

Predicting perceived information overload from social media use: a machine learning approach

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ABSTRACT

The rapid growth of social media has intensified users' exposure to large volumes of information, increasing the risk of perceived information overload. While prior studies have primarily examined this phenomenon using explanatory models, limited attention has been given to its prediction. This study aims to predict perceived information overload from social media use using a machine learning approach. Data were collected through a survey of 349 university students in Malaysian higher education institutions. Social media use across multiple platforms was used as input features, while perceived information overload was treated as a binary target variable. Several machine learning algorithms were evaluated, including decision tree, random forest, k-nearest neighbor, support vector machine, neural network, naïve Bayes, and logistic regression. The results indicate that social media usage patterns contain predictive value for identifying information overload, with the support vector machine demonstrating the strongest discriminative performance. The study contributes to the literature by complementing existing explanatory research with a predictive perspective and highlights the potential of machine learning techniques for early identification of information overload in social media environments.

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1. INTRODUCTION

Social media has become a dominant channel through which individuals access, share, and engage with information in everyday life [1]. Platforms such as social networking sites, messaging applications, and content-sharing services enable rapid dissemination of information and continuous social interaction across personal, professional, and civic domains [2]. While these platforms provide unprecedented opportunities for connectivity and information access, their algorithm-driven content delivery, high update frequency, and emphasis on user engagement have substantially intensified users' information environments [3], [4]. As a result, individuals are increasingly exposed to large volumes of heterogeneous, repetitive, and fast-moving information, raising concerns about their capacity to effectively process and manage the information encountered through social media use [5].

One of the most prominent consequences of this intensified information environment is perceived information overload, a cognitive state in which the volume, complexity, or pace of information exceeds an individual's information-processing capacity [6]. Prior research has consistently associated information

overload with a range of adverse psychological and behavioral outcomes, including cognitive strain, social media fatigue, stress, anxiety, reduced decision quality, and maladaptive information behaviors [7]. In social media contexts, information overload is particularly salient because users are often simultaneously exposed to informational, social, and emotional content, frequently without clear relevance cues or prioritization mechanisms. Importantly, perceived information overload emphasizes users' subjective experiences of being overwhelmed, recognizing that overload is shaped not only by information quantity but also by individual capabilities, usage patterns, and contextual demands [8].

Building on conceptual frameworks that position information overload as the outcome of multiple interacting triggers, recent empirical studies have increasingly examined social media use as a key antecedent of overload experiences [9]. Research has shown that motivations for social media use, such as surveillance, guidance seeking, and anticipated interaction, increase information engagement and discussion, which subsequently heighten perceived information overload [10]. Other studies demonstrate that intensive, habitual, and compulsive social media use significantly amplifies overload experiences, particularly on platforms characterized by high information density and constant connectivity [11]. Evidence from crisis contexts further suggests that heightened emotional concern increases reliance on social media, thereby intensifying information exposure and overload [12]. Collectively, these findings highlight that social media use functions as a critical trigger of perceived information overload, operating through complex combinations of behavioral, cognitive, and contextual factors [13].

Despite the growing body of literature linking social media use to information overload, existing research has predominantly adopted theory-driven and confirmatory analytical approaches, such as regression analysis and structural equation modelling [14], [15]. While these methods have been effective in testing hypothesized relationships and mediation mechanisms, they are less suited for capturing complex, non-linear patterns and interaction effects inherent in social media use behaviors. Given that social media engagement varies across dimensions such as intensity, integration, motivation, and context [16], there is a need for analytical approaches that prioritize prediction accuracy and pattern discovery rather than solely explanatory modelling. In particular, the ability to predict perceived information overload based on users' social media use characteristics remains underexplored. To address this gap, the present study adopts a machine learning approach to predict perceived information overload from social media use. Machine learning techniques are well suited for modelling complex relationships among multiple predictors and for identifying combinations of features that contribute most strongly to prediction outcomes [17]. By shifting the analytical focus from explanation to prediction [18], this study seeks to complement existing theoretical models and provide a data-driven understanding of how social media use patterns are associated with perceived information overload. Such an approach not only advances methodological diversity in information overload research but also offers practical implications for early identification of individuals at risk of experiencing overload in increasingly information-saturated social media environments [19].

Accordingly, this study aims to develop and evaluate machine learning models for predicting perceived information overload based on social media use characteristics. By doing so, the study contributes to the literature in three ways: first, by reinforcing the role of social media use as a key trigger of perceived information overload; second, by extending prior research through a prediction-oriented analytical perspective; and third, by demonstrating the applicability of machine learning methods in understanding complex information behavior phenomena. The findings are expected to inform both theoretical discussions on information overload and practical efforts to design more supportive and cognitively sustainable social media environments.

2. METHOD

This study adopted a quantitative research approach using a survey method to collect data for predicting perceived information overload from social media use. A quantitative design was deemed appropriate given the study's emphasis on measuring perceptions, modelling relationships among variables, and developing prediction models using machine learning techniques. The survey approach enabled the collection of structured data from a relatively large group of respondents, facilitating both statistical and machine learning analyses.

The study population comprised students enrolled in Malaysian higher learning institutions. This population was selected because students are widely recognized as heavy and active users of social media platforms, frequently engaging with multiple platforms for academic, social, and entertainment purposes. Such intensive engagement makes them an appropriate group for examining perceived information overload arising from social media use. Due to the absence of an accessible and comprehensive sampling frame, convenience sampling was employed. Although non-probability in nature, convenience sampling is commonly used in exploratory and prediction-oriented studies involving social media behavior, particularly when the objective is to identify patterns rather than to generalize prevalence estimates to the entire population.

Data were collected using a structured questionnaire administered online. Perceived information overload was measured using an instrument adapted from [20]. The scale comprised 15 items designed to capture respondents' subjective perceptions of being overwhelmed by information. All items were measured using perceptual response formats. For the purpose of prediction modelling, a composite mean score was calculated for each respondent. Respondents with a mean score greater than 3 were categorized as experiencing information overload, while those with a mean score of 3 or below were categorized as not experiencing information overload. This categorization enabled the formulation of a binary target variable suitable for classification-based machine learning analysis.

Social media use was measured by asking respondents to indicate whether they used specific popular social media platforms, including Facebook, Instagram, TikTok, X (formerly Twitter), Snapchat, and others. Respondents were instructed to tick all platforms they actively used. Each platform was coded as a categorical binary variable (yes/no), reflecting users' engagement across multiple social media environments. This approach allowed the study to capture platform-specific usage patterns while maintaining compatibility with machine learning algorithms that handle categorical predictors. Prior to the main data collection, the questionnaire underwent both pre-testing and pilot testing to ensure clarity, validity, and reliability. The pre-test was conducted to assess item wording, comprehension, and overall questionnaire structure, while the pilot test was used to evaluate internal consistency and measurement stability. The results from both exercises indicated that the instrument was suitable for use in the main study, with no major revisions required. Data collection was conducted using the subscribed version of SurveyMonkey, which provided secure data handling and enhanced survey administration features. Respondents were identified and contacted based on their social connections and activity within social media networks. Invitations containing the survey link were distributed online, and participation was voluntary. This approach was consistent with the study's focus on social media users and facilitated efficient access to the target population.

Data analysis was performed using Orange data mining software [21]. A range of machine learning algorithms was employed, including decision tree, random forest, naïve Bayes, k-nearest neighbor, support vector machine, neural network, and logistic regression. Multiple algorithms were used to allow comparative evaluation of predictive performance across different modelling techniques, as each algorithm differs in its underlying assumptions, learning mechanisms, and sensitivity to data characteristics. This multi-model approach enhanced the robustness of the analysis and enabled the identification of the most effective algorithm for predicting perceived information overload from social media use. Model performance was evaluated using standard classification metrics, ensuring objective comparison across models. Figure 1 presents the machine learning workflow employed in this study.

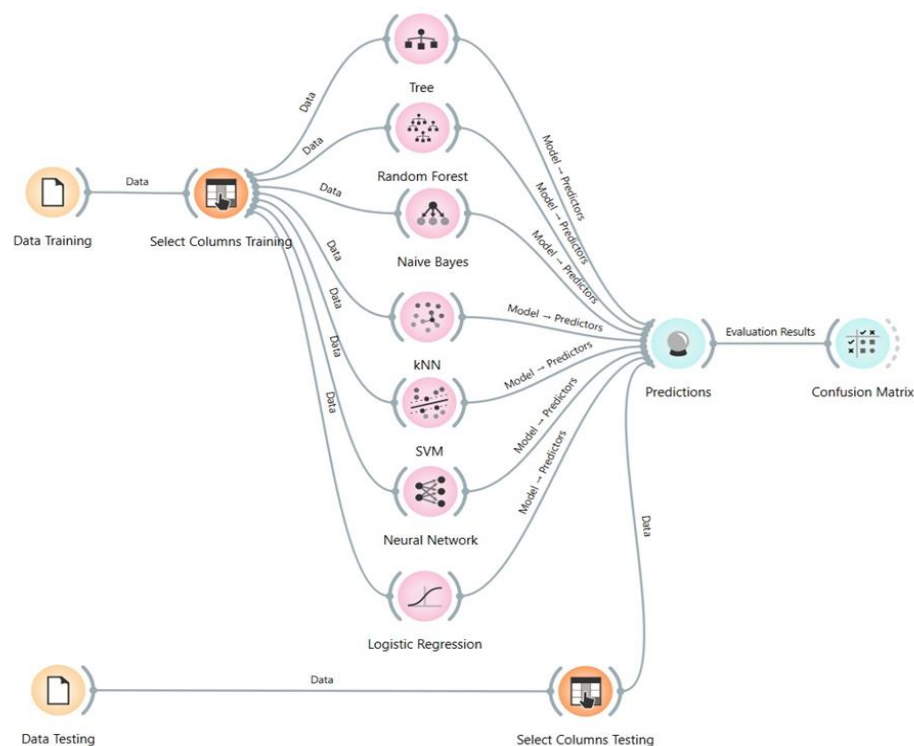


Figure 1. Machine learning workflow for model training, prediction, and performance evaluation

According to Figure 1, the process begins with the preparation of training and testing datasets, followed by the selection of relevant predictor variables through the select columns module. Six classification algorithms were then developed and compared, namely decision tree, random forest, naïve Bayes, k-nearest neighbor, support vector machine, neural network, and logistic regression. The training dataset was used to construct the predictive models, while the testing dataset was used to evaluate their performance. Predictions generated by each model were subsequently assessed using evaluation metrics, including the confusion matrix, to determine classification accuracy and compare the effectiveness of the algorithms. This workflow provides a systematic framework for model development, validation, and performance comparison.

3. RESULTS AND DISCUSSION

The data used in this study were collected as part of a broader research project on social media and information behavior; however, the present analysis focuses specifically on predicting perceived information overload using machine learning techniques. Following data screening, three responses were excluded because the respondents did not report using any social media platforms. Consequently, a total of 349 valid responses were retained for analysis. Table 1 presents the demographic profiles of the respondents included in the machine learning analysis. The sample was predominantly female, accounting for approximately three-quarters of the respondents. Most participants were under 30 years of age, reflecting the typical age distribution of higher education students in Malaysia. In terms of program level, the majority of respondents were enrolled in undergraduate programs, while a smaller proportion consisted of postgraduate students. Regarding academic progression, most respondents were in the early stages of their studies, particularly in years 1 and 2. The field of study distribution indicates that a large proportion of respondents were from social sciences and management disciplines, followed by engineering and technology, with relatively small representation from health sciences, arts, and humanities.

Table 1. Demographic profiles

Variable	Category	Frequency	Percentage (%)
Gender	Male	96	27.5
	Female	253	72.5
Age group	Under 30 years	307	88.0
	30 years and above	42	12
Program level	Undergraduate (diploma and degree)	297	85.1
	Postgraduate (master and Ph.D.)	52	14.0
Year of study	Year 1–2	234	67.0
	Year 3 and above	115	33.0
Field of study	Social Sciences and Management	287	82.2
	Engineering and Technology	50	14.3
	Others (Health Sciences, Arts, and Humanities)	12	3.5

Table 2 presents the distribution of social media platform utilization among the respondents. The results indicate that WhatsApp was the most widely used platform, with nearly all respondents reporting active usage. TikTok and Instagram were also highly prevalent, used by a large majority of the respondents, reflecting their popularity among university students. A substantial proportion of respondents reported using YouTube and Telegram, suggesting frequent engagement with video-based and messaging platforms. In contrast, platforms such as X and Facebook were used by a smaller yet notable segment of respondents, while Pinterest and Snapchat recorded comparatively lower usage levels.

Table 2. Distribution of social media utilization (feature variable)

Social media	Frequency	Percentage (%)
WhatsApp	346	99.1
TikTok	280	80.2
Instagram	276	79.1
YouTube	239	68.2
Telegram	226	64.0
X	155	44.4
Facebook	113	32.4
Pinterest	88	25.2
Snapchat	80	22.9
Others	50	14.3
LinkedIn	44	12.6

Table 3 presents the distribution of perceived information overload categories among the respondents. The results indicate that a substantial majority of respondents were classified as experiencing perceived information overload, while a smaller proportion fell into the non-overload category. This distribution suggests that information overload is prevalent within the studied population. The categorized outcome variable served as the target class in the machine learning analysis, forming the basis for training and evaluating predictive models of perceived information overload.

Table 3. Distribution of perceived information overload categories (target variable)

Perceived information overload	Frequency	Percentage (%)
No information overload	81	23.2
Information overload	268	76.8

Table 4 presents the performance of the seven machine learning models. Several models—random forest, support vector machine, neural network, naïve Bayes, and logistic regression—achieved similarly high classification accuracy (0.800). However, given the imbalanced target variable where overload cases predominated, accuracy alone is an inflated indicator. The support vector machine demonstrated the highest area under the curve (AUC) (0.547), indicating the strongest discriminative capability in distinguishing overload from non-overload cases. Logistic regression and naïve Bayes showed moderate AUC values, while decision tree and k-nearest neighbor performed comparatively weaker. Precision, recall, and F1-scores were consistent across better-performing models, while Matthew's correlation coefficient (MCC) values were near zero for most models, reflecting the challenge of predicting information overload from binary platform usage features alone.

Table 4. Performance comparison of machine learning models for predicting perceived information overload

Model	AUC	Classification accuracy	F1-score	Precision	Recall	MCC
Decision tree	0.352	0.375	0.435	0.566	0.375	-0.275
Random forest	0.398	0.800	0.711	0.640	0.800	0.000
K-nearest neighbor	0.414	0.450	0.504	0.630	0.450	-0.125
Support vector machine	0.547	0.800	0.711	0.640	0.800	0.000
Neural network	0.383	0.800	0.711	0.640	0.800	0.000
Naïve Bayes	0.484	0.800	0.711	0.640	0.800	0.000
Logistic regression	0.457	0.800	0.711	0.640	0.800	0.000

The findings confirm that social media usage patterns contain meaningful predictive signals for information overload, consistent with prior research linking platform engagement to overload experiences [11], [22], [23]. The superior discriminative performance of the support vector machine reflects its capacity to model non-linear decision boundaries, making it well suited to the complex and heterogeneous nature of social media use behaviors. However, the high classification accuracy shared by several models must be interpreted cautiously given the imbalanced distribution of the target variable, where overload cases predominated. Discriminative metrics such as AUC therefore provide a more reliable basis for comparison. The near-zero MCC values across models further indicate that platform-level binary usage indicators alone offer limited predictive precision, consistent with Belabbes *et al.* [24] framework which positions overload as a cognitively mediated outcome shaped by processing capacity and subjective interpretation rather than exposure volume alone [25].

Beyond model performance, the findings carry broader implications. By demonstrating that information overload can be predicted from social media usage patterns, this study offers a pathway for early identification of individuals vulnerable to downstream consequences such as misinformation sharing, information avoidance, and reduced verification practices [9], [26]. The moderate overall predictive performance suggests that future models would benefit substantially from incorporating individual-level features such as cognitive ability, social media information literacy, and content interaction patterns alongside platform usage indicators [27], [28]. Such enriched feature sets would better capture the internal cognitive and emotional mechanisms that underpin overload experiences and are likely to improve both discriminative and correlational performance.

4. CONCLUSION

This study examined the predictive relationship between social media use and perceived information overload using a machine learning approach, revealing that social media usage patterns possess meaningful

predictive value for identifying individuals who experience information overload, with the support vector machine model demonstrating the strongest discriminative performance among the models evaluated. These findings confirm that social media use functions as a salient trigger of information overload, consistent with prior theoretical and empirical work, while also showing that predictive modelling offers a viable complementary perspective to traditional explanatory analyses. The study contributes to the literature by shifting the analytical focus from explanatory relationships to predictive performance and by empirically operationalizing trigger-based conceptualizations of information overload within a machine learning framework, thereby bridging theoretical models of overload with data-driven prediction. However, as the sample consisted exclusively of university students recruited through non-probability convenience sampling, the generalizability of the findings is limited, and future research should incorporate more heterogeneous samples, probability-based sampling techniques, additional predictive features (such as usage intensity, emotional responses, and social media information literacy), and longitudinal or more advanced modelling approaches to further validate and extend these results.

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AUTHOR CONTRIBUTIONS STATEMENT

This journal uses the Contributor Roles Taxonomy (CRediT) to recognize individual author contributions, reduce authorship disputes, and facilitate collaboration.

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C : **C**onceptualization

M : **M**ethodology

So : **S**oftware

Va : **V**alidation

Fo : **F**ormal analysis

I : **I**nvestigation

R : **R**esources

D : **D**ata Curation

O : Writing - **O**riginal Draft

E : Writing - Review & **E**diting

Vi : **V**isualization

Su : **S**upervision

P : **P**roject administration

Fu : **F**unding acquisition

CONFLICT OF INTEREST STATEMENT

The authors declare that there are no conflicts of interest associated with this research.

INFORMED CONSENT

Informed consent was obtained from all participants prior to data collection. The questionnaire was accompanied by a cover letter outlining the study objectives, and participants were clearly informed of their right to participate voluntarily and to withdraw at any time without penalty.

ETHICAL APPROVAL

Ethical approval for this study was obtained from the relevant university ethics committee prior to the commencement of data collection.

DATA AVAILABILITY

The data supporting the findings of this study are available from the corresponding author, [MNM], upon reasonable request.

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