improve the safety as a mother and as part of the local online community member. In the case of the Pohang earthquake, the online community had three functions. First, it served as the official earthquake response opportunities for parenting women. Pohang Mom Noliteo is a multi-purpose online community. Parenting women ran a board with an additional purpose of "Earthquake Preparedness". This created interest among the community users rather than expecting new people to respond to the earthquake. Second, it helped to solve the emotional problems that occurred after the earthquake. In the current Earthquake Preparedness board, various kinds of information were generated as the earthquake response activities and those actions became more concrete. But there were many posts expressing anxiety about disasters at first. Since then, users have expressed feelings of anger through the Geothermal power plant. Users are free to express their feelings like comfort and express their support. This was the basis for women's voluntary response. Thus, some users became the HUB users who led the earthquake response activities showed the positive changes through their positive emotional post. Finally, the Mom Café showed the

disaster response capability in disaster situations. The earthquake response activities of mothers were women-centered grassroots movements that were participatory and active to the vulnerability. The Earthquake Preparedness board is not a refined space. Even if the board is perfect space, women could develop their knowledge based on their experiences by sharing their problems and solutions.

The vulnerability of disasters for parenting women still remains. However, the active disaster response activities can help to improve vulnerabilities. The disaster response activities do not begin with the professional knowledge. Rather, it begins with Dread, Sadness, Hate and Anger, which are essential feelings by disaster. Thus, the disaster response activities make them better Positive. In the case study, the motivation of parenting women's behavior through emotions contributed to the lack of knowledge and the collaboration of problems. Thus, the use of online communities in disaster situations would help the vulnerable people to improve their risk actively.

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