

Social Media Addiction in Adolescents: A Psychological, Sociological, and Anthropological Study Using Mixed Method Machine Learning

Nabila Nabila¹, Karin Azizy², Ananta Yudiarso^{3*}

¹²³Faculty of Psychology, University of Surabaya

Corresponding author:

*Ananta Yudiarso

ananta@staff.ubaya.ac.id

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Abstract

Background: Social media addiction is a multidimensional issue affecting adolescent development in Indonesia. **Objective:** This study examined the influence of age, education, and regional minimum wage on adolescent social media addiction through psychological, sociological, and anthropological perspectives. **Method:** A mixed-methods design integrated machine-learning analysis of secondary data from the Indonesian Central Bureau of Statistics (BPS) with semi-structured interviews involving three adolescents showing indications of social media addiction. The interviews provided contextual insights rather than statistical generalization. Machine-learning algorithms identified the most influential predictors, while qualitative analysis explored social interaction, communication patterns, cultural values, identity construction, self-confidence, and mental health. **Results:** Age, educational status, and socioeconomic conditions emerged as important factors, with adolescents aged 13–20 years identified as the most vulnerable group. Social media also influenced identity formation and social interaction. **Conclusion:** Integrating machine learning with psychological, sociological, and anthropological perspectives provides a comprehensive understanding of adolescent social media addiction and supports future prevention and intervention strategies.

Keywords: Adolescents; Digital Sociology; Media Anthropology; Social Media Addiction.

Abstrak

Latar Belakang: Kecanduan media sosial merupakan isu multidimensional yang berdampak signifikan terhadap perkembangan remaja di Indonesia. **Tujuan:** Penelitian ini bertujuan mengkaji pengaruh usia, tingkat pendidikan, dan upah minimum regional terhadap kecanduan media sosial pada remaja melalui perspektif psikologi, sosiologi, dan antropologi. **Metode:** Penelitian menggunakan desain metode campuran dengan mengintegrasikan analisis data sekunder dari Badan Pusat Statistik (BPS) menggunakan pembelajaran mesin dan wawancara semi-terstruktur terhadap tiga remaja yang menunjukkan indikasi kecanduan media sosial. Wawancara tersebut ditujukan untuk memperoleh penjelasan kontekstual, bukan menghasilkan generalisasi statistik. Analisis kuantitatif digunakan untuk mengidentifikasi prediktor utama, sedangkan wawancara memberikan pemahaman mengenai interaksi sosial, pola komunikasi, nilai budaya, pembentukan identitas, kepercayaan diri, dan kesehatan mental. **Hasil:** Usia, status pendidikan, dan kondisi sosial ekonomi ditemukan sebagai faktor penting, dengan remaja berusia 13–20 tahun sebagai kelompok paling rentan. Media sosial juga memengaruhi pembentukan identitas dan pola interaksi sosial mereka. **Kesimpulan:** Integrasi pembelajaran mesin dengan perspektif psikologis, sosiologis, dan antropologis memberikan pemahaman yang lebih komprehensif serta mendukung pengembangan strategi pencegahan dan intervensi yang tepat.

Kata Kunci: Antropologi Media; Kecanduan media sosial; Remaja; Sosiologi Digital

Introduction

In today's digital era, social media has become an integral part of adolescents' daily lives, providing opportunities for communication, entertainment, and self-expression. However, excessive and uncontrolled use of social media has increasingly been recognized as a form of behavioral addiction that may adversely affect adolescents' psychological well-being, social relationships, and identity development (Savaci et al., 2021; Griffiths et al., 2016). The rapid growth of internet accessibility and smartphone use has further intensified this phenomenon, making social media addiction an important public health and educational concern. One of the impacts of this development is the emergence of behavioral problems in the form of social media addiction, which is a condition where a person continuously and uncontrollably accesses social media platforms (Wahyuni, 2023). Addiction is the habit of continuing to engage in an activity or using a substance without considering its negative impact on an individual's physical, mental, social, mental, and financial health. One form of addiction that is increasingly prevalent in this digital era is the excessive use of social media, especially among teenagers. Social applications that increase people's capacity to share, cooperate, and engage in group activities outside institutional and organizational structures are called social media (Priyowidodo, 2020).

Recent national statistics indicate that Indonesia is one of the countries with the highest levels of internet and social media use among adolescents. According to the Indonesian Internet Service Providers Association (APJII, 2024) and Statistics Indonesia (BPS, 2023), adolescents constitute one of the most active internet user groups, with many spending several hours each day on social media platforms such as Instagram, TikTok, WhatsApp, and Facebook. This increasing exposure has raised concerns regarding excessive use and its potential psychological, social, and cultural consequences. However, economic conditions and educational status also need to be considered as background factors that reinforce social media addiction. Based on data obtained by the Indonesian Central Bureau of Statistics 2023, the level of Regional Minimum Wage (UMR) in various regions in Indonesia shows inequality, which impacts access to entertainment or alternative non-digital activities for teenagers. Teenagers living in areas with low minimum wage tend to use social media more often as their main form of entertainment, due to the limited physical or recreational activities available around them. This finding is reinforced through the feature importance analysis in this study, which shows that the UMR variable is one of the dominant predictors of social media addiction in adolescents. In addition, educational status also affects the tendency to use social media intensively. Data shows that adolescents with a high school educational background show a higher level of social media engagement, especially in the face of academic pressure, search for self-identity, and demands to exist in their social environment (BPS, 2023; APJII, 2024). Social media is often used as a means of self-actualization and escape from these pressures, which can eventually develop into addictive behavior if not controlled.

Although previous studies have examined the psychological consequences of excessive social media use, most have focused on a single disciplinary perspective or relied exclusively on conventional statistical approaches. Limited research has simultaneously examined psychological, sociological, and anthropological factors while employing machine learning techniques to identify the relative importance of socioeconomic and demographic predictors. Consequently, a comprehensive understanding of adolescent social media addiction remains limited, particularly in the Indonesian context.

The increasing use of gadgets among adolescents leads to various changes in attitudes and behaviors. One of the negative impacts of excessive social media use is the decline in learning ability and social skills. Teenagers who are too engrossed in gadgets tend to experience a decline in academic performance due to reduced study time and divided concentration. In addition, their social interactions may also be disrupted, leading to difficulties in communicating and adapting in social settings. Symptoms of gadget and social media addiction are similar to those of addiction in general (Griffiths et al., 2016) which include a) Mood swings: due to dependence on social media. b) Salience: which is a strong urge to continue using until it dominates thoughts and behavior. c) Tolerance: which is the need to continue to increase the duration of use in order to get the same satisfaction. d) Withdrawal symptoms: which is a feeling of discomfort when use is reduced or stopped. e) Relapse: which is the tendency to return to use after stopping. f) Conflict: which is the emergence of conflict between individuals and the surrounding environment due to the use of devices and social media. In dealing with this, the role of parents is very important, namely by setting limits on usage time, selecting age-appropriate content, and encouraging other activities that support their social and academic development. With proper supervision, children can be directed to utilize technology wisely without sacrificing important aspects of their lives.

Among various platforms, social media such as Instagram also has a psychological influence on its users, especially regarding their views on body image. The phenomenon of body dissatisfaction is increasingly

found among female Instagram users. This occurs due to the amount of content that displays certain beauty standards, thus encouraging individuals to compare themselves with others. High social comparison, excessive intensity of Instagram use, and addiction to social media are the main factors that cause body dissatisfaction. This is in line with previous research which shows that there is an influence of social comparison on the tendency of body dissatisfaction in early adult female Instagram users who follow influencer accounts (Anggrainy, 2022). Low self-compassion or self-acceptance also contributes to increased body shape dissatisfaction. The phenomenon of body shape dissatisfaction must be considered as well as possible, so as not to have a negative impact on mental health, such as anxiety, decreased self-confidence, and eating disorders. Therefore, it requires awareness from social media users to be wiser in consuming content and increase self-compassion in order to better accept their bodies.

Several studies have been conducted to explore the impact of social media addiction (Prasetyo et al., 2024). Social media addiction can put people under pressure and cause stress. Feelings of worthlessness, worry, and sadness are some of the mental health consequences. In addition, Ayub (2021) identified several negative impacts, such as decreased empathy for others, internet addiction caused by excessive use of social media, and students' tendency to be reluctant to relate to individuals directly due to the accessibility of online communication. Previous study (Wahyuni (2023) also suggests that low social support may exacerbate social media addiction among college students, highlighting the importance of healthy social interactions in mitigating the negative impact of this addiction. Aside from being a medium of communication, social media has now become an important part of teenagers' cultural lives. From an anthropological perspective, platforms such as Instagram, TikTok, or Twitter are not only used to exchange messages, but also serve as social places where individuals show their identity. Teenagers use social media to express their values, lifestyles, and even social status in an ever-evolving digital environment.

Previous study (Roem and Sarmiati, 2021), the use of Instagram has changed the way teenagers build social identities. They no longer form identities only from the family or school environment, but also from how they are responded to on social media either through the number of followers, likes, or comments. This condition is reinforced by previous research (Intan et al, 2020). The social media encourages the birth of a strong image culture, where adolescents feel the need to continue to show the best side of themselves to remain socially relevant. This causes them to be trapped in a cycle of content and external validation. In a cultural context, this phenomenon is a reflection of how technology has reshaped the way humans define existence and social connection. Social media addiction in anthropology can also be seen as a form of cultural attachment to the virtual world. The presence of communication technology has formed "digital rites" that are carried out repeatedly, such as the routine of opening applications every time you wake up, or the desire to continuously share every personal activity. All of these are symptoms of the emergence of digital habits, which are habits formed from social interactions in the digital space. In terms of data, the latest report from the Indonesian Central Bureau of Statistics (BPS) noted that in 2023, as many as 95.87% of Indonesian teenagers aged 13-19 years are active internet users, with a total of around 85 people. As many as 3% of them access social media as their main activity. Furthermore, more than 27% of these teens spend more than six hours per day on social media, indicating how dominant these platforms are in the daily lives of Indonesian teens (BPS, 2023).

This study aims to determine, "What is the relationship between education, age, and regional minimum wage standards with the level of addiction in adolescents in Indonesia with social media? ". This study is very necessary considering the phenomenon of addiction to social media is increasingly common, especially among adolescents. If not addressed properly, this addiction can have long-term impacts on their cognitive, emotional, and social development. This study is also relevant because it combines three important perspectives, namely psychology, sociology, and anthropology. From a psychological perspective, we can understand how social media affects adolescents' self-confidence and mental health. From a sociological perspective, we can see how this addiction affects social relationships and peer group dynamics. While from an anthropological perspective, we can understand how digital culture shapes habits, identities, and values in the lives of today's adolescents. The reason researchers conducted this study was because they wanted to see the level of addiction in adolescents aged 13-20 years in using social media.

To support a more in-depth and comprehensive analysis, this research will also use a machine learning approach, which is a set of effective methods for managing large amounts of data by utilizing learning algorithms applied to the data. Through machine learning, we can identify hidden patterns of social media user behavior that may be difficult to see manually, such as usage intensity, usage time, or type of content consumed. The advantage of machine learning is its ability to learn data automatically and provide predictions that can help in making the right decisions or interventions. This research uses mixed methods, which include quantitative data (numbers and statistics) and qualitative data (interviews or observations). This approach is

superior because it provides a more comprehensive picture: quantitative data provides statistically robust evidence, while qualitative data provides an in-depth understanding of adolescents' experiences and views on social media use. With this combination of methods and technologies, it is hoped that the research results can provide a more comprehensive and applicable solution in addressing the impact of social media addiction on adolescents in Indonesia.

The phenomenon of social media addiction can be categorized as behavioral addiction, where someone cannot control themselves to use social media and spends too much time accessing it so that the behavior can interfere with productivity. The theory of behavioral addiction explains that individuals can experience dependence on certain activities, including the use of social media, which is similar to substance addiction. This addiction is often caused by the need for social recognition and the ease of interacting with others. A study conducted at Harvard University showed that interaction with social media platforms can affect the brain related to the decision-making process. When someone receives instant rewards such as "likes" or "positive comments", the dopamine production area in the brain will be stimulated which causes an increase in dopamine production. Social media has the ability to provide instant rewards continuously with relatively little effort from the user. This means that users do not need to do much to get recognition, just by uploading content or interacting occasionally they can continue to receive these rewards.

However, despite these benefits, the negative impacts of this addiction are worth noting. Social media addiction can lead to sleep disturbances, decreased productivity, and mental health problems such as anxiety and depression. Social media addiction can cause individuals to feel isolated even though they are connected virtually. This suggests that even though social media users feel connected to others online, they will still experience feelings of loneliness. Connections made in the virtual world cannot always replace deeper social interactions in the real world. Current thinking suggests that social interactions on social media are not always positive. While these platforms are designed to promote communication experiences, social interactions, and community building, many users emphasize social comparison. This will happen when people see other people's more ideal or happy lives on social media, they may experience dissatisfaction with their own lives by feeling inadequate and empty.

Accordingly, this study aims to examine how age, educational status, and regional minimum wage are associated with adolescent social media addiction in Indonesia by integrating psychological, sociological, and anthropological perspectives with machine learning analysis. Unlike previous studies that primarily relied on conventional quantitative or qualitative approaches, this study combines machine learning with qualitative inquiry to identify important predictors while simultaneously providing contextual explanations of adolescents' experiences. This multidisciplinary mixed-methods approach is expected to contribute both theoretically and practically to understanding adolescent social media addiction in Indonesia. One of novelty Machine learning was incorporated into this study because of its ability to identify complex nonlinear relationships among multiple predictors and determine the relative importance of each variable in predicting social media addiction. Unlike conventional statistical analyses, machine learning algorithms can capture hidden patterns within large secondary datasets, thereby providing more robust evidence for identifying adolescents at greater risk of social media addiction. The qualitative component was subsequently employed to complement these quantitative findings by exploring adolescents' lived experiences and providing contextual interpretation.

Method

This study employed an explanatory mixed-methods design that integrated a systematic literature review, secondary quantitative data analysis, and qualitative interviews to obtain a comprehensive understanding of adolescent social media addiction. In the first stage, a systematic literature review was conducted following the PRISMA 2020 protocol (Page et al., 2021) to identify current evidence, theoretical perspectives, and research gaps related to adolescent social media addiction. The PRISMA framework ensured a transparent study selection process through predefined inclusion and exclusion criteria and systematic data extraction.

The second stage consisted of quantitative analysis using secondary data obtained from Statistics Indonesia (BPS). The dataset included regional socioeconomic and demographic indicators relevant to adolescent social media use, including age group, educational status, and Regional Minimum Wage (RMW). These variables were selected because previous studies have consistently identified demographic and socioeconomic characteristics as important determinants of adolescents' digital behaviour. The secondary dataset was organized into a structured tabular format suitable for supervised machine learning analysis using Orange Data Mining version 3.1.

Four machine learning algorithms were implemented, namely Decision Tree, Random Forest, Support Vector Machine (SVM), and Neural Network. This study employed Decision Tree and Random Forest algorithms because Decision Tree generates interpretable classification models by recursively partitioning data based on predictor variables (Quinlan, 1986), whereas Random Forest enhances predictive performance and model stability by aggregating multiple decision trees through an ensemble learning approach (Breiman, 2001). These algorithms were selected because they represent different predictive approaches, allowing comparison of classification performance and identification of the most suitable model for predicting social media addiction. Decision Tree and Random Forest provide interpretable decision structures and feature importance analysis, SVM performs well in high-dimensional classification problems (Cortes & Vapnik, 1995), while Neural Network can model complex nonlinear relationships (LeCun et al., 2015). Model evaluation was carried out using Area Under the Curve (AUC), classification accuracy, precision, recall, F1-score, and Matthews Correlation Coefficient (MCC). Feature importance analysis was subsequently conducted to determine the relative contribution of each predictor to the classification model.

The third stage involved qualitative inquiry using semi-structured interviews to complement the quantitative findings. Rather than validating the machine learning results statistically, the qualitative component was designed to provide contextual explanations regarding adolescents' experiences, perceptions, and social-cultural backgrounds associated with social media use. The integration of quantitative and qualitative findings therefore served the purpose of methodological complementarity within the mixed-methods design (Creswell & Poth, 2018).

Participant

The qualitative participants consisted of three adolescents aged between 13 and 20 years who were active users of social media platforms, including Instagram, TikTok, and WhatsApp. Participants were purposively selected because they reported intensive social media use and represented three different cultural settings in Indonesia, namely Bali, South Sulawesi, and Jakarta. These regions were intentionally selected to provide variation in cultural and social backgrounds rather than statistical representation. Considering that the primary objective of the qualitative phase was to obtain in-depth contextual understanding, a small purposive sample was considered appropriate for exploring adolescents' lived experiences within the mixed-methods framework. Therefore, the qualitative findings are interpreted as contextual evidence that complement the quantitative analysis rather than providing population-level generalization.

Data Measurement

For the quantitative component, the variables analysed included age group, educational status, and Regional Minimum Wage (RMW) as predictor variables within the machine learning models. Social media addiction served as the outcome variable represented in the secondary dataset used for predictive modelling. In the qualitative stage, information was obtained through semi-structured interviews. The interviews were conducted both directly and indirectly, recorded with the participants' consent, and transcribed verbatim for analysis. The interview protocol explored motivations for social media use, emotional experiences, peer influence, family context, and cultural values shaping adolescents' digital behaviour. The researcher also explored how local traditions, community norms, and cultural identity influenced adolescents' interactions with social media.

Data Analysis

Quantitative data were analysed using Orange Data Mining software. Four supervised machine learning algorithms—Decision Tree, Random Forest, Support Vector Machine, and Neural Network—were developed and compared based on their predictive performance. Model performance was evaluated using AUC, accuracy, precision, recall, F1-score, and MCC. Higher values on these evaluation metrics indicate better classification performance, while feature importance analysis was used to identify the predictors that contributed most strongly to the classification of adolescent social media addiction. For the qualitative data, thematic analysis was conducted following repeated reading of interview transcripts, open coding, category development, and theme identification. Emerging themes were interpreted in relation to the quantitative findings to explain how psychological, sociological, and anthropological factors influenced adolescents' experiences with social media addiction. Representative quotations were included to support the interpretation of each theme.

Result

The quantitative analysis was conducted using four supervised machine learning algorithms, namely Decision Tree, Random Forest, Support Vector Machine (SVM), and Neural Network. Model performance was evaluated using Area Under the Curve (AUC), Classification Accuracy (CA), Precision, Recall, F1-score, and Matthews Correlation Coefficient (MCC). These evaluation metrics provide complementary information regarding the predictive performance of each model, while feature importance analysis was used to identify the variables that contributed most strongly to the prediction of adolescent social media addiction.

Based on the secondary data collected, this study refers to three main sources that form the basis of analysis of the phenomenon of deviant behavior in the form of social media addiction in adolescents, using psychological, sociological, and anthropological approaches. First, the results of data analysis using the Orange application produce several important outputs such as ROC Curve, Prediction, and Feature Importance that help measure the accuracy of the model and identify the dominant factors that contribute to social media addiction. Second, the PRISMA flow chart was used to map the process of screening relevant articles in the literature review in a systematic and transparent manner. Third, the literature review from various scientific journals was used to strengthen the theoretical foundation and provide a broader social and cultural context for the empirical findings. These three data complement each other in forming a comprehensive understanding of social media addiction as a form of deviant behavior that not only has psychological impacts, but is also closely related to social pressure, modern cultural values, and adolescents' interactions with their social environment.

1. *Result of Secondary Data Analysis using machine learning*

Based on the data results for models to predict social media addiction, three types of models have been tested, namely Decision Tree, Random Forest, and Support Vector Machine (SVM). Among the three models, Decision Tree performed the best with an AUC value of 0.987, accuracy (CA) of 0.935, as well as precision, recall, and F1-score values that were also very high at 0.935. In addition, the MCC value reached 0.868, indicating that this model is very reliable and efficient in detecting social media addiction. Meanwhile, the Random Forest model also showed excellent results with an AUC value of 0.979, accuracy of 0.903, F1-score of 0.901, precision of 0.917, MCC of 0.812, and recall of 0.903. Although the results are below Decision Tree, Random Forest is still accurate and quite stable, especially in reducing false positive misclassification, reflected in the higher precision value. On the other hand, the SVM model showed the lowest performance with a very low AUC value of 0.124. Although the accuracy value is 0.677 and precision reaches 0.715, SVM only has an F1-score of 0.635 and MCC of 0.338, indicating that this model is less effective in distinguishing between positive and negative clearly. Based on these findings, it can be concluded that Decision Tree is the most effective model in predicting social media addiction in the data used, followed by Random Forest. SVM is less recommended for this situation due to its inconsistent performance and tends to be low in terms of classification accuracy.

Tabel 1. Matrix evaluation

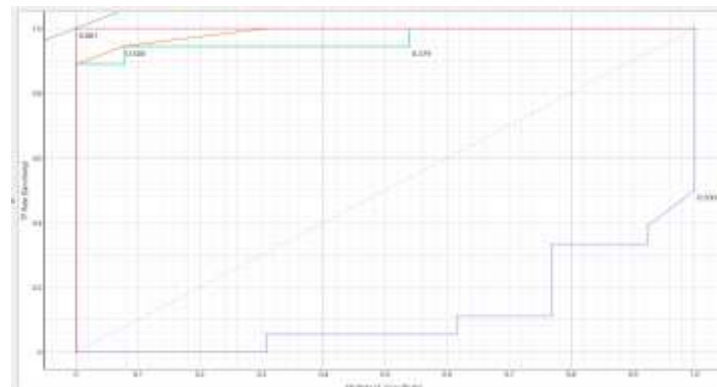
Model	AUC	CA	F1	Prec	Recall	MCC
Random Forest	0.979	0.903	0.901	0.917	0.903	0.812
Tree	0.987	0.935	0.935	0.935	0.935	0.868
SVM	0.124	0.677	0.635	0.715	0.677	0.338

Overall, the evaluation metrics indicate that the developed machine learning models achieved satisfactory classification performance. Higher AUC values demonstrate better discrimination between adolescents with different levels of social media addiction risk, whereas higher accuracy, precision, recall, and F1-score indicate more reliable classification performance. The MCC values further confirm the robustness of the models by accounting for balanced classification performance across different outcome categories.

The figure below shows a ROC (Receiver Operating Characteristic) graph used to evaluate the performance of a classification model in distinguishing between two groups, such as adolescents who are affected by social media dependence and those who are not. In the graph, the Y-axis represents the True Positive Rate (TPR) or sensitivity, while the X-axis represents the False Positive Rate (FPR) or specificity 1. An ideal ROC graph is shown by a curve close to the upper left corner, as this indicates a high level of accuracy (high sensitivity and low prediction error rate). Based on the figure, there are several ROC curves that show the performance of different models or test scenarios. One of the curves (colored red or orange) is very close to the top left corner with a TPR value of 0.881, which indicates that the model has excellent classification ability. Meanwhile, the other curve (blue) is close to the diagonal line, which is the random limit, so the model

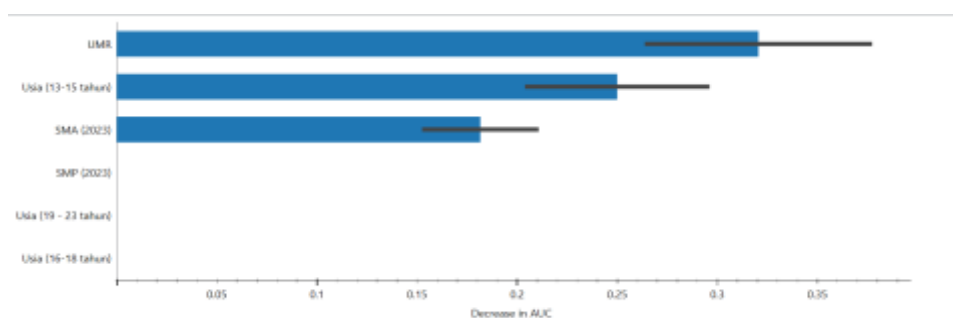
performs poorly or even no better than a random guess. The gray diagonal graph as a reference line shows the performance of the model that is unable to distinguish classes effectively. Overall, this graph shows that not all models perform well, and one of the models (red/orange curve) has the best potential as it shows a high area under the curve (AUC).

Picture 1. Grafik ROC



According to the results of the feature important using Orange Data Mining, there are a number of variables that significantly affect the level of adolescent social media addiction. UMR (Regional Minimum Wage) is the factor that contributes the most to the accuracy of the prediction model. This suggests that the socio-economic condition of teenagers, which can be seen from the UMR level in the area where they live, is related to the pattern of social media use. Teenagers from areas with low minimum wage more often use social media as an alternative activity because they do not have many entertainment options. In addition, the age between 13 - 15 years old is also one of the most influential. This is because peer influence and identity seeking are particularly strong in this age group, which is in transition from childhood to early adolescence. Social media has developed into an important tool for expression, comparing oneself with others and gaining social validation. However, these can all lead to over-attachment and even addiction. The 2023 high school education status is also important. It shows high social media use among high school teens. At this age, academic pressure, identity search, and complex social dynamics encourage them to become more active in social media as a means of escape or self-actualization. However, junior high school (2023), 16-18 years old, and 19-23 years old, showed low levels of importance. This may indicate that self-control over social media use increases with age, or perhaps preferences towards online platforms change.

Picture 2. Feature Important



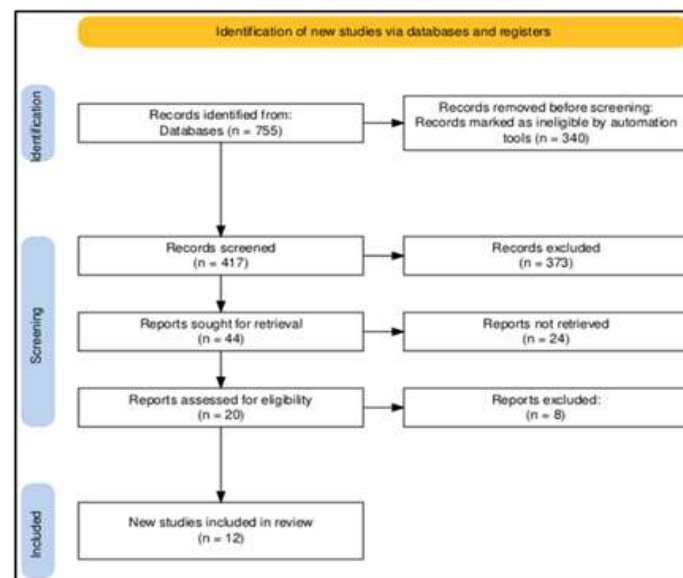
Overall, the evaluation metrics indicate that the developed machine learning models achieved satisfactory classification performance. Higher AUC values demonstrate better discrimination between adolescents with different levels of social media addiction risk, whereas higher accuracy, precision, recall, and F1-score indicate more reliable classification performance. The MCC values further confirm the robustness of the models by accounting for balanced classification performance across different outcome categories.

2. Result from literature review using PRISMA

In the literature review section, the PRISMA diagram is used to describe the process of selecting articles to be explained in this study. This diagram illustrates the method of systematically filtering articles so that only articles that are in accordance with the theme and have the right information will be used. Articles that are not selected are caused by data that is not relevant to the desired theme, studies that do not support the research,

and articles without clear references. The process began by collecting 755 articles from various database sources. Of the total, 340 articles were automatically deleted due to data incompatibility. Furthermore, 417 articles were manually re-selected, and 373 other articles did not meet the established criteria. Then, 44 articles were selected for further analysis, but 24 articles could not be accessed in their entirety. Of the 20 articles that could be explained, 8 articles were not selected because their content did not match the research needs. In the end, only 12 relevant and high-quality articles were used in this study. The application of PRISMA helps ensure that the articles reviewed truly support the research objectives, both in terms of the appropriateness of the theme and delivering the data provided.

Picture 3. PRISMA Table



In this study, a literature review was systematically conducted to explore existing research related to social media addiction in Indonesia, specifically regarding internet penetration rate, age, education, income (UMR). Through the identification and synthesis of 12 peer-reviewed journal articles, this section outlines the key thematic insights upon which the analytical framework of this study is developed.

Table 2. Literature Review

Researchers	Methods	Results
(Akmaluddin & Dewayanto, 2023)	Quantitative Correlation	His study will also use a machine learning approach, which is a set of effective methods for managing large amounts of data by utilizing learning algorithms applied to the data
Wulandari & Netrawati (2020)	Quantitative Correlation	This convenience is supported by the presence of connectivity applications such as the internet and social media platforms, which allow users to socialize and communicate remotely
Intan, T., Akhsaniyah, & Tiananda, F. (2020)	Qualitative Study	Social media influences people's lifestyles, especially in the aspects of consumption and social relations.
Griffiths, M. D., et al. (2016)	Theoretical Review (Critical Commentary)	Developing international consensus criteria for the diagnosis of Internet Gaming Disorder.

Anggrainy, (2022)	Theoretical Review	Social media is shaping a new culture and changes in social communication patterns.
Prasetyo et al. (2024)	Quantitative Correlation	Social media addiction can put people under pressure and lead to stress. Feelings of worthlessness, worry, and sadness are some of the mental health consequences.
Priowidodo, G. (2020)	Netnography	Analysis of communication on social media shows changes in online social interactions.
Roem, E. R., & Sarmiati (2021)	Qualitative Study	Instagram causes changes in social culture among Padang female students.
Riyanto, G. P. (2022)	Statistical reports	Internet users in Indonesia will reach 210 million by 2022.
Ayub, M. (2022)	Systematic review	Identified several negative effects, such as a decline in empathy for other people, internet addiction brought on by excessive social media use, and a propensity for students to grow reluctant to contact individuals in person because of the accessibility of online communication.
Savaci, Kutlu, & Ozen (2021)	Quantitative Correlation	Almost all levels of society are now dependent on technology, with the growth of internet usage increasing significantly
BPS (2023) dan APJII (2024)	National Statistics Survey	Internet and social media usage continues to increase among Indonesian youth.

To complement the quantitative findings, semi-structured interviews were conducted with three adolescents from different cultural backgrounds. The qualitative analysis aimed to explore how psychological experiences, social relationships, and cultural values influenced adolescents' social media use. These findings are presented as contextual explanations rather than statistical generalizations.

Social media addiction in adolescents is a contemporary deviant behavior phenomenon that can be analyzed holistically through psychology, sociology, anthropology, and social pathology approaches. From a psychological perspective, this addiction reflects a disorder of self-regulation, where adolescents show symptoms such as difficulty controlling the duration of use, anxiety if they do not open social media, and dependence on social validation. This is in line with the interviewee's statement: *"On holiday I can do up to 10 hours ... because it's a holiday so there are no activities and I don't do anything"* (Beno, May 18, 2025). *"I can't ... I don't open social media when I'm at university, I'm very easily distracted"* (Nami, May 20, 2025). This indicates that social media is used as a form of emotional escape.

From a social pathology perspective, social media addiction can be considered a type of behavioral deviation in the digital world that disrupts a person's social interactions. In this case, adolescents who are too focused on online activities experience decreased productivity, sleep problems, and weaker real-world social relationships. It is also explained in the literature that digital addiction can lead to social isolation, even though individuals appear "connected" online. The spike in depression and social isolation in American adolescents is correlated with increased social media use and decreased face-to-face interactions (Twenge et al., 2018). This suggests that online connections cannot replace the depth of face-to-face interpersonal relationships.

Sociologically, social media has become a new platform for shaping social identity and self-image, where peer pressure and popular culture encourage teenagers to follow trends. The interviewee revealed that she has been following the TikTok trend since she was in middle school because her neighborhood also followed the trend: *"Like, for example... other circles are making it... why don't we"* (Beno, May 18, 2025).

This suggests that the need to be socially accepted and the pressure to stay relevant in peer groups strongly influence adolescents' digital behavior.

From an anthropological perspective, social media addiction can be understood as part of a new culture called "digital sites", which are digital habits such as opening social media every time you wake up or sharing daily activities. Digital culture does not replace local culture, but rather interacts with it. Interviewee P mentioned that documentation of traditional ceremonies is still done, but adjusted to the norms of modesty and sacredness: *"During the ceremony ... usually before it starts anyway ... there are some people who document it, but during the prayer process itself we focus first ... after it's finished, we usually sometimes take photos for documentation."* (Beno, May 18, 2025). This shows the process of adapting local culture to digital technology. Digital culture formed through the use of social media does not replace local culture, but rather becomes a new means of expression. A study by Ardévol (2021) shows that digital media becomes a space for the creation of new cultural identities, where local traditions are displayed in the form of digital visuals and narratives.

When viewed through a multi-level approach, at the individual level, this addiction starts from psychological elements such as the desire for entertainment, avoiding boredom, or gaining social acceptance. *"For this, yes, quite often, especially on holidays like that ... because on vacation we don't have anything to do ... so I very often scroll social media or play games."* (Beno, May 18, 2025).

At the social level, addictive behavior is reinforced by the demand to always be active online, peer group dynamics, and the normalization of social media use in the family environment. This is reinforced by the statement of an informant who revealed that he never received a reprimand even though he continued to use social media, because his environment considered it as something normal: *"It's okay... everyone does it."* *"For me, in my family or my environment, so far there is nothing, if for example they see a child playing a cellphone ... it's just like oh he's playing a game or like oh he's scrolling IG or TikTok, so it's not like ... eh he's a kid playing with his cellphone all the time ... so it's like his child is labeled as lazy or like he has nothing to do, no?"* (Wenny, May 15, 2025).

Meanwhile, at the level of social and cultural structures, addiction is influenced by age, education, and economic conditions, as shown by the results of the feature importance analysis in Orange Data Mining, where age 13-20 years, high school status, and areas with low minimum wage are dominant predictors of addiction. This suggests that unequal access to entertainment and educational pressures contribute to compulsive use of social media as a form of escape or compensation. Culturally, social media has shaped a new value system including the meaning of digital existence, status symbols, and online interaction ethics that are now embedded in the lives of Indonesian teenagers.

Every culture has unique characteristics, consisting of a set of values and symbols that are passed down from generation to generation, and influence individual and group behavior in daily activities. One culture that continues to be maintained to this day is the Balinese culture, which has a social order based on the caste system in Hinduism and is full of traditions and spiritual values. *"In Bali, it's more about the culture. . because the majority of the population is Hindu, so it's more about the Hindu culture itself, because there are castes too... and then there is also like a funeral ceremony... so if it's Brahmin, it's usually a big ceremony... but if it's Jaba, it's just simple."* (Beno, May 18, 2025). Balinese culture, which is rich in spiritual symbols and ceremonies, makes its people accustomed to hierarchical social structures and strong cultural expressions. In this case, social media becomes a new platform to portray this cultural identity. Based on the view of anthropological theory, digital media is not only a communication tool, but also a new cultural space where individuals symbolically demonstrate their social values and identity.

Likewise, the next interviewee from Toraja also has her own uniqueness from her culture. N experience shows that there is a lot of diversity in the use of social media that is influenced by geographical and local cultural elements. Due to limited signal and a simple lifestyle, he said that in his hometown, Toraja, the use of social media is not very dominant. *"If you talk specifically about Toraja... the signal is not as good as in the city... they rarely use social media."* (Nami, May 20, 2025). Even so, N also mentioned that some of his family members in Toraja kota have started to actively use WhatsApp or Instagram, especially for certain events. This shows that local cultures do not completely reject technology, but adopt it selectively according to the cultural context. *"In Toraja city... yes, I think the people are progressive... but only at certain events."* (Nami, May 18, 2025).

In terms of social media addiction in adolescents, it can be seen from the very high duration of use and the habit of opening social media continuously. This is in line with BPS data which states that 26.48% of teenagers use social media more than 7 hours per day, and this habit forms a kind of "digital rite", such as opening social media every time they wake up or when there are no other activities. This is also reinforced by

the results of an interview with informant B who said: *“On vacation you can do up to 10 hours ... because it's a vacation so there's no activity and nothing to do”* (Beno, May 18, 2025).

This statement shows that social media use can go on for a very long time, especially in the absence of activities, and this is one of the main characteristics of addiction, namely difficulty controlling the time of use. This is also reinforced by the statement of informant B: *“For now, I'm probably quite addicted to it, especially during holidays, if for my own addiction, maybe it's more to online games, because I also like to play games”. “If for example I'm really active ... and also like my friends who are joining too, it can be up to 12 hours more ... especially if it's a holiday ... when I was at covid-19, I from waking up until that night I could play ... the most stops are also for eating, bathing, like that”*. (Beno, May 18, 2025).

For this reason, social media addiction is not just a mental health problem or an individual issue; rather, it is a sign of the growing socio-cultural impact of the modern digital era. The environment in which this addiction can grow and establish itself in the everyday lives of young people is influenced by psychological, social, and cultural forces. As a result, social media addiction should be viewed through a multilevel and multidisciplinary lens that takes into account social, personal, and structural elements. Digital literacy, improving self-regulation, and social programs that promote a positive and inclusive online environment should be included in efforts to combat and prevent addiction.

Discussion

The findings of this study demonstrate that adolescent social media addiction should be understood as a multidimensional phenomenon influenced by developmental, socioeconomic, and sociocultural factors rather than by psychological characteristics alone. The systematic literature review consistently indicates that problematic social media use among adolescents is associated with poorer psychological well-being, increased emotional distress, and disruptions in social functioning, supporting the need for multidisciplinary approaches in understanding this behaviour (Shannon et al., 2022; Purba et al., 2023). Furthermore, recent evidence suggests that approximately one in four adolescents worldwide exhibits problematic social networking site use, highlighting that excessive social media engagement has become an important public health concern requiring both individual and contextual interventions.

The machine learning analysis complements these findings by demonstrating that age, educational status, and Regional Minimum Wage (RMW) were the most influential predictors of adolescent social media addiction. These results suggest that developmental stage and socioeconomic context contribute substantially to adolescents' vulnerability, indicating that behavioural risks emerge from interactions between personal characteristics and environmental conditions rather than from isolated psychological factors. Machine learning is particularly valuable in this context because it can identify complex relationships among predictors that may not be readily detected using conventional statistical approaches.

The qualitative findings further strengthen the quantitative results by explaining how these predictors are manifested in adolescents' everyday experiences. Participants described social media as an important medium for maintaining peer relationships, constructing personal identity, and seeking social acceptance. However, they also reported difficulties controlling usage time, emotional discomfort when disconnected from social media, and pressure to remain continuously engaged with online communities. These narratives provide contextual evidence that psychological vulnerability is closely intertwined with social expectations and cultural norms surrounding digital communication.

The convergence of the literature review, machine learning analysis, and qualitative findings supports the proposition that adolescent social media addiction is best interpreted through an integrated psychological, sociological, and anthropological framework. From a psychological perspective, adolescents experience increased sensitivity to peer evaluation and emotional reward, making them more susceptible to compulsive social media use. Sociologically, online interactions have become embedded within adolescents' daily social relationships, reinforcing behavioural patterns through peer influence and digital social capital. Anthropologically, social media also functions as a cultural space where identity, values, and belonging are continuously negotiated across diverse social contexts.

The importance of socioeconomic indicators identified by the machine learning models also suggests that structural conditions shape adolescents' digital behaviour. Differences in educational opportunities, household resources, and regional economic characteristics may influence internet accessibility, patterns of technology use, parental supervision, and exposure to digital environments. Consequently, prevention strategies should extend beyond individual behavioural interventions by incorporating educational institutions, families, and community environments as complementary sources of support. Overall, the integration of systematic literature review, secondary quantitative analysis, and qualitative inquiry represents one of the

principal contributions of this study. Rather than treating machine learning and qualitative research as separate approaches, this study demonstrates how predictive modelling can identify important risk factors while qualitative evidence explains the underlying psychosocial and cultural mechanisms associated with those predictors. This complementary mixed-methods approach provides a more comprehensive understanding of adolescent social media addiction and offers stronger empirical evidence for developing culturally appropriate prevention and intervention programmes.

Conclusion

This study demonstrates that adolescent social media addiction is influenced by the interaction of psychological, sociological, anthropological, and socioeconomic factors. The machine learning analysis identified age, educational status, and Regional Minimum Wage (RMW) as important predictors of adolescent social media addiction, while the qualitative findings provided contextual explanations of how these factors shape adolescents' experiences, identity development, and social interactions. The integration of machine learning and qualitative inquiry offers a more comprehensive understanding of adolescent social media addiction by combining predictive modelling with contextual interpretation. The findings have practical implications for parents, educators, mental health professionals, and policymakers in developing preventive strategies and interventions that consider not only individual psychological factors but also broader social and cultural contexts. This study has several limitations. First, the quantitative analysis relied on secondary data, limiting the availability of variables directly related to individual psychological characteristics. Second, the qualitative findings were based on interviews with only three participants and therefore should be interpreted as contextual insights rather than generalized conclusions. Future studies are encouraged to employ larger qualitative samples and incorporate additional psychological, behavioural, and environmental variables to improve the predictive performance and generalizability of machine learning models.

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