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A Sentiment Analysis of Blended Learning Experience and Users' Satisfaction Across Twitter

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ABSTRACT

Social media has the power to spread information among users. It is very beneficial for improving education by giving valuable feedback or sharing perceptions on some related issues. Blended learning approaches are massively being used by most organisations, especially in higher education. However, there are many issues triggered among users when blended learning is implemented. Many researchers keep accomplishing new studies since this method has already been applied in many organisations and institutions. This paper aims to identify tweets regarding blended learning experiences. This study will use these tweets to define users' perception and acceptance of the blended learning method by producing a classifier model. This model will classify the tweets into positive and negative experiences in the blended learning approach. All the processes involved are implemented using Rapid Miner software. About 448 relevant reviews have been selected, and 84.38% of users give positive responses. The Naïve Bayes technique produced the best classifier model with 91.90% accuracy. The result defines most of the positive reviews are involving students, which are occurred 107 times, and 20 times for negative reviews. Meanwhile, the word "teacher" is appeared in 41 positive reviews and 14 negative reviews. This study suggests that blended learning should be continued because most users give positive reviews of the blended learning method. However, some acceptance criteria in blended learning should be considered such as age, gender, and region.

Keywords: *Blended Learning, Sentiment Analysis, Social Media, Twitter, Rapid Miner.*

1. INTRODUCTION

The rise of the internet has changed how people communicate; keep their friendship; buy their necessities; deal in business; and do their hobbies. As the internet became more and more available in the 1990s, online communication may play a critical part in public opinion formation. It became more visible by the 1980s when people started to have home computers, and social media became more sophisticated. Generation Y is bound to social media to get friends online and express their mind. Internet technology has not only changed the way people communicate and work, it also changed the way students learn today. Students can study online to give more time to delve into their courses at their own pace. However, to ensure that the learning process still has guidance from the teacher or lecturer, blended learning is introduced. Blended learning is a hybrid learning that combines both face-to-face learning and online courses [1]. It is a model that integrates technology to enhance the learning process and deliver

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knowledge online. Blended learning is often associated with the education sector and corporate training.

However, there are some arguments among users about this method. A lot of previous research have been conducted regarding blended learning from different point of views. Some studies the design of blended learning [2],[3] or on the students' perspective and context [4]. A study highlighting students with lower-income backgrounds has affected educational equality while increasing access, thereby alleviating lower income-students' issues [1]. The blended learning method has been argued regarding education quality when it becomes independent learning and mostly said it should be observer-dependent [1]. Furthermore, some issues make students or participants interested in blended learning courses and the factors that influence their interest. There is also research regarding blended learning that study from the teachers' perspective. [4] Teachers face many challenges in making blended learning working such as adopting new teaching and technological skills, dealing with changing pedagogical roles, or coping with the possibility associated with teaching through blended learning. Therefore, they have investigated teachers' qualities and characteristics that affect the implementation process in two ways is crucial for establishing sustainable anchoring of blended learning pedagogy in higher education.

Although many kinds of research have been done in the users' perception of blended learning, research through social media reviews is still rare. The authors believe that this study can identify the importance of blended learning by using reviews on Twitter. This study aims to analyse users' reviews from Twitter; whether they are satisfied with blended learning or not. Therefore, this method can be considered to continue as a teaching method or not. This study also will produce an accurate classifier model that can classify the reviews accurately. The paper is organised as follows. The following section is the literature review of the study. The literature review consists of blended learning, social media, and sentiment analysis. Next, the research method will be discussed in section 3. Section 4 discusses the experiments and results. It follows by discussing the conclusion and future work in the last section.

2. LITERATURE REVIEW

2.1 Blended Learning

Blended learning (or mixed or hybrid learning) became apparent in the late 1990s as a modern way of teaching through the application of technology and the internet for distance learning [5]. Blended learning is a combination of online (e-learning) and face-to-face teaching approaches by engagement between both students and teachers to stimulate learning outcomes [1],[6],[7]. From the previous definitions, the researchers describe blended learning as a modern learning technique that combines traditional learning in its various forms and e-learning in its different models to boost student engagement and enhance learning achievement [8], [9], [10], [11].

The idea of the blended learning approach starts from the distance learning process invented by Sir Isaac Pitman in the 1840s. He established a training program that allowed people to join the program by sending shorthand through mailed postcards. In the 1960s to 1970s, the first training was deployed to countless workers without face-to-face using mainframe computer-based training. This idea shifted the learning in a traditional classroom to taking it to where the learner is and increasing flexibility in time [7]. The evolution of various digital platforms such as TV-based technology, CD-ROMs, and web-based technology has widened the learning delivery,

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which helps the organisation and learning institutions adopt a blended learning approach. Blended learning has redefined teaching pedagogy among instructors, whereby it helps the learners to stimulate interaction during their learning process. It also allows learners and instructors to use any possible digital technologies to improve participation and monitor students' progress online. However, there are challenges in the new paradigm of teaching and learning since adapting to new learning norms can raise possible issues, namely technical infrastructure, students' learning style, and culture in each class environment.

Nowadays, extensive studies have been conducted on blended learning and its impact on students' achievement in educational institutions such as schools and universities [7], [8], [12-17]. Most researchers test students' performance after implementing blended learning approaches [8],[12-14]. Most of them found that students manage to improve their achievement on that subject. The researchers compare the result with the traditional teaching approaches by giving a short test after beginning blended learning [12]. Besides, they also evaluate the approaches by pre- and post-interventional stages.

Besides testing students' performance, some researchers found that the blended learning approach can enhance some of the students' skills, such as social abilities, collaborative learning skills, team learning, and time management. According to [13],[18], blended learning has given students accessibility and flexibility in their studies. Meanwhile, [7] defines this approach increasing social interaction and learning with team learning, thereby it helps students to undertake comprehensive tasks and improve their learning. [14] has done their study on blended learning to postgraduate students in a school of nursing. Most of them were given positive feedback on blended learning in concern of time management. Most of them were registered as full-time nurses with family commitments and lived long distances from the campus. They also took responsibility for their learning. They defined that the blended learning approach could give them flexible time and a chance to manage their own time.

Nonetheless, students address several challenges when undergoing blended learning. Online communication can reduce social interaction and a lost sense of community [16-17]. The educator who plays as a facilitator should guide students and play the roles to encourage everyone to participate in blended learning. A conducive environment and exciting topic will attract student engagement. However, some students said they had an obstacle in learning at home, following a day at work. They preferred the conventional approach, which is face- to-face as it is much easier for students to separate between study time and personal time. These students felt affected at times, which was more time consuming [15],[17]. Students were also confused about how the marks were allocated when doing online learning. Additionally, blended learning is relying on technology. Students need the necessary computer skills. Besides, poor internet connectivity affects students commencing on a blended learning program. Students also need feedback from educators on their online activities, or else they will get frustrated [15],[17].

The authors suggest that blended learning could improve students' performance in learning. Several factors should not be overlooked to make sure blended learning works in the best way for both students and teachers. Factors such as technology facilities can influence the delivery of the courses. Teachers' preparation for delivering the material also plays a critical act. Students attitude towards learning through blended learning is also crucial. Students should manage their time wisely, although the classes are conducted online. They should be able to study

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independently and ask their teachers if they have any problem understanding their courses. Technology facilities sometimes give some students problems as they live in the circuit area who come from B40 class family. All these factors should be addressed to ensure blended learning could benefit both students and teachers.

2.2 Social Media Background

Social media is referred to as websites and interactive applications that facilitate sharing content in ideas, thought, and information through virtual communities and networks. Starting with MySpace and LinkedIn in early 2000, social media sites began to explode in popularity, and online photo sharing was encouraged by Photobucket and Flickr. Meanwhile, in 2005, YouTube came out offering a new way for individuals to connect through distances. In 2006, Facebook and Twitter became open to all users around the world. These sites remain some of the most influential social media on the internet. There are many social media sites today, and many of them can be linked to allow cross-posting. This environment allows users to reach the maximum number of people without losing the intimacy of person-to-person communication. Nowadays, one of the popular social media is Twitter.

Twitter is an American microblogging that was established back in 2006. According to [19], Twitter has 330 million monthly active users and 145 million daily active users. Post on the Twitter is coined as a tweet that is sent and received among Twitter users. Tweets can be composed up to 280 characters long, and they can include links to any relevant websites and resources. Like other media social, Twitter allows users to follow other users with similar academic and personal interests. Hence, their tweets will be appearing in the user's timeline. Twitter allows users to reach a large number of people quickly through tweets and retweets. Besides, the user may seek input about work and send others feedback. Users can also establish relationships with professionals and stay up to date with the latest news. Currently, Twitter is becoming more popular with scholars as well as students, policymakers, and politicians.

According to [20], the researchers usually use Twitter as a source in text classification because of its unique attributes, distinguishing it from other social media. They preferred Twitter tweets since there is a maximum character length of 280 characters for Twitter. It also offers information that can be viewed openly using the Twitter API, making it simpler to collect several tweets. Twitter also has language models that allow users to post messages across a range of media. Besides, users can also send short notes about different topics tailored to a specific subject that is globally relevant. Twitter is a social network that rich in data sources. It is used by a hundred million active users continuously broadcasting their perception, opinion, review, experience, and feeling in the form of a tweet [21].

2.3 Sentiment Analysis

In recent years, sentiment analysis has become a research trend, especially in big data and Natural Language Processing. This research's growth is connected to social media, the internet of things, big data, machine learning, and visualisation. Sentiment analysis is one area in natural language processing that automatically classifies the sentiment expressed in a free text [22]. It can be defined as an opinion mining process used to examine whether the author's opinions are positive, negative, or neutral [23]. The opinion can be of different ways such as posts, comments, and reviews uploaded by users in forums, electronic businesses, social networks, and other platforms. These opinions are about a specified entity like product, service, event,

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person, idea, or method. Sentiment analysis is based on Natural Language Processing (NLP), text analysis, and some data mining techniques in extracting or remove unnecessary parts to define the pattern in opinion [24]. Most of the past research use sentiment analysis to classify text to a class target depending on the dataset and the research objectives. Sentiment Classification can be binary class targets or multi-class targets. User satisfaction is an opinion and real expectation by users. Nowadays, many users have been attracted to write their opinions on social networking like Twitter, Facebook, and Instagram. The opinions from users are significant and should be considered as it may improve the service or method used by some organisations [25]. This study investigates the perception of users on blended learning based on their experience through Twitter comments.

3. RESEARCH METHOD

Blended learning becomes a popular approach to boost student engagement and enhance learning achievement [8], [9], [10], [11]. The execution of this approach has been discussed in many mediums including Twitter. This section elaborates on the sentiment analysis process on blended learning experience and users' satisfaction using Twitter data. Most of the users on Twitter are free to give their opinion about some issues. To get a sincere opinion on blended learning experience and satisfaction, this study mines the opinions from Twitter social media to get a classifier model of blended learning experience from the text mining approach. This paper uses a basic process in text mining. It involves a few steps as in figure 1; document acquisition, split the data into training and testing, data pre-processing in producing a bag of words, calculate sentiments score, classified the data, evaluate a classifier model, and select the best sentiment analysis model. All the processes involved are implemented using Rapid Miner software.

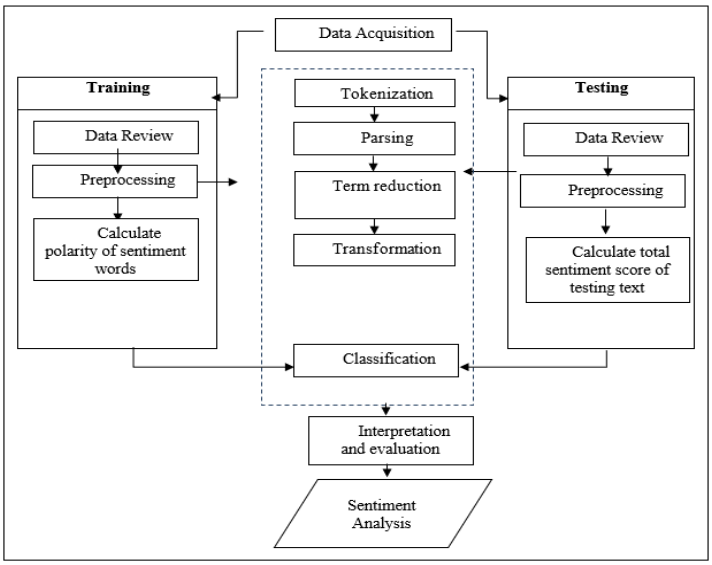

Figure 1: Research Methodology

3.1 Document/Data Acquisition and Data Review

The data regarding blended learning experience have been obtained from Twitter using a free streaming Application Programming Interface (API). The searching process has been

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conducted using blended learning and hybrid learning keywords. About 2759 tweets have been collected from blended learning keywords. Meanwhile, 194 tweets are obtained from hybrid learning. The scope is limited to English tweets. In total, 2953 tweets have been selected, which focus on the experience of applying blended learning concepts in a course.

All the reviews collected are cleaned, such as by checking the spelling mistakes and emoticon that will influence the result. Only relevant reviews related to research requirements, including users' experience and requirements, are retained. The neutral review, which is the opinion, does not support any part or just given a fact or statement is removed from the dataset. After the review process, about 22 tweets have been selected from hybrid learning and 426 from blended learning keywords. The review involves natural language processing with machine learning to identify the review structure trends [21]. It is essential to clean the sentences to remove noise and uninformative parts to distort the sentiment analysis. Examples include retweets, hyperlinks in reviews, hashtags, scripts, advertisements, and emoticon. Likewise, any spelling mistakes are fixed to the correct one.

3.2 Pre-processing

Figure 2 shows the steps in the pre-processing phase. It involves a few steps depending on the condition of the data. The first step is the tokenization process. This process is to split the text of the document into a sequence of the token. There are many ways to specify the splitting points such as by using a regular expression and based on characters or delimiters. In this study, the non-letter character technique is preferred. This technique produces tokens consisting of one single word. The collection of phrases and words represent in the bag of words presentation. This study has 3060 attributes in the bag of words, which are considered very high dimensions. Thus, the processing time will become more longer.

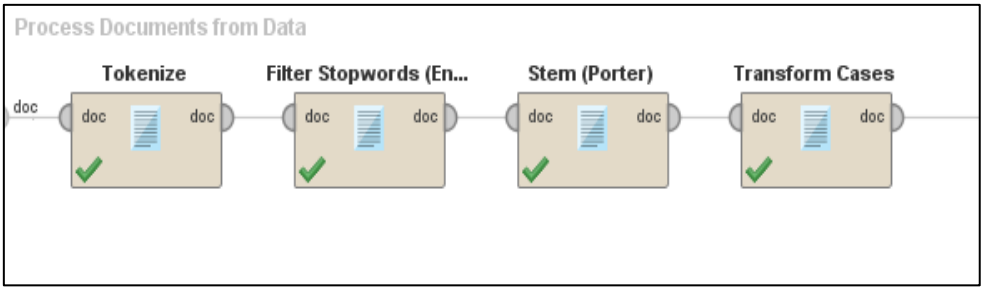

Figure 2: Pre-processing

In reducing the dimension in the bag of words, the first step is to remove stop words, which the most common words such as articles, pronouns, and prepositions that do not give the meaning of the documents [24]. Stemming is the process of reducing inflected or sometimes derived words to their word stem, base, or root form, generally a written word form. For example, some reviews use different suffixes on the same word such as study, studies, studied, and studying. The stemming process removes various suffixes and stem from the word study. This process reduces the number of words, accurately match stems, and save time and memory space. This study uses a standard suffix stemming approach, which is the Stem Porter technique [26]. This technique is a stemming technique for English words. The transform cases process is done to change all the letters into a lowercase letter or uppercase letter and not mixed [18]. After all the pre-processing phases are done, there are about 1550 attributes left.

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3.3 Polarity of Sentiment Words

The dataset used in this study has been split into training and testing. The polarity of the reviews from the dataset must be identified. This process is called a tagging process to determine whether the review is positive or negative. The polarity of the review will be set as a class target. The class target for this study involves a binary class target, which is positive or negative labels. The tagging process is done by utilising the sentiment dictionary in the Aylien extension in Rapid Miner. All the data with positive and negative reviews are selected in evaluating the perceptions of blended learning implementation. The process of defining the reviews' polarity is confirmed by the researcher by rechecking the tagging produced to make sure the studies' polarity is accurately labelled.

3.4 Sentiment Score Calculation

The sentiment score calculation is to determine how positive or negative that word in the review. The score produced is based on the algorithms used. The higher the score, the more positive the word, and similarly for the negative words. Not every word in a positive review is positive, and the same goes for the negative review. Feeding the number of identified words and their scores into the algorithm is ended up with a score for the text's sentiment.

3.5 Classification

The dataset collected from Twitter after the cleaning process is 448 data. The dataset is split into training and testing for producing a classifier model. About 358 data are used for training and 90 data for testing. Figure 3 shows the overall process of creating a classifier model for the sentiment model. A few algorithms have been chosen in producing a model such as Naïve Bayes (NB), K-Nearest Neighbors (KNN), and Decision Tree (DT). The NB algorithm is a simple probabilistic classifier that can define the distribution of data based on experience. Meanwhile, the KNN classify the data based on similarity measurement. This algorithm is very simple and robust in classifying dataset. The DT algorithm can discriminate instances most clearly by producing a set of rules [27]. Besides, K-Fold cross-validation has been applied in the validation process to avoid bias when producing a classifier model.

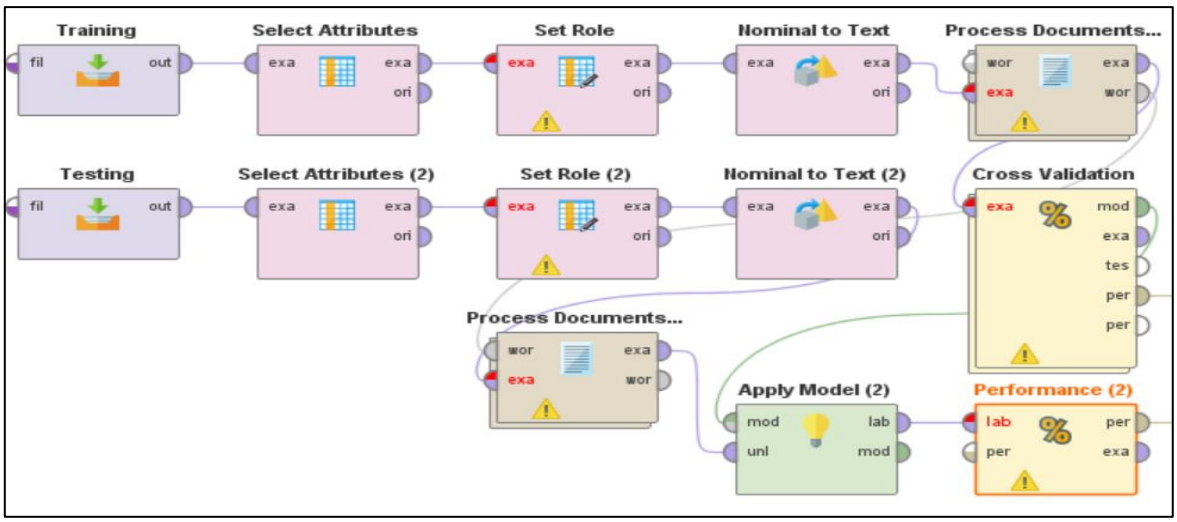

Figure 3: Producing a classifier model

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3.6 Evaluation

All the classifier models produced are evaluated using accuracy, precision, and recall. These measurements are the right metric for the classifier task, considering the overall dataset and each class labels. These metrics are based on the confusion matrix, which consist of true positive (TP), true negative (TN), false positive (FP), and false-negative (FN). TP means the actual and the predicted are the same for the positive review of blended learning. TN is otherwise from TP. Meanwhile, FP is seen when the actual is a negative review, but the model predicts as a positive review. FN is otherwise from FP. Accuracy is the ratio of the number of correct predictions to the total number of input samples. Meanwhile, recall is the ratio of the correctly positive labelled by the model to all who are positive. It purposely calculates the percentage from all users who agree with blended learning and how many are correctly predicted. Meanwhile, precision is the ratio of the precisely positive labels by the model to all positive labels. It is to define how many of those labelled as positive reviews on blended learning is positive reviews. The formula for all these three metric measurements as equations are listed below.

$$\text{Accuracy} = (TP+TN)/(TP+TN+FN+FP) \quad (1)$$

$$\text{Precision} = TP/(TP+FP) \quad (2)$$

$$\text{Recall} = TP/(TP+FN) \quad (3)$$

4. EXPERIMENT AND RESULT

A searching process using keywords ‘blended learning' and 'hybrid learning' has been done through Twitter's public Streaming API. The process has been limited to 10000 reviews from December 2019 until April 2020. Both keywords produced 2953 reviews or documents. After the data has been cleaned, only 448 relevant documents have been chosen as related to this study. There are two important attributes to be considered in the dataset: the reviews and the review's polarity, as shown in Figure 4.

Text ↑	polarity
not suitable for my subject	negative
preferred to read book than blended	negative
providing an overview of the value of Program for enhancing online and blended learning to reduce cost of time a...	positive
so fortunate to have an Instructional Technology Coach @doc__brew & Digital Lead teachers to help our staff w b...	positive
take time	negative
technology & personalization of learning in blended learning gives our our Ss choices in discovering and sharing ...	positive
technology constraint please	negative
thanks to Heather for sharing her tech tips process. As always, great collaborative conversations	positive
too much money to be made on for-profit "solutions" like blended learning and "personalized" learning	negative
waste my time waiting for respond in blended	negative
work hard just to prepare quiz for blended learning purpose	negative
xplorers Thank you for pushing me to try blended learning years ago...	positive

Figure 4: Screenshot of Dataset Sample

The polarity of the reviews has been defined based on a sentiment dictionary. After pre-processing the reviews dataset, about 84.38% is a positive review, and 15.63% is a negative review. The result shows an imbalance ratio between the tweets from Twitter. Most of the users

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tweeted an excellent experience and satisfied with the blended learning implementation. Based on the bag of words collected from the dataset, most of the positive reviews are related to students. The highest frequency of 'student' word occurred for the positive polarity, which is in 107 documents as compared to 20 times in a negative review. The term 'teacher' appears in 55 documents, 41 in a positive document, and 14 in negative documents. Most of the positive reviews are collected from students who agree with blended learning because they can manage their own time, increase training convenience, and cost savings. Besides, most positive reviews agree that blended learning gives more benefit to the students' side. Meanwhile, most negative reviews show the burden on the teachers' side. Some teachers face difficulty in preparing blended learning material instead of face-to-face teaching methods. They are not trusted how far the students will utilize the times online given for studying.

The data collected is trained to produce a classifier model. This model classifies or predicts the reviews' criteria, whether positive or negative. Table 1 shows the dataset that has been split into training and testing. In the training dataset, 85.47% of the dataset is a positive review, and 14.53% is a negative review. Meanwhile, for the testing data set, 80% of the dataset is a positive review; 20% is a negative review. The ratio between positive and negative reviews is 80:20, which is an imbalance. Thus, the model's evaluation should be measured in various metric measurements to ensure a reliable model.

Table 1: Polarity of Training and Testing Dataset

	Positive	Negative
Training	306 (85.47%)	52 (14.53%)
Testing	72 (80%)	18 (20%)

The training dataset is used in producing a classifier model. Meanwhile, the testing dataset is used to test the classifier model's accuracy in predicting the new reviews. This model is produced using Rapid Miner software and tested with three classifier algorithms: NB, KNN, and DT. The result from these three algorithms is compared and the best classifier model from those techniques is selected. The best model is used on the testing dataset.

Table 2 shows the summarised results using three different algorithms. The experiment evaluates the model using three metrics measurement, such as accuracy, precision, and recall. The experiment process uses the same parameters and is conducted the same number of times to avoid the bias comparison between all the algorithms. These three algorithms manage to get high accuracy where NB is 91.90%, KNN is 83.53, and DT is 87.14%. NB gets the highest accuracy where the model can predict very well with TP is 295 and TN 34. However, the result for DT also high with TP is 302 and TN is 10. Both algorithms produced models that can predict positive reviews very well, but NB gives a more reasonable model for negative reviews. NB can correctly predict 34 data from 52, which 65.38% correctly for negative reviews. Meanwhile, DT predicts 10 data correctly from 52 data with negative reviews, which is 19.23%. Compared to precision measurement, NB gives a promising result compared to other algorithms whose positive class precision is 94.24% and negative class is 75.56%. It shows that NB is efficient in predicting both classes. Meanwhile, for the recall value, DT gives the highest result, which is 98.65% withjust 2.24% higher than NB.

The NB model has been chosen as the best classifier model to predict users' satisfaction with blended learning implementation from the three algorithms. NB is an algorithm employed for

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flexibility and efficiency; thus, it performs well when classified as positive and negative reviews.

Table 2: Comparison of Classifier Model using Naïve Bayes, K-Nearest Neighbors, and Decision Tree

Algorithms		True Positive (TP)	True Negative (TN)	Class Precision
Naïve Bayes	Predictive Positive	295	18	94.24%
	Predictive Negative	11	34	75.56%
	Class Recall	96.41%	65.38%	
K-Nearest Neighbors	Predictive Positive	292	45	86.65%
	Predictive Negative	14	7	33.33%
	Class Recall	95.42%	13.46%	
Decision Tree	Predictive Positive	302	42	87.79%
	Predictive Negative	4	10	71.43%
	Class Recall	98.69%	19.23%	

The classifier model from the Naïve Bayes algorithm will be re-evaluated using the testing model. The following, as shown in Table 3, is the result of testing data. The accuracy of the testing model is 82.22%, and it is considered accurate in predicting a new dataset. The precision and recall for the testing model produce the same value, which the positive and negative classes are 88.89% and 55.56. The negative class result shows a low result, which is influenced by the small number of negative reviews.

Table 3: Model Performance for Testing Dataset.

	True Positive	True Negative	Class Precision
Predictive Positive	64	8	88.89%
Predictive Negative	8	10	55.56%
Class Recall	88.89%	55.56%	

CONCLUSION

The study has shown the result using NB, KNN, and DT algorithms to produce a blended learning experience classifier model. The analysis shows that the distribution between positive and negative user reviews is skewed to positive reviews. Most of the positive reviews show the students agree with blended learning. However, most of the negative reviews show the teachers who are not satisfied with the blended learning approach. The NB algorithm has produced an accurate model in classifying blended learning reviews into positive or negative reviews. The positive experience agrees to blended learning implementation that will encourage other users, educators, and organisers to empower the blended learning methods. The results indicate that the blended learning approach should be continued as one of the teaching and learning processes. In the future, the research of sentiment analysis of blended learning can be expanded further by increasing the number and variety of data sources such as Facebook, forum, and blog. Besides, exploring blended learning perception can be expanded by adding other elements or attributes, such as gender, age, and region, to know the valuable factors that influence blended learning experience and satisfaction.

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REFERENCES

[1] Dziuban, C., Graham, C., Moskal, P., Norberg, A. and Sicilia, N., "Blended Learning: The New Normal and Emerging Technologies," *International Journal of Education Technology Higher Education*, vol.15, no. 3, pp. 1-16, 2018.

[2] Owston, R., and York, D. N., "The Nagging Question When Designing Blended Courses: Does the Proportion of Time Devoted to Online Activities Matter?" *The Internet and Higher Education*, vol. 36. pp. 22-32, 2018.

[3] Tsankov, N. and Damyanov, I., "Education Majors' Preferences on the Functionalities of E-Learning Platforms in the Context of Blended Learning," *International Journal of Emerging Technologies in Learning*, vol. 12, no.5, pp. 202-209, 2017.

[4] Bruggemana, B., Tondeura, J., Struyvenb, K. C., Pynooa, B.D., Garoneb, A. and Vanslambrouckb, B., "Experts Speaking: Crucial Teacher Attributes for Implementing Blended Learning in Higher Education," *The Internet and Higher Education*, vol. 48, pp. 1-11, 2021.

[5] Tagoe, M. And Abakah, E., "Determining distance education students' readiness for mobile learning at University of Ghana Using the Theory of Planned Behavior," *International Journal of Education and Development using Information and Communication Technology (IJEDICT)*, vol. 10, no. 1, pp. 91-106, 2014.

[6] Clark, R.C. and Mayer, R. E., "Proven Guidelines for Consumers and Designers of Multimedia Learning," *4th Edition*, *Wiley*, 2016.

[7] Lin, C.Y., Huang, C.K. and Ko, C.K., "The impact of perceived enjoyment on team effectiveness and individual learning in a blended learning business course: The mediating effect of knowledge sharing," *Australasian Journal of Educational Technology*, vol. 36, no. 1, pp. 126-141, 2020.

[8] Alsalhi, N. R., Eltahir, M. E., and Al-qatawneh, S. S., "Heliyon The Effect of Blended Learning on The Achievement of Ninth Grade Students in Science and Their Attitudes Towards Its Use", 2019.

[9] Rahman, N.A., Arifin, N., Manaf, M., Ahmad, M., Zin, N. A. M and Jamaludin, M. "Students' Perception in Blended Learning among Science and Technology Cluster Students," *Journal of Physics: Conference Series (ICMSCT) 2020*, vol. 1496, no. 2020, pp. 1-11, 2020.

[10] Sahni, J., "Does Blended Learning Enhance Student Engagement? Evidence from Higher Education," *Journal of e-Learning and Higher Education*, vol. 2019, no. 2019, pp. 1-14, 2019.

[11] "The Effect of "Here and Now" Learning on Student Engagement and Academic Achievement," *British Journal of Educational Technology*, vol. 49, no. 2, pp. 321-333, 2018.

[12] Marchalot, A., Dureuil, B., Veber, B., Fellahi, J., Lorne, E., Gerard, J. and Hanouz, J., "Effectiveness of A Blended Learning Course and Flipped Classroom in First Year Anaesthesia Training," *Anaesth. Criteria Care Pain Med.*, vol. 37, vol. 5, pp. 411-415, 2018.

[13] Ireland, J., Martindale, S., Johnson, N., Adams, D., Eboh, W. and Mowatt, E., "Blended Learning in Education: Effects on Knowledge and Attitude," *British Journal of Nursing*, vol. 18, no. 2, pp.124-130, 2009.

[14] Smyth, S., Houghton, C., Cooney, A., and Casey, D., "Nurse Education Today Students' Experiences of Blended Learning Across A Range of Postgraduate Programmes," *YNEDT*, vol. 32, no. 4, pp. 464-468, 2012.

[15] McVeigh, H., "Factors Influencing the Utilisation Of E-Learning in Post-Registration Nursing Students," *Nurse Education Today*, vol. 29, no.1, pp. 91-99, 2009.

[16] Bailey, M., Gosper, M., Ifenthaler D., Ware, C. and Kretzchma, M., "On-campus, distance or online? Influences on student decision-making about study modes at university," *Australasian Journal of Educational Technology*, vol. 34, no. 5, pp. 59-70, 2018.

p-ISSN 1675-7939; e-ISSN 2289-4934

[17] Welker, J. and Berardino, L., "Blended Learning: Understanding the Middle Ground Between Traditional Classroom and Fully Online Instruction," *Journal of Educational Technology System*, vol. 34, no. 1, pp. 33-55, 2005.

[18] So, H.J., "Is Blended Learning A Viable Option in Public Health Education? A Case Study of Student Satisfaction with A Blended Graduate Course," *Journal of Public Health Management Practice*, vol. 15, no. 1, pp. 59-66, 2009.

[19] Lin, Y., "10 Twitter Statistics Every Marketer Should Know in 2020 [Infographic]," *Retrieved 15 September 2020, from https://my.oberlo.com/blog/twitter-statistics.*

[20] Fitri, V. A., Andreswari, R., Hasibuan, M. A., Fitri, V. A., Andreswari, R., and Hasibuan, M. A., "Sentiment Analysis of Social Media Twitter with Case of Anti- LGBT Campaign in Indonesia using Naïve Bayes, Decision Tree and Random Forest Algorithm," *Procedia Computer Science*, vol. 161, pp. 765-772, 2019.

[21] Wong, K., Davis, F., Zaliane, O., and Yasul, Y., "Sentiment Analysis of Breast Cancer Screening in the United States using Twitter," *8th International Conference on Knowledge Discovery and Information Retrieval KDIR 2016*, pp. 265-274, 2016.

[22] Zunic, A., Corcoran, P. And Spasic, I, "Sentiment Analysis in Health and Well-Being: Systematic Review," *JMIR Medical Informatic*, vol. 8, no. 1, 2020.

[23] Clark, E.M, et.al., "A Sentiment Analysis of Breast Cancer Treatment Experiences and Healthcare Perception Across Twitter," *Sentiment Analysis Information*, 2018.

[24] Lakosono, R.A et.al., "Sentiment Analysis of Restaurant Customer Reviews on Trip Advisor using Naïve Bayes," *12th International Conference on Information & Communication Technology and System (ICTS) 2019*, pp. 49-54, 2019.

[25] Hasan, A., Moin, S., Karim, A. and Shamshirband, A. "Machine Learning-Based Sentiment Analysis for Twitter Accounts," *Journal of Mathematical and Computational Applications*, vol. 23, no. 1, pp. 11, 2018.

[26] Farrar, D., and Hayes, J.H. "A Comparison of Stemming Techniques in Tracing," *10th International Symposium on Software and Systems Traceability (SST) 2019*, pp. 37-44, 2019.

[27] Othman, Z.A., Bakar, A.B, Sani, N.S. and Sallim, J. "Household Overspending Model Amongst B40, M40 and T20 using Classification Algorithm," *International Journal of Advanced Computer Science and Applications (IJACSA)*, vol. 11, no. 7, pp. 392-399 2020.

p-ISSN 1675-7939; e-ISSN 2289-4934