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SENTIMENT ANALYSIS OF NATIONAL EXAM PUBLIC POLICY WITH NAIVE BAYES CLASSIFIER METHOD (NBC)

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ABSTRACT

The national exam (UN) is a government policy to evaluate the education level on a national scale to measure the competence of students who graduate with those of other schools at the same educational level. The policy in conducting the UN is always a topic of discussion and phenomenon that is covered in various media, because it causes various problems that become pro and contra in society. An analysis sentiment or opinion mining in this research is applied to analyze public sentiment and group polarities of opinions or texts in a document, whether it shows positive or negative sentiment, in conducting the UN. The analytical process and data processing for document classification uses two classification methods: the quintuple method and one of the methods for learning machines, the Naive Bayes Classifier (NBC) method. The data used to classify documents is in the form of news text documents about conducting the UN, which is taken from online news media (detik.com). The data gathered comes from 420 news documents about conducting the UN from 2012 and 2013. Based on the analytical results and document classifications, it has been found that public sentiment towards carrying out the UN in 2012 and 2013 shows negative sentiment. The results of the data processing and document classification of conducting the UN overall show a positive opinion of 32% and a negative opinion of 68%. The results of the document classification are based on the polarization of public opinion about carrying out the UN, which reveal in the opinion category of carrying out the UN in 2012 that there was a positive opinion of 44% and a negative opinion of 56%. Meanwhile, for conducting the UN in 2013, there is a positive opinion of 20% and a negative opinion of 80%. These results reveal an increase in negative public sentiment in conducting the UN in 2013.

Keywords: *Sentiment Analysis, Opining Mining, National Exam, Quintuple, Naive Bayes Classifier*

1. INTRODUCTION

The national exam, which is known as UN, is one of the forms of evaluation done on a national scale in the education world and adjusted with the national achievement standards [1]. The UN is carried out at elementary, middle and high school (SD, SLTP and SMA/MA/SMK) levels to measure student graduate competence nationally in certain subjects in knowledge and technology subjects as well as to map the level of achievement for students at the school level and the regional level [2].

The UN is used as an instrument to monitor the educational quality in a school compared with other schools of the same educational level. This is supported by research done by Mardapi (2000), who states that the UN results of an elementary education unit function to observe the educational quality, whether between regions or over time; motivate students, teachers, and schools in order that they have higher achievements; and provide feedback for education implementers [3]. Next, Tilaar (2006) stated that the UN is a mapping activity for national education problems as well as an agreement to handle basic problems faced by the national education system [4].

Conducting the UN is not without problems, as it has already drawn harsh criticism from many intellectual scholars like Oey-Gardiner and Lie, who stated that carrying out the UN is a bad way to measure student academic achievement [5][6]. The UN system makes determinations that hold back Indonesian education, because it just measures cognitive student ability, like the ability to memorize certain topics from a class [7]. Lie also criticizes government policy about the UN. Lie believes that enforcement of the UN system implies that the government does not like decentralized authority; the central government tries to maintain

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control and authority over education management all over Indonesia [7][5].

Conducting the UN has many pros and contras in society whether from the education world or non-education world [8][9]. The UN has caused a phenomenon to arise that is always covered in various kinds of media, like online news media that is found on the Web. Conducting the UN in high schools and vocational high schools in 2013 is a topic of discussion in all news media. This started from the delay of conducting the UN in 11 provinces, because of tests being delivered late. Meanwhile, complaints arose in schools that already conducted the UN. The complaints include the low quality of UN answer sheets (the paper is too thin and ripped easily), exchange of problem packets, and the lack of problem sheets and answer sheets for the UN, which resulted in dishonesty in the field [10].

In this research, an analytic sentiment is applied to analyze public policy sentiment in carrying out the UN. An analysis sentiment or opinion mining is a computational study from opinions, sentiments, and emotions that are expressed textually [11]. Opinions are found on the Web for every entity or object (people, products, service, topics, among others). The goal of an analysis sentiment is to group polarities from texts or opinions in a document, whether the opinions found are positive, negative, or neutral [12][13][14][15]. For the analytical process and document classification, this research uses data in the form of Indonesian news text documents that are taken from online news media sources (detik.com). The data gathered is news documents about conducting the UN in 2012 and 2013. One of the methods used for document classification is Naive Bayes, which is often known as Naive Bayes Classifier (NBC). An advantage of the NBC is it is simple but has high accuracy [13][14].

This research uses an analytical sentiment approach regarding public policy in conducting the UN. The results of this research will show the percentage of public sentiment in conducting the UN, differences in public sentiment towards the UN in 2012 and 2013, and document classification work force accuracy with NBC and quintuple methods.

2. LITERATURE REVIEW

2.1 Related Works

Research related to using the Naive Bayes method for document classification is as follows:

There is a research titled Understanding Online Consumer Review Opinions with Sentiment Analysis using Machine Learning. This research uses two techniques: supervised learning, which is class association rules, and the Naive Bayes Classifier to classify opinions in appropriate product feature classes and produce consumer review summaries. This research compares work performance of class association rules and the Naive Bayes Classifier for sentiment analysis. These research results show that from the suggested technique, the results reach more than 70% from macro and micro F-measures [16].

There is a research titled Sentiment Analysis of Online Media. This research combines a statistics model for annotation bias users and a Naive Bayes model for document classification. The data used is taken from online media sources in the form of news articles about negative user annotation, positive user annotation, and irrelevant effects on the Irish economy. This research uses an EM algorithm for a user annotation bias model estimation, parameter classifier, and sentiment from articles. The results from this research reveal joining the two methods has results that are more prominent from using bias estimation and classifier parameter estimation [17].

A research has been done titled Personality Types Classification for Indonesian Text in Partners Searching Website Using Naive Bayes Methods. This research used text mining with a Naive Bias method for personality type classification from users to determine their partners based on personality type compatibility. The data used is user data as learning documents. The level of success for classification depends on the number of learning documents used. The process of personality classification is done by determining the biggest VMap from every category. To match the partner output, the program uses a personality compatibility theory, where the matching partner is one who has a contrasting personality [18].

There is a research titled Text Mining with Naive Bayes Classifier Method and Vector Machines Support for Sentiment Analysis. This research is used to compare usage of Naive Bayes and SVM for Sentiment Analysis. The data used is

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Indonesian language data and English language documents. Every kind of data has positive and negative values, as each of them are tested using NBC and SVM methods. These research results reveal that SVM provides good results for positive testing data, and NBC provides good results for negative testing data [15].

2.2 Sentiment Analysis

Sentiment analysis has many names. It is often called subjectivity analysis, opinion mining, and appraisal extraction [14]. Sentiment analysis or opinion mining is a computational study from opinions, sentiment, and emotions expressed textually [11]. The basic tasks of sentiment analysis are to detect subjective information occasionally in various sources and determine thinking pattern of a person towards a problem or characteristic overall from a document. Wiebe et al. depict subjectivity as a linguistic expression of someone's opinion, sentiment, emotion, evaluation, assurance, and speculation [19].

Liu identifies that an opinion sentence is a sentence that expresses positive or negative opinions explicitly or implicitly. Liu also states that an opinion sentence can be in the form of a subjective sentence or objective sentence. An explicit opinion is an opinion that is expressed explicitly towards a feature or object in a subjective sentence. Meanwhile, an implicit opinion is an opinion about a feature or object that is implicit in an objective sentence [11].

Sentiment analysis is a method that applies a sentiment classification technique to process a number of texts that are produced from users and group the polarities from texts or opinions that are in the document, whether the opinions found are positive, negative, or neutral. [12][13][14][15]. A sentiment analysis is used in this research to determine the polarity of a text or opinion and analyze public sentiment towards conducting the UN.

The sentiment analysis model can be seen in Figure 1. Data preparation is a data gathering and pre-processing process that needs to be done in a data set that is then analyzed. In every pre-processing stage, information in a document that is not used for the sentiment analysis process is deleted. In the review analysis stage, the document in the data set is identified and classified to find interesting information, including opinions about features from entities. Next, there is a sentiment classification process that is done to determine the results of the sentiment aspect classification, whether they are positive or negative [20].

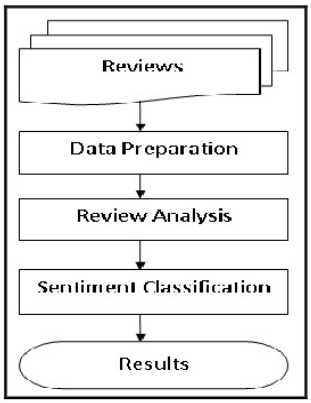

Figure 1: Sentiment Analysis Model [20]

2.3 Naive Bayes Classifier (NBC)

The naive bayes algorithm is a method that is often used for document classification because it is simple and quick [13][14]. The naive bayes method is from a machine learning method based on applying the naive bayes theorem with an independent assumption. The naive bayes method work performance has two stages in the document classification process: the learning stage and classification stage. In the learning stage, the classification process is done in sample documents that choose words from aspects that express sentiment in a document. Every aspect from an entity represents an opinion in a document by counting the probability of a word surfacing. The naive bayes assumption is every word that expresses an aspect from an entity that is not dependent on the position of where the word is. Next, there is a document classification process by looking for maximum probability values from every word that arises in a document with considering the naive bayes classifier.

For every class, the classifier will estimate the probability from the class (c), put in a document (d), and with word input (w), so the tabulation can be seen in Equation (1).

$$P(c|d) = P(c)\prod_{i=1}^{n} P(w_i|c) \qquad (1)$$

With equation 1, the classifier will produce a class with the highest probability value from the document. In the testing phase, the probability log is estimated by using Equation (2).

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$$\arg\max_{c} \log(P(c)) + \sum_{i=1}^{n} \log(P(w_i|c)) \quad (2)$$

The probability value is produced from the appearance of words when the document is tested. The NBC method is implemented to determine the document classification work performance analysis in this research, using Weka tools.

Weka (Waikato Environment for Knowledge Analysis) is a popular tools packet from learning machine software written in Java, which was developed at the University of Waikato, New Zealand. Weka is an open source software that was issued under GNU (General Public License) [21].

3. METHODOLOGY

The research method suggested in this research can be seen in Figure 2. First, the document notes are in the form of literature studies and data gathering. The data used in this research is in the form of news text documents in Indonesian language from online news media sources (detik.com). The data gathered has 420 documents about the implementation of the UN in 2012 and 2013. For the data gathering period, in 2012 it went from March 22, 2012, until April 30, 2012, and for 2013 it was from March 4, 2013 to April 30, 2013. The data gathering process is done manually. The data is gathered and then classified to find the appropriate opinions in the documents.

In this research, the news data processing about implementing the UN uses a quintuple method. A quintuple method is a method that was developed by Liu, B, who defines an opinion (or regular opinion) as a quintuple (*ei, aij, ooijkl, hk, tl*), where *ei* is the name of an entity, *aij* is an aspect from *ei*, *ooijkl* is an orientation from an opinion about the *aij* aspect and *ei* entity, *hk* is the opinion holder, and *tl* is the time when an opinion is expressed by *hk*. The orientation of an *ooijkl* opinion can be positive, negative, or neutral, or expressed with a different level of intensity. An opinion (regular opinion) has two types, for example a direct opinion and indirect opinion. For a direct opinion, it is an opinion that is expressed directly towards an entity or aspect. Meanwhile, an indirect opinion is an objective opinion about an entity that is expressed based on influences from several other entities [22].

A quintuple method has five primary components, which are entity (*ei*), aspects (*aij*) from an entity, orientation of opinion (*ooijkl*), opinion holder (*hk*), and time (*tl*). An entity *e* is a product, service, person, event, organization, or topic. The term entity is used to determine the target object that has been evaluated. An entity can have one component group (or a part of one) and an attribute group. Every component has sub-components (or parts) and an attribute group. An aspect from entity *e* is a component and attribute from *e*. The name of an aspect is given by the user, while the expression of the aspect is a word or phrase that actually appears in a text that reveals an aspect. The name of an entity is given by the user, while the expression of an entity is a word or phrase that appears in a text and reveals an entity. This research uses the topic the implementation of the national exam (UN) as an entity or object and for an aspect or component from the entity, like a problem, answer, passing, etc. The definition of an opinion holder is an individual or organization that expresses an opinion [22]. To review news on online news media, the opinion holder usually writes by making postings. The opinion holder is more important in a news article that explicitly states an individual or organization has an opinion [22][23][24][25]. The opinion holder is also called the source of the opinion [26].

All of the components from the quintuple method have to be appropriate with the others. This means that (*ooijkl*) opinion has to be given by the opinion holder (*hk*) about an aspect (*aij*) from an entity (*ei*) during (*tl*). This definition provides a basis to change an unstructured text to become structured data. The goal of opinion mining is to find all quintuples (*ei, aij, ooijkl, hk, tl*) in a document. The stages that need to be done to find all quintuple components are as follows:

1. (*entity extraction and grouping*): Extract all entity expressions in a document, and group the entity expressions that are identical in entity groups. Each entity expression group reveals an entity (*ei*).
2. (*aspect extraction and grouping*): Extract all aspect expressions from an entity, and group the aspect expression in aspect groups. Every aspect expression group from entity *ei* reveals a unique aspect (*aij*).
3. (*opinion holder and time extraction*): Extract information bits from a text or data structure to find who the opinion holders are and when the opinions are posted.

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4. (*aspect sentiment classification*): Determine whether every opinion in an aspect is positive, negative, or neutral.
5. (*opinion quintuple generation*): Produce all quintuples (*ei, aij, ooijkl, hk, tl*) in a document based on the results above [22].

For example, in the following news text @detik.com: "pelaksanaan ujian nasional tertunda karena keterlambatan soal (implementing the national exam is delayed due to late question sheets)", the entity or object (*ei*) is national exam, the aspect (*aij*) is the problem, and the orientation of the text or opinion (*ooijkl*) is negative, because the late test papers causes the national exam to be delayed, the opinion holder (*hk*) is @detik.com, and the time (*t*) is the time the news text is posted.

For the document classification process, this research uses the NBC method. The NBC method has two classification stages: the learning stage and the classification stage. In the learning stage, the sample documents will be classified by counting the probability values of every word that enters in a word category from an aspect to obtain learning data. Next, in the classification stage, new documents will be classified based on the previous data in the learning stage. The document classification process is done by counting the maximum probability value from the appearance of words in a document to determine sentiment class.

The purpose of the news document classification in implementing the UN is to determine the polarization of a text or opinions in a document, and whether it shows positive or negative sentiments. The main point of the classification process is to determine a sentence as a positive opinion class member or as a negative opinion class member based on calculating the bigger probability value. If the probability results from the sentence for the positive opinion class are bigger, then the sentence is put into a positive opinion category and vice versa.

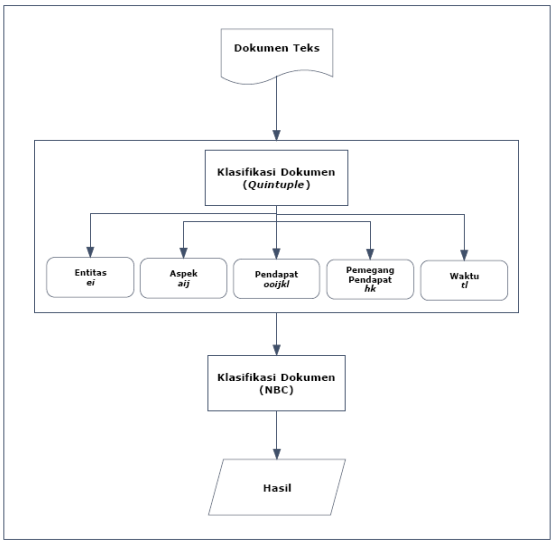

Figure 2: Research Method Diagram

4. ANALYSIS AND DISCUSSION

The document classification process in this research uses two classification processes: the learning stage and the classification stage. In the learning stage, the classification process is done on news documents related to implementing the UN in 2013, as sample documents to obtain learning data. In contrast, for the classification stage, the classification process is done on news documents related to implementing the UN in 2012 based on previous data in the learning stage.

The results of the data processing and document classification in implementing the UN in 2012 and 2013 overall have a positive opinion of 32% and a negative opinion of 68%. The results of the document classification based on the UN aspect can be seen in Table 1.

Table 1: Results of UN Opinion Classification

No	UN Aspect	Opinion (%)	
		2012	2013
1	Problem	28	30
2	Answer	7	18
3	Success	30	6
4	Delay	0	18
5	Violations	0	25
6	Passed	19	3
7	Preparedness	16	0

The results of the document classification in implementing the UN in 2012 and 2013 based on opinion orientation and the UN aspect can be seen in Table 2.

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Table 2: Results of UN Opinion Polarization

No	UN Aspect	Opinion (%)			
		2012		2013	
		Positive	Negative	Positive	Negative
1	Problem	33	28	18	32
2	Answer	8	27	3	11
3	Success	24	5	44	7
4	Delay	0	4	0	28
5	Violations	0	32	0	20
6	Passed	19	5	19	1
7	Preparedness	16	0	15	0

The results of the document classification in conducting the UN overall can be seen in Figure 3.

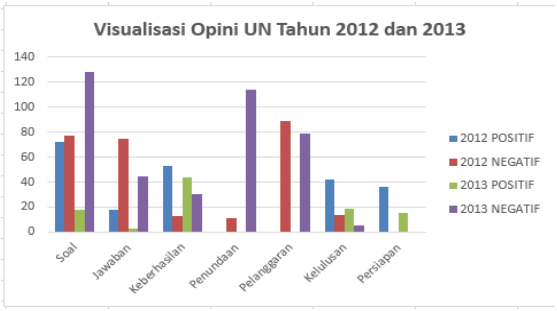

Figure 3: Visualization of UN Opinions

4.1 Classification of UN Documents in 2013

The news text document data processing in implementing the 2013 UN found 400 opinions from 210 documents. The results of the document classification that was done by using a quintuple method approach [22] found the entity expression from the document collection was "UN", while the aspect expression of the UN entity and number of opinions can be seen in Table 3.

Table 3: UN Aspects and Opinions

No	UN Aspects	Opinions
1	Problem	146
2	Answer	48
3	Success	74
4	Delay	114
5	Violations	79
6	Passed	24
7	Preparedness	15

In Table 3, it is seen that the entity aspects that were found from the results of the document classification were aspects that express the entities in conducting the UN in 2013. The expression of the "problem" aspect explains the usage process and problems that occur in the problems in implementing the UN. For example, lateness in problem sheet distribution, lack of problem sheets, distribution of problem sheets before the proper time, etc. The "answer" aspect expresses using the answer sheets and problems that occur in implementing the UN. For example, there may be answer key sheets distributed, poor paper quality, lack of answer sheets, etc. The "success" aspect expresses the process of carrying out the UN, whether it is run well or not. For example, it considers whether the UN runs smoothly, the UN has many hindrances, the UN fails, etc. The "delay" aspect expresses problems with delays and lateness in implementing the UN. For example, the UN may be delayed because the problem sheets have not arrived or other similar problems. The "violations" aspect expresses general problems that occur while implementing the UN. Last, the "preparedness" aspect expresses participant (student) preparedness in joining the UN.

The results of the document classification are based on 2013 UN aspects to determine polarities and opinions in a document collection, which can be seen in Table 4.

Table 4: Results of 2013 UN Opinion Polarization

No	UN Aspects	Opinions	
		Positive	Negative
1	Problem	18	128
2	Answer	3	45
3	Success	44	30
4	Delay	0	114
5	Violations	0	79
6	Passed	19	5
7	Preparedness	15	0

The results of the document classification based on the 2013 UN aspect categories show that aspect expressions which have the highest percentage in the positive opinion category are "success" with 44% and "passed" with 19%. These results reveal the level of success and passing rate in implementing the 2013 UN. Meanwhile, for the negative opinion category, the "problem" aspect expression is 32%, and the "delay" aspect is 28% from the total number of individual aspects for the negative opinion category. This means that in implementing the 2013 UN, many problems occur and cause negative sentiment related to test problems and delays in implementing the UN.

Visualization of the 2013 UN opinions based on the results of opinion polarizations can be seen in Figure 4.

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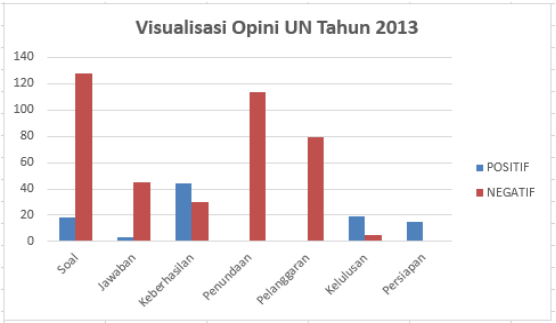

Figure 4: Visualization of 2013 UN Opinions

The results of processing the news texts document data in implementing the 2013 UN can be classified based on the number of oriented opinions per day. The purpose of this is to see the differences and shifts in opinions while the 2013 UN is implemented. The results of the classifications can be seen in Figure 5.

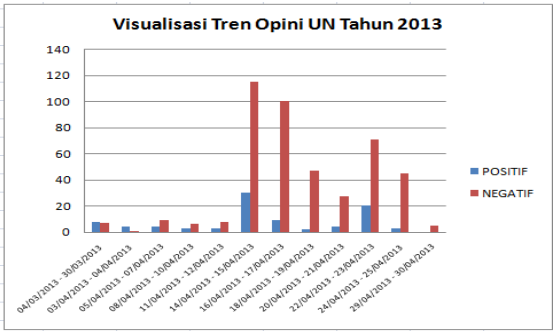

Figure 5: Visualization of 2013 UN Opinion Trends

In Figure 5, the results of the document classification are based on opinion orientation per day, which show that the opinion orientation increased from 14/04/2013-15/04/2013, with percentage results as follows: positive opinion of 21% and negative opinion of 79%.

With the results of the data processing and news text document classification in implementing the 2013 UN, the percentage of document classification based on opinion orientation overall reveals a positive opinion of 20% and a negative opinion of 80%.

4.2 Classification of UN Documents in 2012

The news text document data processing about conducting the 2012 UN found 400 opinions from 210 documents. The 2012 UN document classification results to determine polarities from opinions in document collections can be seen in Table 5.

Table 5: Results of 2012 UN Opinion Polarization

No	UN Aspects	Opinions	
		Positive	Negative
1	Problem	72	77
2	Answer	18	75
3	Success	53	13
4	Delay	0	11
5	Violations	0	89
6	Passed	42	14
7	Preparedness	36	0

The results of the document classification are based on 2012 UN aspects, which reveal that the aspect expressions with the highest percentage for the positive opinion category are the "problem" aspect expression with 33% and the "success" aspect expression with 24%. Meanwhile, for the negative opinion category, the "violations" aspect expression is 32%, and the "problem" aspect expression is 28%.

From the results of the opinion category polarization based on the 2012 UN aspects, for negative opinions, it shows that most of the problems that occur and cause negative sentiment are related to violations and problems in the problem sheets in implementing the UN. Meanwhile, for positive opinions, "problem" and "success" show positive sentiments that explain that conducting the 2012 UN went well and smoothly. Visualization of the 2012 UN aspects based on opinion polarizations can be seen in Figure 6.

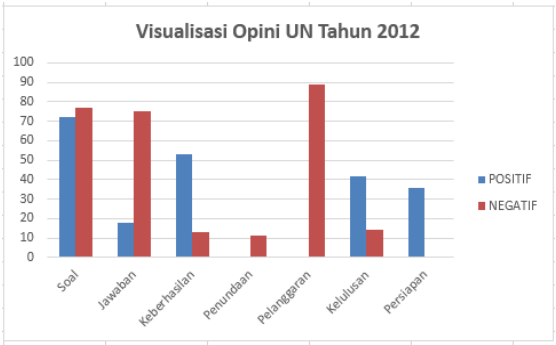

Figure 6: Visualization of 2012 UN Opinions

The results of processing the news text document data in implementing the 2012 UN can be classified based on the number of oriented opinions per day. The purpose of this is to see shifts in opinion orientation while conducting the 2012 UN. The classification results can be seen in Figure 7.

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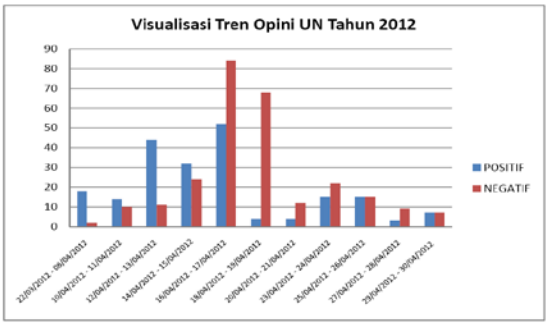

Figure 7: Visualization of 2012 UN Opinion Trends

In Figure 7, the document classification results based on opinion orientation per day show that opinions increase from 16/04/2012 - 17/04/2012, with percentage results as follows: positive opinions comprise 38%, and negative opinions comprise 62%.

With the data processing results and news text document classification in implementing the 2012 UN, the percentage of document classification based on opinion orientation overall shows a positive opinion of 44% and negative opinion of 56%.

4.3 Document Classification with NBC Method and Quintuple Method

The results of the document classification with quintuple method [22] and NBC method to determine polarizations and opinions in news documents in implementing the 2012 UN and 2013 UN overall can be seen in Table 6.

Table 6: Results of UN Polarization

No	UN	*Quintuple*		NBC	
		Positive	**Negative**	**Positive**	**Negative**
1	2012	44%	56%	34%	66%
2	2013	20%	80%	31%	69%

The results of the document classification accuracy in implementing the UN in 2012 and 2013 with a quintuple method and NBC method can be seen in Table 7.

Table 7: Results of Document Classification Accuracy

No	UN	Quintuple	NBC
1	2012	77%	94%
2	2013	89%	91%

The results of the document classification accuracy to determine public opinion polarizations towards conducting the 2012 UN and 2013 UN overall reveal that document classification accuracy using an NBC method has a high degree of accuracy, reaching 93%, compared with using a quintuple method of 83%.

5. CONCLUSION

From the analytical results and explanations, it can be concluded that the results of the document classification overall determine public sentiment in implementing the UN has a negative sentiment, with a positive opinion category of 32% and a negative opinion category of 68%. The results of the data processing and document classification based on opinion polarizations reveal that for the positive opinion category, conducting the 2012 UN had a higher positive sentiment with 44%, compared with the 2013 UN with 20%. In contrast, for the negative opinion category, implementing the 2013 UN has the highest negative sentiment with 80%, compared with the 2012 UN with 56%. The results of the document classification accuracy to determine public opinion polarization in conducting the UN overall reveal a higher document classification accuracy with the NBC method, with 93%, compared with the quintuple method, with 83%.

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